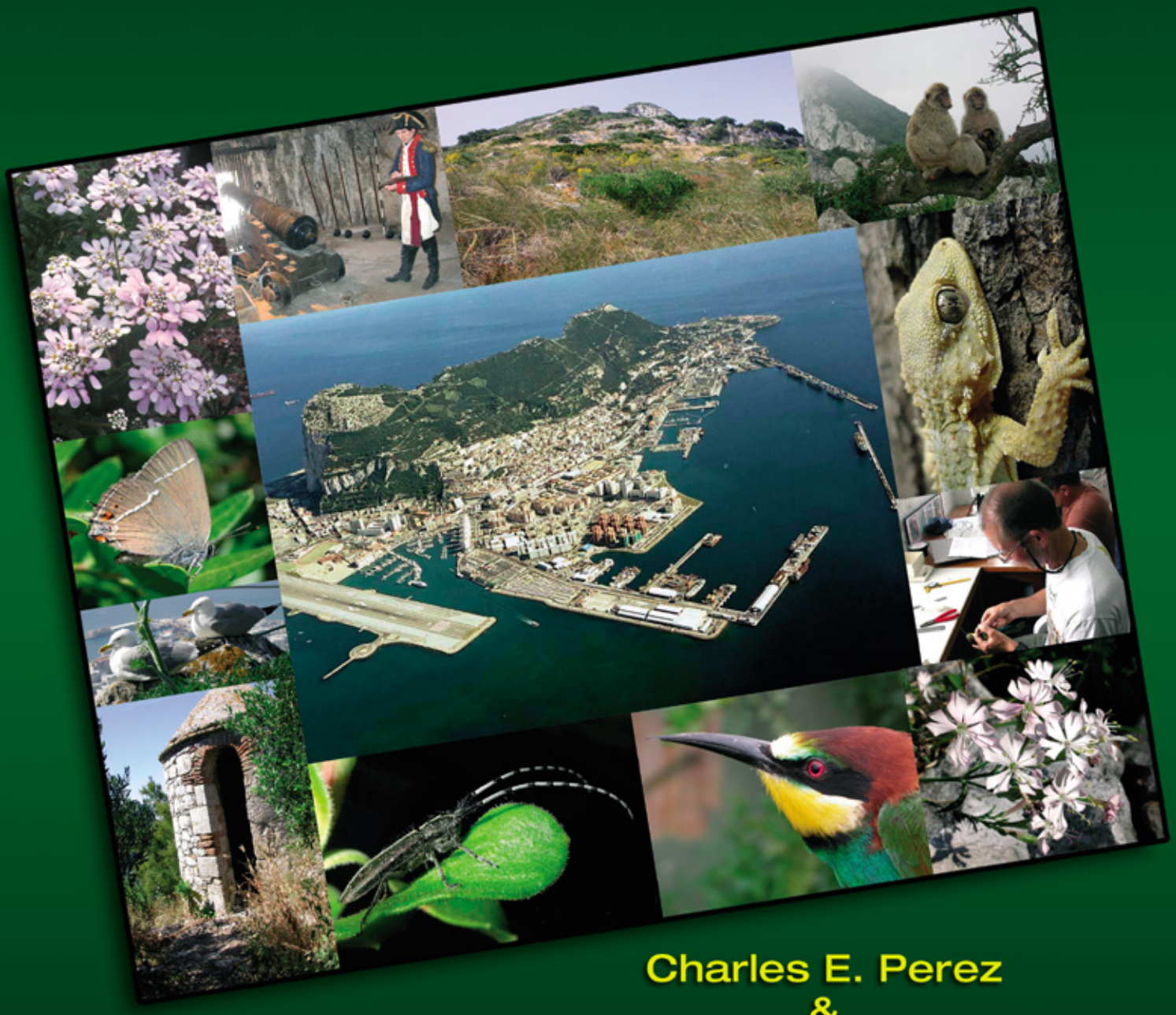
Upper Rock Nature Reserve

A Management and Action Plan



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&
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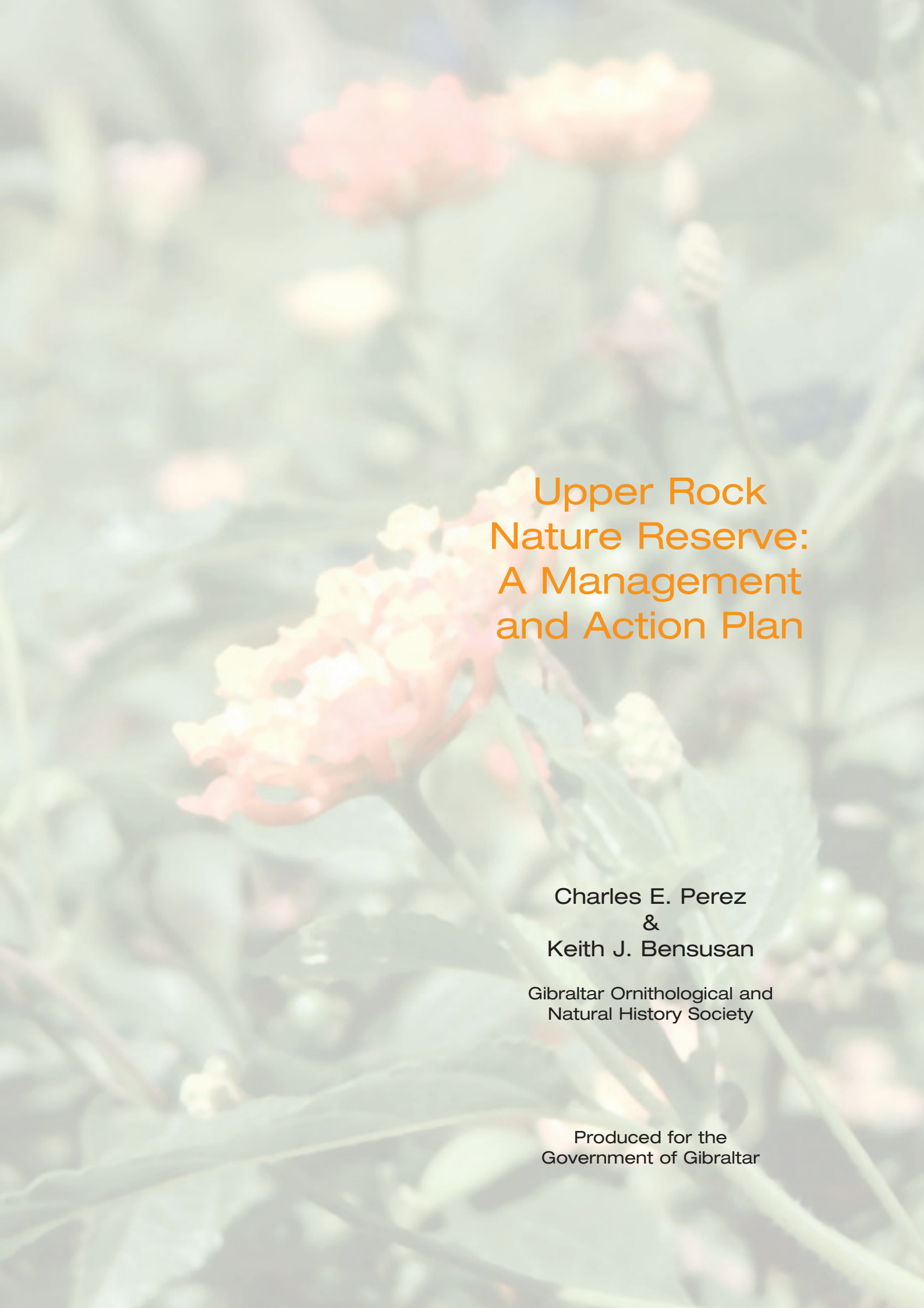
Gibraltar Ornithological and Natural History Society

EUROPEAN COMMUNITY



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Produced for the
Government of Gibraltar

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Contents

Foreword

The Upper Rock has seen many changes, even in recent decades. As a schoolboy, a young birdwatcher and a Scout I used to wander through lonely roads and paths across areas of low vegetation, not ever chancing on a stray cat, and certainly never experiencing a traffic jam, and I used to assume, as one does at that age, that things would never change. The Upper Rock was busy in those days of a closed frontier, when many Gibraltarians would visit "el monte" for a stroll or a picnic at weekends. But other than that, it was for the wildlife – and for a dedicated few.

Times moved on, and with an open frontier and increasing tourism, with growing vegetation and the encouraging of exotic species of animals and plants, as well as an ever-increasing amount of litter, the Upper Rock is no longer the quiet place it once was.

As urban areas in Gibraltar become more densely populated, as bits of open ground get converted into buildings, as even its quiet heights of wilderness are threatened by Mickey Mouse ideas, the importance of the Upper Rock to Gibraltar has increased. As we acquire more and more knowledge about its natural inhabitants our concern for their survival also increases, and our realisation that we can do something about it becomes all the stronger. And so does our responsibility as a mature Community to protect the natural riches in our custody.

Tourists abound on the Upper Rock, and often complain about it. Locally, individuals and organisations periodically raise the issue, but then all goes quiet. In 2002, following another spate of negative comments in the press, GONHS considered the possibility of initiating a campaign to improve the Upper Rock, based on its already extensive knowledge of the area. But the opportunity afforded by the possibility of European Union Funds for a study of the feasibility of managing the area for all its users, but consistent with the protection and enhancement of nature, was not one to be missed. With the support of the then Minister for the Environment, the Hon E M Britto, and after reassuring all parties that our work would be a scientific, factual one with the aim of asking the right questions and providing fair answers, we embarked on this project.

We were lucky to be able to count on the services of two dedicated and extremely knowledgeable people, longstanding members of GONHS, Charles Perez and Keith Bensusan, whose work primarily this is. Their enthusiasm, energy and thoroughly likeable personalities have all contributed in equal measure with their sound scientific discipline to producing a fine piece of work.

A management plan, an action plan, and an assessment of the feasibility of these, provide more than just a nice report. They provide an essential tool for facilitating improvement, and this document already fulfils much of what would be required of Gibraltar as a World Heritage Site, a Natura 2000 site, or even as part of the Strait of Gibraltar Biosphere Reserve of the future.

We acknowledge the confidence shown in us by the Government of Gibraltar in supporting the production of this report, despite the problems that implementing some of the recommendations may present. We acknowledge also that progress may be slow. But knowing in detail what the problems are is always the first step to resolving them. It is clear, and important to understand, that as a result of this document, we now know a great deal more about what makes up the Upper Rock and about what can be done to improve it.

We present it to the Government of Gibraltar with a commitment to co-operate in whatever way we can in implementing the recommendations which it is their prerogative to accept. But the proper management of the Upper Rock as a resource for Gibraltar and a reserve for nature depends on all its users having a long term vision and being willing to work towards it.

GONHS will continue to work with all interested parties in providing a nature reserve that is an asset useful to all, but abused by none.

John E. Cortes
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General Secretary
The Gibraltar Ornithological & Natural History Society
January 2005

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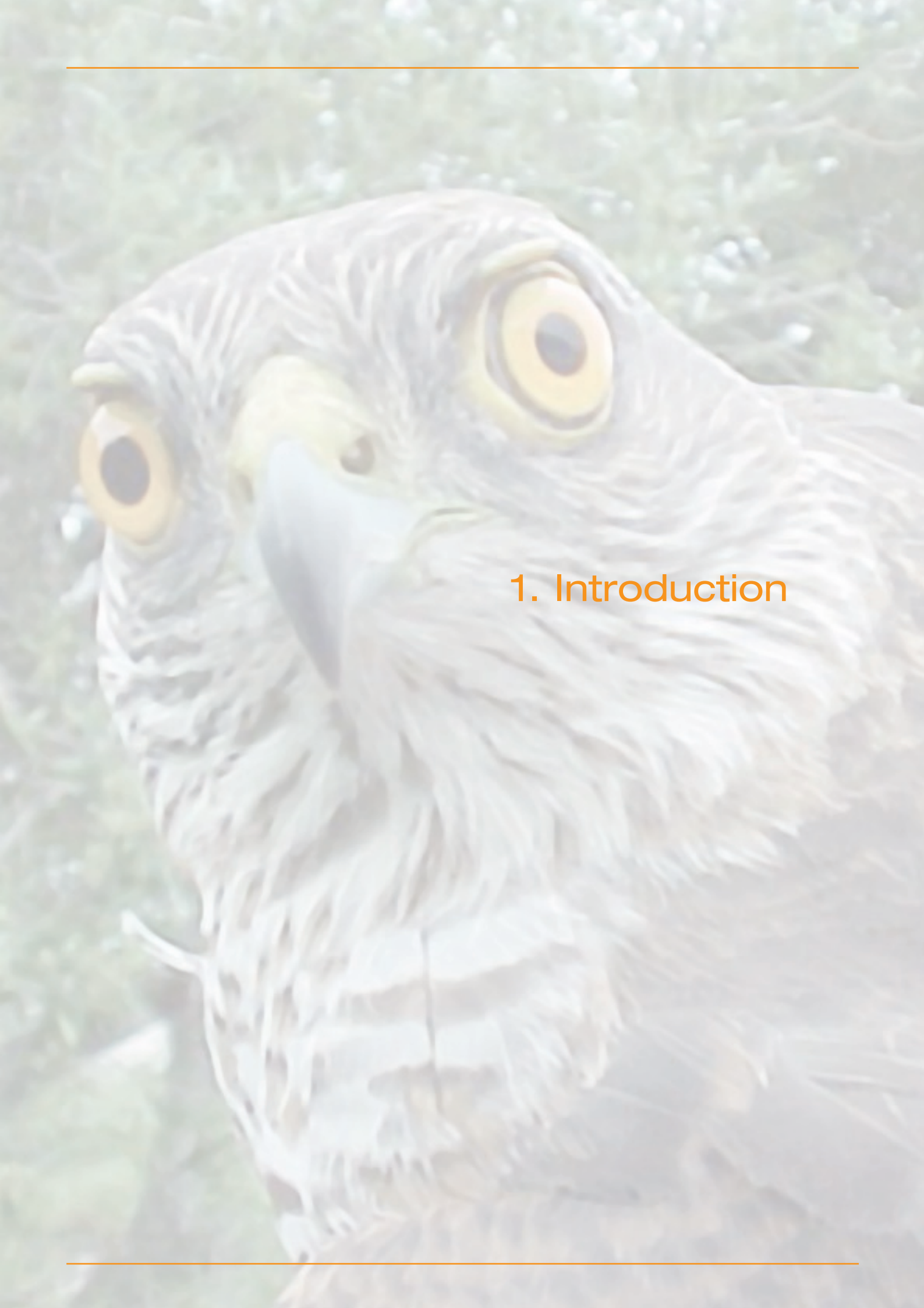

1. Introduction

1. Introduction

1.1 The Upper Rock Nature Reserve

The Upper Rock has undergone several transformations in its habitats and uses. Habitats have ranged from a once (presumably) forested landscape to a totally denuded slope during the Great Siege, to a succession of vegetation back to dense maquis with scattered patches of garrigue and pseudosteppe in recent times. In earlier days, goats and some cattle grazed the slopes, trees were felled for fuel, and the military installed batteries on the higher reaches of the northern part of the Rock for the protection of the fortress. The Upper Rock continued to play a mainly military role until well into the 20th Century. More recently, the emphasis has changed to that of a Nature Reserve and, most noticeably, a tourist attraction.

During the early part of the 20th century the Upper Rock was reinforced and more gun batteries and military installations were constructed, especially on the advent of WWII. The area became a total exclusion zone to the resident population, and an 'unclimbable fence' was erected. Soon after the war the area was again opened to the public, but only during daylight hours. The area was controlled by the 'Security Police', (now the Gibraltar Services Police), and firebreak and vegetation maintenance on the lower slopes and Upper Rock was carried out by the MOD.

In the mid to late 1900's most of the Upper Rock was ceded to the Gibraltar Government, with the MOD retaining control of Middle Hill, Rock Gun, Spyglass and, significantly, the Barbary macaques. St. Michael's cave and the Upper Galleries where the first two sites to be developed for tourism, but the macaques quickly became (and still remain) the most important attraction enticing tourists to Gibraltar. The macaques continued under the responsibility of the military under the Gibraltar Regiment until 1990, when 'MEDAMBIOS', a company run by macaque expert Dr John Fa, took over for the following two years under contract to the Gibraltar Tourism Agency Ltd.

In the meantime, the Gibraltar Ornithological and Natural History Society (GONHS) was striving for a more conservation-oriented policy for the natural habitats in Gibraltar. Some keen conservationists (many of whom were founder members of GONHS) published 'Environmental Conservation in Gibraltar' and the first basis of a management plan for Gibraltar's natural environment was drawn up as early as 1978 by Dr John Cortes in his document 'Conservation – A Future? Semi-natural nature reserve GIBRALTAR: A management Plan' (Cortes 1978). These were the first steps towards an awareness campaign aimed at the authorities. Cortes (1978) analysed the problems and provided solutions, noting that the Town and City Plan of 1976 recognised the need for conservation. Very little heed was paid to this. These documents are unfortunately probably gathering dust in the Government's archives.

Eventually, the Government of Gibraltar Recognised that it had to take steps in conserving the Rock's Natural Heritage. The GONHS was instrumental in drafting the 'Nature Protection Ordinance, 1991' (L/N11 1991), which affords protection to numerous species and provides for the protection of habitats. This ordinance was based on the United Kingdom's legislation on wildlife, and was amended and improved to suit Gibraltar's needs and peculiarities.

In 1992 'Sights Management Ltd.' was given a management contract that included the tourist sites and the Barbary macaques, and overall responsibility for the Upper Rock. The 'Nature Conservation Area (Upper Rock) Designation Order, 1993' (L/N 51 of 1993) was drafted in 1993 when the Upper Rock was designated a Nature Reserve, and was published as a regulation as provided by the 'Nature Protection Ordinance, 1991'. A map of the area designated as a Nature Reserve by the Designation Order can be seen in Fig. 1. As a result entrance fees to the Upper Rock were now collected, which included entry to all sites. A concerted effort, presumably using gate monies, was made to improve sites, and roadsides were cleaned and firebreaks cleared on a regular basis. This arrangement continued until 1997 when the Gibraltar Tourist Board ended the contract and took over responsibility for the management of the Upper Rock Nature Reserve. The feeding and watering for the Barbary macaques was contracted to GONHS in 1999.

Figure 1. Outline map of Gibraltar with the boundary of the Upper Rock Nature Reserve in blue.

During this period, the Gibraltar Tourist Board invested very little time and money towards improving the condition and appearance to many of their sites, except for a lighting facility for the cave costing close to £750,000. The natural environment was totally disregarded, despite regular increases in the entrance fees with the audacious inclusion of an environmental levy, from which the environment never benefited. Adverse publicity in the press prompted the authorities to contract Master Services to clean the Upper Rock, but contractual constraints have limited this to a face-saving exercise, clearing only roadsides that are visible to visitors, and only recently cliff areas.

Uncontrolled entry into the Reserve at night, vandalism, graffiti and refuse depositions are just a few of the immense problems facing the existence of the Upper Rock as a Nature Reserve. Added to this is a lack of regular maintenance of sites, footpaths, firebreaks and roadways, which together with insufficient sanitation facilities compound the problem. At least some of these problems, those relating to nature conservation, would have been solved if many of the European Directives on nature protection and the environment had been implemented, and especially if the Nature Protection Ordinance were enforced rigidly.

These concerns prompted one of the authors, Charles Perez, to write a report entitled 'The Upper Rock Nature Reserve. An Environmental Impact Assessment Report 2002' (Perez 2002), dated 15th March 2002, on the state of the Upper Rock Nature Reserve. Copies were submitted to the Chief Minister and to the Ministers for the Environment and Tourism. The report was acknowledged, but very little action was taken on the many issues that had been put forward. As the deterioration of the Nature Reserve continued during the summer months of that year, numerous letters of complaint appeared in the press and several articles appeared in the Gibraltar Chronicle, highlighting the problems. These came from, amongst others, opposition parties who had been approached by concerned citizens and significantly from the Taxi Association, who carried out a cleaning campaign spurred on by the negative response they got from their clients, the tourists themselves.

The GONHS took a passive stand and observed how the situation evolved, taking note of the developments. The GONHS could have backed and substantiated the numerous, often totally justified criticisms and accusations, and even expanded on these. However, it decided to adopt this stance with a view to looking at constructive ways to approach the situation. The consensus was to produce a feasibility study and management plan, not only on environmental matters but also on all factors affecting the well being of the Upper Rock Nature Reserve, as all of these have a direct bearing on the sustainable development of the Upper Rock as a Nature Reserve. Success in obtaining European funding was crucial in instigating this report, and research on the same commenced at the beginning of 2003.

When the Government of Gibraltar resumed responsibility for the Reserve, very little money was re-invested into the product. This resulted in an intensification and accumulation of the many problems that one can read about in this report. It is therefore unwise that the Government of Gibraltar maintains this status without recognising how vitally important it is to regularly maintain all aspects of the Nature Reserve. We argue that there should be a concerted effort to re-invest the profits of the gate money of the Upper Rock. This Management Plan, therefore, specifically tackles all areas of concern within the Upper Rock, many of which are particularly important and have a direct bearing on the sustainable interests and development of the Nature Reserve. It focuses particularly on the natural environment, which has been totally neglected by management, but also on other sectors of socio-economic interests, which would complement the running and well being of the Reserve.

This plan will need the implementation of the requirements of the numerous European Directives and Conventions on wildlife and heritage conservation, such as the Bern Convention, Bonn Convention, the Biodiversity Convention, the World Heritage Convention, the EC Birds Directive and the EC Habitats Directive. Some of the requirements were transposed into Gibraltar law[1], but implementation and designation of sites is still awaited. Even implementation alone is insufficient without the enforcement of the 'Nature Protection Ordinance, 1991' law and its subsequent amendments.

1.2 Research

In elaborating this plan we have adopted an open minded approach in considering the requirements, fundamentally for the survival of the Upper Rock as a Nature Reserve, but also including socio-economic interests within the reserve, which ultimately will provide the means for the maintenance and development of the area as a whole. Taking this approach, we identified all departments, agencies and other bodies that had vested interests or participated in any way in the use, control, maintenance or development of the Upper Rock Nature Reserve. These are the stakeholders. In this respect the majority, especially those that had a greater bearing toward the survival or development of the Nature Reserve, were interviewed.

In addition, we embarked on research into uses of the Upper Rock throughout its long history. The Garrison Library was instrumental in furnishing us with numerous books, directories and journals, all of which provided a detailed account of the development of the environment of the Upper Rock and the transitions it has undergone through the ages to the present day. It also provided us with an account of all the articles that were published in the Gibraltar Chronicle in relation to the Upper Rock in the last two years before this report was written, and therefore gave us an excellent background on the condition of the area and the concerns of the general public and political parties.

Additional research was required to assess the condition of the environment. This was undertaken in the field and consisted of the mapping of the vegetation by types, height and species and a census of all the pine trees on the Rock, which was carried out during the spring and summer of 2003. In conjunction with this, invasive species of plants were also recorded and mapped and a detailed account of the findings can be obtained in their respective chapters. The aesthetic nature of the area, the condition of main paths and health and safety aspects were also of prime importance in elaborating the management plan for these specific topics.

Legislation was given priority and the 'Nature Protection Ordinance, 1991' (L/N 11 of 1991) and subsequent additions were scrutinised. A proposed summary of possible improvements and subsequent measures is given. Also included is an account of the necessary implementation, and in particular the *enforcement* of the laws, and consideration is given to many of our findings. In addition, EC directives and conventions that apply to the Upper Rock were investigated. Measures proposed would, in our opinion, improve the situation drastically.

[1] Nature Protection Ordinance, 1991 (Amendment) Regulation, 1995

Transport and traffic were some of the issues that particularly worried us. The visual impact of traffic jams at bottlenecks in the Nature Reserve, the ensuing pollution and the detrimental effect to all sectors spurred us on to analyse this problem. In this respect we established a survey of all traffic, commencing at the beginning of 2003, on a monthly basis. This gave us the necessary figures to be able to quantify traffic flow through the Reserve and make subsequent speculations on environmental impact. This problem is a difficult one to resolve, but there are possible ways in which the interested parties could investigate more environmentally friendly ways in their approach whilst at the same time not undermining their own economic benefits.

Residential areas within the reserve were also investigated. Land Property Services were contacted and a synopsis of the situation was obtained. It emerged that all residents are now owner-occupiers except for the housing complex of Poca Roca, which is still rented accommodation and is the responsibility of the Housing Department. The Town Planning Department closely monitors additions and/or extensions to existing buildings.

Research into the geology and especially caves was carried out and obtained from the Garrison Library in many old books and journals and also the excellent publications and writings by Rose & Rosenbaum (1991) and Palao (*Unpubl.*). Most of the caves were also visited to assess their condition. In addition, historical buildings and World War II installations were mapped and their condition described. We sought the opinion of the two heritage bodies, the Gibraltar Museum and the Gibraltar Heritage Trust, together with the Government's Heritage and Planning Division, on their strategy towards the historical heritage on the Nature Reserve. Their suggestions and comments will form the basis of the proposed programme dealing with this subject.

As part of our investigation into the ways nature reserves are managed we decided to visit a small Nature Reserve in the immediate vicinity. We chose the 'Parque Natural Breña y Marismas del Barbate', a reserve that suited our needs due to several factors that it has in common with the Upper Rock. The Directors of the reserve hosted our visit and provided us with ample documentation that allowed us to make comparisons and include suggestions within our own management plan.

Finally, a note on the style in which this document has been written. The reader may be struck by the occasional repetition of themes from one chapter to another. This is deliberate, given that some people may choose to read some chapters and not others according to their interests and/or responsibilities, and so the same points have to be stressed time and again. In addition, information on each subject being tackled is extensive for the reasons that, a) this provides a greater understanding of the issues raised and, b) literature on many aspects of the Nature Reserve (including much on its wildlife) is lacking.

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2. GONHS and The Nature Reserve

2. GONHS and The Nature Reserve

2.1 Introduction

The relationship between GONHS and the Upper Rock began many years ago. GONHS was originally set up by a group of school students from the Grammar School in 1969 as a bird-watching group. It was composed of approximately a dozen people and was eventually affiliated in 1972 to the 'Gibraltar Society', a cultural institution, as the Gibraltar Ornithological Group. Most of the groups' activities took place within the Upper Rock where most of the recording of bird migration took place. Here the members of the group acquired the necessary experience and skills and more importantly the appreciation of our natural heritage. This encouraged some of its members to dedicate and further their studies in the field of biology and natural history, with some researching and completing their doctoral studies on work done within the Nature Reserve, in Gibraltar. With such an academic base and the contribution of many experienced amateurs in the field, the Gibraltar Ornithological Society was established in 1976. The interest of many members in other fields of natural history, especially flora, bats, reptiles, marine life and lepidoptera prompted the inclusion of 'Natural History' in the title of the society although it still retained the original ornithological connotations due to its historical foundations. Thus the 'Gibraltar Ornithological & Natural History Society' of today saw the light of day in 1982.

2.2 History

In 1977, a GONHS member (John Cortes) prepared a report entitled 'Conservation: A Future? Gibraltar: A Management Plan' (Cortes 1977), which was the first attempt to provide guidelines for overall conservation management within the Upper Rock.

GONHS members who were concerned with the state of the Upper Rock and other areas later brought this to the attention of the authorities. A document entitled 'Environmental Conservation in Gibraltar', published by several members of GONHS under the banner of 'The Gibraltar Environmental Group' (Bensusan, *et.al.* 1980) highlighted many of the problems that the Upper Rock is still suffering from. Several recommendations, including greater legal and administrative control, wardening of the Upper Rock, cat control, and the litter problem still form part of environmental problems the Nature Reserve faces now.

In 2002, Charles Perez, also a GONHS member and one of the authors of this report prepared a further report on the Upper Rock (Perez 2001), on which much of this document is based. Despite wide distribution, no action ensued.

2.3 Current Work

The GONHS has been instrumental in researching, documenting and studying the flora and fauna of the Upper Rock for many decades and this was one of the factors that led to the designation of the area as a 'Nature Reserve'. Bird migration has constantly been monitored from Jews' Gate and the Cable Car top station for over 35 years, and a study on the distribution of the flora, reptiles, mammals, Lepidoptera and Coleoptera is ongoing. This has resulted in many publications in scientific journals (e.g., Cortes 1983, 1994a, Cortes 1994b; Linares 1993, 1994; Menez 1993) and has included several books (e.g., Cortes *et. al.*1980; Finlayson 1992; Linares *et al.* 1996) on some of the better-known subjects. GONHS has also produced papers based on the Upper Rock, its development, fauna and flora, habitats and future. All of this has helped situate the Upper Rock as a unique environment within the region of the Strait of Gibraltar.

The establishment of the Jews' Gate Field Study Centre in 1990 set the foundations for the Gibraltar Ringing Group, the only section of the British Trust for Ornithology outside the United Kingdom. This has enabled hundreds of researchers to visit and work on Mediterranean birds within the Upper Rock. During this time the GONHS also prepared the draft for the Nature Protection Ordinance, which was published on the 9th May 1991 (L/N 11 of 1991), and included protection for many species of flora and fauna found within the Nature Reserve. On the 20th June 1991, the Governor, by the Nature Conservation Area (Upper Rock) Designation Order 1991 (Legal Notice No 116 of 1991) in exercise of the powers conferred upon him by section 18 (1) of the Ordinance and after consultation with the Nature Conservancy Council, designated an area of the Upper Rock as a Nature Conservation Area.

The creation of the Gibraltar Trust for Natural History whose trustees were members of the committee of GONHS followed this, and the Lower Bruce's Farm quarters, Governor's Cottage and the PSA nursery came into the hands of GONHS. The former was developed into a research centre and accommodation for visiting students. A healthy relationship with Zurich University through Professor Bob Martin and other similar institutions and universities guaranteed regular visits from students studying in particular the Barbary macaques, but also other wildlife. This programme continues.

A programme for the replanting of indigenous tree species was initiated in the former PSA nursery with the propagation of pine, oak, and carob trees. This goes hand in hand with the

removal of invasive species that is currently taking place there. In addition, some habitat management has also been carried out by GONHS volunteers in areas such Governor's Lookout and Inglis Way, entailing vegetation control in what would otherwise be very dense maquis.

In 1994 the GONHS published 'The Biodiversity Initiative: Gibraltar. A Case for Maintaining Biodiversity' (GONHS 1994). Around this time a group of volunteers with an interest in nature and proud of the natural environment of the Upper Rock, agreed to undertake some habitat management within the Nature Reserve. They successfully demolished the illegal construction at Governor's Lookout and set about clearing the dense vegetation and commenced a pine-replanting programme in the area to replace those that had died in the drought. Other areas have been similarly cleared, but the task for the whole of the Upper Rock would need a total commitment from permanently employed workers.

In 1997 the GONHS was contracted to control the yellow-legged gull population. Most of the culling takes place within the Nature Reserve and therefore GONHS maintains an active presence in the area. The awarding of the contract for the feeding and management of the Barbary macaques in 1999 followed this, and has placed GONHS in an enviable and solid position as the most capable and effective organisation in the management of the environmental heritage of the Upper Rock Nature Reserve.

2.4 The future

GONHS been relied upon to advise on nature conservation and other environmental issues while at the same time, as an NGO, being able to carry out in dependent work and if necessary publicly take issue with the authorities. This is clearly true within the Upper Rock. While some would question the logic of this arrangement, it is important to judge by the results. There is no doubt that while many things in the Upper Rock need improving, much has been achieved in general terms on nature conservation issues.

The strategy of GONHS, to ensure a constant dialogue with key players, including Gibraltar Government, Ministry of Defence, as well as private firms and organisations has nowhere been more clearly demonstrated than in the events leading up to the preparation of this report. These relationships are in the interests of all players, in particular of the natural systems that GONHS wishes to protect.

Jews' Gate Field Centre

It is for this reason that within its proposals, the Management Plan (chapter 23) includes a key role for GONHS in each of its options. It is inconceivable that the firm base of research, and experience in the principles of conservation that in Gibraltar can only be provided by GONHS should not be used as a basis for the necessary further improvements.

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3. Legislation

3. Legislation

Wildlife protection laws in Gibraltar are centred around the 'Nature Protection Ordinance, 1991' (L/N 11 of 1991). This item of legislation deals with the protection of plants and animals on the Rock, including those that are rare and endangered, in terms of the conservation of our own indigenous flora, fauna and habitats. Also included in the 'Nature Protection Ordinance' is legislation relating to practices, such as fishing, that affect local natural communities. The Nature Protection Ordinance was drafted using as a guide the UK Wildlife & Countryside Act (1981), the EU Birds Directive, and early drafts of the EU Habitats Directive (*see* Chapter 4). In addition, more general legislation on the trade of wild animals and plants is included in the Endangered Species Ordinance (L/N 54 of 1990) and its subsequent amendments, incorporating the requirements of the Convention on International trade in Endangered Species of Flora and Fauna (1976) and the European Directives that transposed this.

The 'Nature Conservation Area (Upper Rock) Designation Order 1993' (L/N 51 of 1993) was published in 1993 when the Upper Rock was designated a Nature Reserve, although part of it had already been designated a Nature Conservation Area in L/N 11 of 1991. In it are included all of the wildlife protection laws that are unique to the Nature Reserve[1]. These include sections on traffic, introduced fauna, access, administration, protection of wildlife, structures, nuisances and wildlife wardens. The laws that this Designation Order stipulates are not, however, adhered to with any rigour. In fact, it is incredible to see, on examining the Designation Order, that most of these laws are disregarded flagrantly. This is a result of several factors. Ignorance of the law is an important reason behind this, although one has to take into account when saying this that, apart from those with legal training, people are generally oblivious to *most* items of legislation, and yet this does not stop the authorities from enforcing these laws (and in any case, ignorance of the law does not excuse one from breaking it). Having said this, a greater effort should be made to make people aware of some of the more important laws that apply within the Nature Reserve, as has been done, for example, with the erection of signs at sites where tourists view macaques.

A lack of responsibility on behalf of some tour operators and taxi drivers also plays a considerable role. These people are familiar with many of the laws that apply within the Nature Reserve (particularly those banning the feeding of wild animals and litter control laws), and yet do little to stop tourists from breaking the law, even breaking the law themselves frequently. It is commonplace, for example, to observe some tour operators amusing their customers by feeding the macaques (this can be observed daily), an offence that is supposedly punishable by a £500 fine; a fine which has still to be imposed on an offender.

Figure 1. Warning sign at Hayne's Cave Pumping Station site.

[1] i.e. those wildlife protection regulations that apply within the boundaries of the Nature Reserve and are not covered in the 'Nature Protection Ordinance 1991'

Most worrying of all is the lack of enforcement of the law within the Nature Reserve. The Upper Rock Nature Reserve is not patrolled by the Royal Gibraltar Police as often as it should be (given that during our vehicle survey we recorded only a single patrol car accessing the Nature Reserve a few times in 48 days throughout the year). However, the main problem with regard to law enforcement is due to the lack of specialised Wildlife Wardens within the Reserve, whose job it would be to ensure that all of the laws concerning the conservation of wildlife and the environment are enforced. All of these problems are highlighted in the sections that follow, together with lists of proposals that seek possible solutions to these problems.

3.1 Administration

The 'Nature Conservation Area (Upper Rock Nature Reserve) (Fees and Admission) Regulations, 1993' (L/N 50 of 1993) dealt with fees and admissions in the Nature Reserve. This has since been superseded. Section 3[2] of these regulations stated that '*The fees provided for in regulation 2 shall be collected by Sights Management Limited on behalf of the Gibraltar Tourism Agency and shall be retained by the Gibraltar Tourism Agency for the purposes of the administration of the Nature Conservation Area.*' Sights Management Limited no longer exists on the Upper Rock and the Gibraltar Tourism Agency has been replaced by the Gibraltar Tourist Board, which now manages the Upper Rock Nature Reserve. L/N 50 of 1993 was therefore revoked and replaced with the 'Upper Rock Nature Reserve (Admission Fees) Regulations, 2001' (L/N 137 of 2001), but the resulting item of legislation has been less than satisfactory. Whilst the 2001 regulations supersede the entire L/N 50 of 1993 regulations, no replacement has been provided for section 3, which stated that money paid as fees should be spent on administering the Nature Reserve. In other words, there is now clearly no obligation to spend money gathered at the gates of the Reserve *on* the Reserve and its administration. What is particularly worrying is the fact that this was done without publicity, possibly surreptitiously, with the result that money earned at the Nature Reserve is spent elsewhere. The possibility that section 3 was not replaced due to an oversight seems less likely. Either way, an amendment to the current regulations should be made stating that money earned at the Nature Reserve gates (or at least a large percentage of this) should go towards the administration, maintenance and conservation of the Nature Reserve.

In addition to L/N 137 of 2001, the year 2001 also saw the introduction of the 'Nature Protection (Amendment) Ordinance, 2001' (L/N 23 of 2001). Section 2[3] of L/N 23 of 2001 states that:

> The Minister with responsibility for the environment may by order published in the Gazette set-
>
> (a) the terms and conditions of entry, including times and dates; and
> (b) the fees for entry,
>
> to a nature conservation area or tourist or other sites within or comprising that area in respect of different classes of persons and vehicles.

It is interesting that the Minister with responsibility for the environment should set the fees for entry, given that his ministry is not responsible for the management of the Upper Rock *or* the money that the Nature Reserve generates. In other words, the Government uses this item of Nature Protection legislation to run a business, with none of the income being used to conserve wildlife or improve the environment, let alone the rest of the Upper Rock. Furthermore, although the Tourist Board's management may be apt for the tourist sites, it is far from ideal from the point of view of management of the natural aspects of the Nature Reserve, which in actual fact comprise the vast majority of the Upper Rock. It is the authors' opinion that the Tourist Board should, if anything, only manage the tourist sites. The actual Nature Reserve should be managed by either a designated private enterprise or a Management Board as recommended in the Management Plan (Chapter 23), and administered by the Department of the Environment under the Ministry for the Environment, Roads and Utilities.

[2] Pp. 110.
[3] Pp. 160.

3.2 Recommendations

1) Legislation should be drafted to state that at least a large percentage of fees should be reinvested in the Nature Reserve, and in broad terms at least how the money earned through admission fees at the Gate is to be spent on the Nature Reserve.

2) A substantial percentage of the fees collected at the gate should be invested in environmental management, heritage, awareness, supervision and research of the Upper Rock Nature Reserve.

3) The Tourist Board should not be responsible for the management of the whole Nature

Reserve. Rather, the Nature Reserve should be the responsibility of a Management Board with the administration duties carried out by the Ministry for the Environment, Roads and Utilities, if it is to be managed as a Nature Reserve at all. This would then mirror the situation found in other countries, where Nature Reserves are better administered and conserved. The Tourist Board should only manage tourist sites. Those sites considered apt for management by the Tourist Board are listed below:

- St. Michael's Cave
- O'Hara's Battery
- Upper Galleries
- Princess Caroline's Battery
- 'City Under Siege' Exhibition
- Moorish Castle (which lies at the edge of the Nature Reserve).

The Upper Rock Nature Reserve should come under the proposed Management Board and be administered by the Ministry for the Environment. This should include the Barbary Macaques, which are currently managed by GONHS for the Gibraltar Tourist Board (the reason for this is fully explained in Chapter 14).

3.3 Traffic

There are several sections in the 'Nature Conservation Area (Upper Rock) Designation Order 1993' which apply, either directly or indirectly, to traffic within the Upper Rock Nature Reserve. These are highlighted below, together with an account of how most of these are not enforced and suggestions for improvements.

3.3.1 Parking

The Designation Order states that '*No vehicle shall be parked in the Reserve except in an area designated for this purpose by the Authority*'[4]. There are two main problems concerning parking within the Nature Reserve. Firstly, there are very few suitable areas within the Upper Rock Nature Reserve that are clearly designated as parking areas. Lay-bys, etc. are taken to be parking places by the general public. Most people, locals and tourists alike, park in such places, where no obstruction to traffic occurs. These areas should be clearly demarcated as parking areas.

Taxi and coach drivers, particularly at Jews' Gate, St. Michael's Cave, Prince Phillip's Arch and at Princess Caroline's Battery aggravate this problem. At Jews' Gate taxis and coaches block access to the parking area to private vehicles in order not to lose their queue priority on arrival at the Reserve. This problem is further compounded at St Michael's Cave where, despite the best efforts of the security guards to manage traffic, taxis queue up in the middle of the road preventing access of authorised vehicles to the upper roads. This problem is repeated at Prince Phillip's Arch and at the approaches to Princess Caroline's Battery on Queen's Road, where during the height of the summer, up to twenty vehicles are left unattended in the middle of the road whilst taxi-drivers show their clients the attractions. There have been occasions where the authors have witnessed the emergency services (i.e., ambulance) stuck in the queue at the Jews' Gate ticket office for an inordinate amount of time whilst the security guard tried his best to clear the way. On both occasions none of the public service vehicles moved on and after a long time, only manoeuvred their vehicles sufficiently to allow the ambulance through on a medical emergency. This brings to light the problems that this would pose if a serious fire were to occur on the Upper Rock Nature Reserve. The problem has been exacerbated by the decision to increase the already saturated Nature Reserve by a further twenty coaches, also adding to the noise and pollution levels already prevalent on the Upper Rock Nature Reserve.

3.3.2 Traffic and Noise

The Designation Order requires that a person must not '*use a radio, television, cassette or disc player except where such equipment is fitted with headphones and is operated in such a manner as to be inaudible to any person other than the person wearing the headphones*'[5]. This law applies to vehicles within the Nature Reserve. Whilst the authors consider it unreasonable that a person should not be able to listen to music within his vehicle without the use of headphones, the law should state that the volume of the appliance should not be set at a level to cause an unreasonable degree of disturbance to persons and/or fauna within the Upper Rock. The law controlling the volume at which music can be played from a vehicle in other areas of Gibraltar exists, and should be adopted with a clause to include disturbance to wildlife. The regulations should however allow for total prohibition of such noise in particular areas and circumstances (e.g. in the proposed Biological Reserve (see chapters 17, 18 & 23) or close to the nesting site of a rare bird).

[4] Section 4.(4), pp.114 of L/N 51 of 1993.
[5] Section 8.(b), pp.117 of L/N 51 of 1993.

Rather more worrying than loud music, though, is the constant use of vehicle horns in certain parts of the Nature Reserve due to traffic congestion. This has been most evident at Jews' Gate, where taxis and coaches that arrived via Lathbury Barracks used to sound their horns constantly in order to be let through the barrier. Since the erection of a second booth addressing this traffic the noise levels and hooting has improved. Sometimes, some of the blame goes to the inconsiderate way in which these tour vehicles, both taxis and coaches, are parked in this area. The sounding of horns is a cause of serious concern given the negative effect that this must undoubtedly have on local, and in particular, breeding fauna.

3.3.3 Access

It is stated in the Designation Order that '*The Authority may, in its discretion and for the purpose of the good management of the Reserve, close or restrict access to any part of the Reserve or to any road or path in the Reserve*'[6]. This is taken by the authors to apply to the temporary closure of paths and roads, possibly in view of road repairs, safety issues, etc. However, it may in some cases also be useful to apply this law for the benefit of the Nature Reserve's wildlife. For example, vehicular traffic could be restricted in certain areas temporarily during the breeding season, if a species that is vulnerable to traffic pollution and/or noise and disturbance is found to be breeding in the area. This is common practice is other Nature Reserves.

The Designation Order also states that '*No vehicle shall be used on the Reserve except on permitted routes or with the prior written consent of the Authority*'[7]. This law has been disregarded excessively. Although traffic is not supposed to ascend beyond St. Michael's cave, it is abundantly clear that most traffic does so. An effort has been made to control this through the use of security guards at the hill leading to St. Michael's cave. However, these people are only present during working hours (09:00 – 17:00), before and after which there is nobody to ensure that anyone '*without written consent of the Authority*' does not drive up beyond St. Michael's cave.

The Government of Gibraltar's decision to grant access to taxis beyond St. Michael's Cave, which dates back to the early 1990s (ironically the time when the Nature Reserve was created), is regrettable. This causes excessive noise and pollution along the upper reaches of the Nature Reserve, as well as a deplorable amount of litter around sites such as Prince Phillip's Arch. Evidence of the amount of disturbance that this activity causes is given, for example, in the drastic decrease in the number of migratory booted eagles (*Hieraaetus pennatus*) (which is considered 'Rare' by BirdLife International, and is protected under Annex 1 of Council Directive 79/409/EEC) roosting along the upper reaches of the Upper Rock Nature Reserve.

The increased level of traffic that currently utilises the roads along the upper reaches of the Nature Reserve may also in the long run cause considerable problems to the infrastructure of these roads, given that these were never designed to support such heavy traffic, having originally been MOD roads (B. Bagu, *pers. comm.*). The effect that this increased stress has on sections of these roads can be seen at the section of Signal Station Road running down to the Governor's Lookout, where part of the road is subsiding. Access along this road has been restricted as a result (although since July 2003, it was sometimes used by taxis and others vehicles, even though access is still restricted, until several barriers were erected).

3.3.4 Access at Night

With regard to access to the Nature Reserve at night, the Designation Order states that '*No person shall enter or remain in the Reserve between sunset and sunrise except with prior written consent of the Authority to do so which consent may specify the part or parts of the Reserve that the person may enter or remain in*'[8].

There are two main problems that are associated with this section.

The first of these problems is that this law is typically not adhered to. Cars are frequently encountered within the Nature Reserve after sunset, and after the entrance gate (below Jews' Gate) has been locked. This is hardly surprising, given that the barrier at the Moorish Castle end of the Nature Reserve frequently remains open all night, and there is nobody employed to ensure that people do not remain within the reserve after sunset. This could be tackled by the police or, for example, if Wildlife Wardens were employed. Traffic within the Upper Rock Nature Reserve after sunset causes undue disturbance to the fauna of the reserve. Furthermore, activities undertaken after dark within the Nature Reserve are often illegal.

The second problem that arises from this section is that although it states that no person should enter or remain in the reserve between sunset and sunrise, an actual time is not stat-

[6] Section 3.(3), pp.114 of L/N 51 of 1993.
[7] Section 4.(4), pp.114 of L/N 51 of 1993.
[8] Section 3.(3), pp.114 of L/N 51 of 1993.

ed, given that the time at which the sun rises or sets changes throughout the year. It is important to note that the time at which the entrance below Jews' Gate is locked is consistent throughout the year (at about 10pm). In light of this fact, perhaps it would be better to specify a time in the Designation Order in accordance with the time at which the gate is locked.

Figure 2. Closing time is inconsistent with the regulation that does not allow anyone after sunset, especially in the winter months.

Although virtually all persons encountered within the Nature Reserve after dark are in vehicles, pedestrians are not exempt. This section of the Designation Order not only applies to motor vehicles, but also to pedestrians, and should be applied to these with equal rigour.

3.4 Recommendations

1) Areas that are suitable for parking within the Nature Reserve should be clearly demarcated as being so. At present, many of these areas are not properly designated as parking areas.

2) The Designation Order should be amended to include a section or sub-section on obstruction of roads by cars, particularly taxis and coaches (at places such as St. Michael's Cave and Prince Phillip's Arch). The problem of obstruction by taxis and coaches could be alleviated by restricting access to all roads beyond St. Michael's Cave, given that there are two other sites for Barbary Macaques, namely Haynes Cave pumping Station and Princess Caroline's Battery, which were not available when access was granted for taxis to reach the Prince Phillip's pack. This would also reduce noise pollution and emanations and relieve the taxi and coach drivers' fuel bill.

3) Anyone with authority to enforce the sections specified in the Designation Order should have the power to stop and fine the driver of a vehicle if that vehicle is playing music at a volume that is causing a nuisance and that is audible from outside the vehicle. Persons with this authority should include the Royal Gibraltar Police and Wildlife Wardens.

4) A serious effort should be made to reduce the amount of horn sounding that occurs in some areas of the Upper Rock Nature Reserve. This is not in any way consistent with the aims of a Nature Reserve, and does not give tourists a good image of the way that such areas are managed in Gibraltar. This horn sounding could be tackled, for example, through more sensible use of parking by taxis and coaches and through a little patience by the drivers of these vehicles.

5) The Management of the Nature Reserve should consider temporary restrictions of access along roads or paths for the purpose of road repairs, safety issues or wildlife concerns.

6) It is the authors' opinion that all vehicular access, including public service vehicles, to the upper reaches of the Nature Reserve should be restricted unless the reason for use is consistent with wildlife conservation aims, Nature Reserve staff requirements or emergency and essential vehicular use.

7) Residents of the Upper Rock Nature Reserve should be issued with an Upper Rock Nature Reserve disk, which should be displayed on the windscreen and which permits authorised access to their residences via Willis's Road, through the barrier at Moorish Castle entrance, after closing time.

8) Closing and opening times to be amended and set at 07:00hrs and 22:00hrs during the change to summer time at GMT+2 and set at 07:00hrs and 20:00hrs during the change to wintertime at GMT +1. These opening and closing times should be known as the 'specified time'.

9) The barrier at the Moorish Castle should remain down after the specified time, unless the driver of the vehicle requesting entry to the Nature Reserve is a resident with a valid Upper Rock Nature Reserve disk, or guest of the same and produces proof of permission or identity and specifies location or residence where he will be visiting. In this last case, visitors should only be allowed to proceed after the Security Guard confirms destination via a phone call to the residence in question.

10) An effort should be made to ensure that no person without permission remains within the Upper Rock Nature Reserve after the specified time. This could be achieved through patrolling, following the recruitment of Wildlife Wardens.

11) The time at which no person shall remain within the Nature Reserve in the evening should be clearly stated in the Designation Order. After these hours, authorised access to the Nature reserve should be via Willis' Road at the barrier at Moorish Castle.

12) The security guard must close the gates at Lathbury Barracks at the specified time in conjunction with the main gates on Engineer Road in order to ensure no unauthorised access.

3.5 Vandalism, Defacement and Litter

Litter poses one of the Nature Reserve's greatest problems. It can be seen everywhere, lining the roads and accumulated around sites, and does much to mar the aesthetic appeal of the Upper Rock. The Designation Order states that '*No person shall, in the Reserve, …deposit litter or waste*'[9], yet the amount of litter that can be seen within the Nature Reserve, particularly around popular stopping points, is of grave concern (*see* Chapter 5, section 5.1). Although legislation exists, laws are typically not enforced (due mostly to the fact that usually, there is nobody present to enforce such laws). The visual impact that litter causes within the Nature Reserve is illustrated in Appendix 2.

Similarly, large areas of the Upper Rock have been vandalised and defaced with graffiti. Graffiti is evident, for example, at Spur Battery (graffiti was actually painted over during August 2003, but has since returned) and O'Hara's Battery. Vandalism is of particular concern given that amongst structures and objects vandalised are fire-fighting cisterns and equipment (*see* Chapter 11). Although vandalism, and in particular graffiti abounds on the Upper Rock, this is restricted to roadsides and areas with very easy access, and could therefore be tackled effectively with relative ease.

The Designation Order states that '*No person shall damage or deface any structure including any natural structure in the Reserve*'[10]. In addition to this, more general legislation against vandalism and defacement exists. The problem here, once again, is that of enforcement of legislation and regular policing. If there is an absence of a police or warden presence within the Nature Reserve, then these practices will continue.

[9] Section 8.(a), pp.117 of L/N 51 of 1993.
[10] Section 6.(2), pp.116 of L/N 51 of 1993.

3.6 Recommendations

1) A greater effort should be made to clean the Upper Rock effectively, as is described in more detail in Chapter 5.

2) It may be an idea to place CCTV cameras at spots where large amounts of litter are deposited. This would not only expose offenders, but also act as a deterrent to those who are about to commit an offence.

3) Tour operators should be held responsible for the actions of their clients. This should apply to litter offences as well as to the feeding of the macaques. In this way, tour operators

would be encouraged to properly inform their clients that litter should not be discarded and macaques should not be fed, and that these practices constitute breaches of the law.

4) Police and/or Wildlife Wardens should be present within the Nature Reserve to ensure that acts of vandalism and defacement, and the deposition of litter do not take place.

3.7 Buildings and Structures

The Designation Order states that '*No person shall erect whether permanently or temporarily any structure which may obstruct the visibility of the Reserve or change the appearance of the Reserve except with the prior written consent of the Authority and subject to such conditions as the Authority may impose for the protection of the Reserve*'[11]. One of the problems regarding this section is that it refers to the written consent of the Authority (at present the Government) and makes no reference to the Nature Conservancy Council, or for that matter the Heritage Trust. This is of some concern, given that the interests of the Government may sometimes be at odds with the aims of the Nature Reserve and its effective conservation. The most notable proposal for a new structure was the 'Lumen Christi' Millennium sanctuary that was proposed by the Catholic Church for the area just behind the cable-car top station in 1999. Although allegedly the Government originally favoured the erection of this shrine, it did in fact go against not only legislation, but also 'The Gibraltar Development Plan' (1991). This contains a policy on the Upper Rock known as 'Policy Z19', which states that:

'Planning Permission will only be granted for new development within the Upper Rock Nature Reserve where it can be demonstrated that:

(1) It is compatible with the preservation and enhancement of the existing character of the area,
(2) There is no adverse environmental effect,
(3) Any permanent buildings are:
(a) essential
(b) of limited size, and
(c) are located and designed so as to fit into the Natural Landscape.'

The 'Lumen Christi', even when reduced in size response to public objections, failed to meet these objectives (*see* Gibraltar Nature News No. 6), and after a lengthy public debate in which popular opinion turned against the idea of the shrine, the Catholic Church finally aborted this enterprise. Similarly, permission should not be granted to any project that would affect the integrity of the Nature Reserve.

On the subject of existing dwellings within the Nature Reserve, 'Policy Z20' of 'The Gibraltar Development Plan' (1991) states that:

'The extension and replacement of existing dwellings within the Upper Rock Nature Reserve will only be considered in exceptional circumstances, and will be subject to the following criteria:

(1) They satisfy the criteria contained in policy H9
(2) There is no increase in the site area, and
(3) The amount of accommodation does not exceed the existing dwelling by more than 20%.'

In actual fact, plenty of work seems to take place in all residential areas of the Upper Rock, and this regularly seems to include extensions. If permission has been granted in all cases, then circumstances do not seem to be as exceptional as suggested in the development plan.

[11] Section 6.(1), pp.116 of L/N 51 of 1993.

3.8 Recommendations

1) No building or structure should be erected within the Upper Rock, without prior approval from the Board of Management, and then only for the purposes of the administration and conservation of the Nature Reserve, or the enhancement of existing and future tourist sites.

2) Section 6.(1) of the Designation Order should be amended to include the phrase, '*…except with the prior written consent of the Authority, in consultation with the Nature Conservancy Council…*'.

3) Policies within 'The Gibraltar Development Plan' pertaining to the integrity of the Upper Rock as a Nature Reserve should be included within the 'Nature Conservation Area (Upper Rock) Designation Order'.

3.9 Wildlife Wardens

The 'Nature Conservation Area (Upper Rock) Designation Order 1993' includes a section concerning Wildlife Wardens. Some of the issues concerning this matter are highlighted in the sub-sections below.

3.9.1 The Wardens' Powers

Section 21 of the 'Nature Protection Ordinance, 1991' deals with the appointment of Wildlife Wardens in Gibraltar, appointed by the Governor after consultation with the Nature Conservancy Council, either professional or honorary[12], adding that the Governor '*…may make regulations for the purpose of determining the powers and duties of any person appointed…*'[13]. It is interesting to note that authority is handed to the Governor, who both appoints and regulates the Wildlife Wardens. Although the former is done after consultation with the Nature Conservancy Council, the latter is left solely to the Governor. Although in these cases 'Governor' is usually deemed to read 'Government', in either case it is the authors' opinion that the 'Governor' should refer to the Nature Conservancy Council in all matters relating to Wardens and not just to their appointment.

More specifically, in relation to the Upper Rock Nature Reserve, section 9.(1) of the 'Nature Conservation (Upper Rock) Designation Order, 1993' states that '*Any person appointed as a Wildlife Warden in accordance with section 21 of the Nature Protection Ordinance 1991, shall carry out such duties in the Reserve as the Authority shall specify and shall have the power, in the Reserve, to stop any person who, it appears to the wildlife warden, has failed to comply with the requirements of these regulations and require that person to give to the warden details of the person's name and address evidenced by the production of an identity card or passport*'. Again, the 'Governor' should not hold absolute power in this matter, and everything should be carried out in consultation with the Nature Conservancy Council.

The powers of the Warden within the reserve are given in section 9.(2) of the Designation Order, which states that 'Any wildlife warden shall have, in the Reserve, the powers specified in section 16 of the Nature Protection Ordinance 1991'. Section 16 of the 'Nature Protection Ordinance, 1991' (pp. 65) gives a person appointed to enforce the Ordinance power to stop and search any person suspected of committing an offence and to seize any evidence for the purposes of proceedings. This clearly does not go far enough in elucidating the role and powers of a Warden. The Warden's role should thus be specified to include the implementation of all laws within the Designation Order that concern the Conservation of wildlife and the environment within the Nature Reserve.

3.9.2 Application of Section 9 of the 'Nature Conservation Area (Upper Rock) Designation Order, 1993'

The section dealing with the introduction of Wardens into the Nature Reserve, section 9, is one of the most important sections contained in the Designation Order, in that it is vital to the implementation of wildlife protection laws within the Nature Reserve. Given the vital importance of Wildlife Wardens within any nature reserve, it is tantamount to the gross mismanagement of the Upper Rock Nature Reserve that our Reserve has, for many years, found itself without any Wildlife Wardens. This is extremely worrying, given that the Reserve finds itself in a state of dereliction and deterioration. Also, the macaques, our largest economic asset within the reserve, find themselves being fed and harassed constantly, due to there not being any authority to ensure that this does not happen (*see* Chapter 14, on Barbary macaques for more details). Wildlife Wardens are therefore desperately needed in the Upper Rock Nature Reserve if it is to carry on being a site of considerable importance for wildlife.

[12] Section 21.(1), pp.71 of L/N 51 of 1993.
[13] Section 21.(2), pp.71 of L/N 51 of 1993.

3.10 Recommendations

1) Section 9 of the Designation Order does not specify the number of Wardens that should be appointed in the Upper Rock Nature Reserve. There should be at the very least a minimum of six Wardens employed by the Nature Reserve to cover the 40% of Gibraltar that comprises the Nature Reserve. This is vital given the pressures that are exerted on wildlife in the Nature Reserve by the very large number of tourists who enter it daily.

2) Granting certain people the title of 'honorary warden' may also prove useful, in addition to the appointment of professional wardens. For example, people who are employed by GONHS for the maintenance of macaques or gull culling, and who are knowledgeable in matters of Natural History and spend a considerable amount of time within the Nature Reserve could be appointed as 'honorary wardens'. This would allow them to take action upon anyone who they witness to be in breach of wildlife protection laws.

3) All wardens should have considerable experience in matters of natural history, and should be well versed with all of the Gibraltar wildlife protection laws that apply within the

Upper Rock Nature Reserve.

4) All wardens should have a knowledge and understanding of matters relating to the Upper Rock's historical value, and should be willing to act as a ready source of information, should any visitor to the Nature Reserve have any queries.

5) The 'Governor' should not have exclusive authority over the appointment and role of Wildlife Wardens. All sections or sub-sections which do not already do so should be amended to include the words '…after consultation with the Nature Conservancy Council,' when a decision is to be made by the Governor. This applies both to section 9 of the 'Nature Conservation Area (Upper Rock) Designation Order 1993' and to section 21 of the 'Nature Protection Ordinance, 1991'.

6) The 'Nature Conservation Area (Upper Rock) Designation Order 1993' should be amended to include a detailed account of the Wardens' responsibilities and authority. This should include authority to enforce any law that deals with the conservation of wildlife and the environment, within the Nature Reserve. It should also include a responsibility to have a constant awareness of all matters that are of environmental and/or wildlife concern within the Nature Reserve.

7) Most importantly, an effort should be made to employ Wildlife Wardens within the Nature Reserve as soon as possible, as this is vital in ensuring that the Upper Rock's natural heritage is properly conserved.

8) Finally, the Designation Order uses the term 'Wild Life Warden'. This should be changed to 'Wildlife Warden', which is the correct term for such a position.

3.11 Disturbance to Fauna

Although considerable disturbance is caused to fauna within the Upper Rock Nature Reserve, little direct disturbance actually occurs. The vast majority of disturbance is caused indirectly, through such factors as unrestricted access to traffic, traffic at night and excessively loud music. There have been instances in the past where there have been problems with finch catchers in the autumn and with persons hunting rabbits and partridges with air rifles and/or dogs. Fortunately, this appears not to have happened now for a number of years. There are, however, a few cases where direct, deliberate disturbance has occurred recently, or still occurs regularly. These are highlighted below.

3.11.1 Bats

The Designation Order decrees that no person may (without written consent) '*enter in to any cave or tunnel used as a roost by bats*'[14]. It is worrying to note that a great deal of disturbance has in the past been caused at sites that are used as a roost by bats. Noticeable in this respect is Martin's cave, which regularly held very large numbers of bats. For example, during the 1960's, an estimated 5000 Schreiber's bats *Miniopterus schreibersii*, and 1000 large mouse-eared bats *Myotis myotis*, were recorded in this cave (Palao, *Unpubl.*). However, no bats were recorded during a survey carried out during December 2002 (Santana, A., *pers. comm.*).

Martin's Cave has suffered greatly from repeated intrusions, particularly from youths, who have at times deliberately disturbed the bats to the extent of setting fireworks off within the cave. Grilles have been placed at the entrance to the cave on several occasions to prevent people from entering, but these have been repeatedly vandalised. Apart from contravening Section 5.(1)(c) of the Designation Order, it also goes against Section 6.(2)[15], which states that '*No person shall damage or deface any structure including any natural structure in the Reserve*'.

All bat species are protected under the 'Nature Protection Ordinance, 1991'. Furthermore, *Miniopterus schreibersii* and *Myotis myotis* are protected within the 'Habitats Directive' under Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. This Directive not only recommends the conservation of these species, but also their habitats, stating that 'These caves and feeding habitats require designation as Special Areas of Conservation (SACs)'. An effort has been made over the years to protect both populations of these bats *and* their roosting sites. However, this effort has largely been a result of hard work by volunteers rather than by local authorities or the Upper Rock management, who are actually responsible for this. As a result, the effort has not been adequate in ensuring the conservation of these bats and their habitats.

Council Directive 92/43/EEC also specifies that the feeding habitats of these bats should be conserved. These bats feed within the Upper Rock Nature Reserve, especially in open

[14] Section 5.(1)(c), pp.115 of L/N 51 of 1993.
[15] Pp. 116.

areas, such as firebreaks. Most of the firebreaks on the Upper Rock are mismanaged and are becoming increasingly dense (*see* Chapter 11), and are consequently becoming unsuitable as bat feeding sites. Bats provide just one of the reasons why firebreaks should be cleared regularly. Bats could also, for example, be feeding over the newly restored Great Sand Slopes of the East Side, which as yet has no formal protection. Legislation should therefore be provided to ensure that feeding habitats for these species are conserved.

3.11.2 Barbary Macaques

Barbary macaques within the Upper Rock Nature Reserve present a considerable problem from a conservation perspective, given that they are unique in that they freely interact with humans. All of the problems associated with these animals are dealt with in the Chapter on Barbary macaques. However, two specific points need to be highlighted here in relation to the 'Nature Conservation Area (Upper Rock) Designation Order 1993'.

The Designation Order states that it is illegal to '*feed any wild animal within the reserve*'[16], adding that it is also illegal to '*disturb any wild animal or wild bird in the reserve*'[17]. Whilst this first part was included largely in view of the way that macaques are fed by tourists and locals alike, it is blatantly disregarded. Furthermore, macaques are frequently disturbed and harassed whilst being fed or observed by tourists and locals. As mentioned above, this is dealt with more fully in the Chapter on Barbary macaques (*see* Chapter 14).

[16] Section 5.(1)(i), pp.115 of L/N 51 of 1993.
[17] Section 5.(1)(j), pp.115 of L/N 51 of 1993.

3.12 Recommendations

1) There should be a greater effort to ensure that people, who have not obtained prior consent from the proposed Cave Management Committee and from the Nature Reserve Management, do not enter caves or tunnels that are used as roosts by bats. A list of these caves should be included as an amendment to the 'Nature Protection Ordinance, 1991'. Protective grilles should be placed at the entrance to any cave or tunnel that is of importance to roosting bats within the Upper Rock Nature Reserve, and these should be checked on a regular basis to ensure that they have not been vandalised. This work should be carried out by those departments responsible for this, namely the management of the Upper Rock.

2) Natural areas that are important as feeding sites for bats should be protected in accordance with Council Directive 92/43/EEC. This should include sites that fall outside the boundary of the Upper Rock Nature Reserve.

3) Recommendations for the Barbary macaques are dealt with in Chapter 14.

3.13 Introduced Fauna and Flora

The 'Nature Conservation Area (Upper Rock) Designation Order 1993' includes sections dealing with the introduction of faunal and floral species which are not indigenous to the Upper Rock. Section 5.(1)(h) of the Designation Order states that it is illegal to '*introduce any animal or plant which is of a kind which is not ordinarily resident or is not a regular visitor to Gibraltar in a wild state or does not grow in the wild in Gibraltar, as the case may be*'. As with most sections of this Designation Order, these laws are, for the most part, ignored. This is highlighted in the next sub-sections.

3.13.1 Domestic cats

A rapidly growing number of domestic cats *Felis catus*, can be found within the Upper Rock Nature Reserve. This is nowhere more obvious than in the St. Michael's cave area and the Upper Galleries, where cats are routinely fed. This increase in cats within the Nature Reserve is of grave concern, given the devastating effect that the introduction of domestic cats has had on native faunas all over the world. Our native rabbit *Oryctolagus cuniculus*, Barbary partridge *Alectoris barbara*, and white-toothed shrew *Crocidura russula*, populations are particularly vulnerable to predation from domestic cats, especially given that the populations of these species within the Upper Rock, particularly the rabbit, are becoming increasingly depauperate.

Apart from contravening the section highlighted above, this also goes against section 5.(2) of the Designation Order, which states that '*…no animal other than a wild animal, may be taken into or kept in the Reserve*', given that once inside the Reserve, these animals are also being actively fed, and encouraged to stay within the Reserve boundary.

Figure 3. A domestic cat at St. Michael's Cave, within the Nature Reserve.
Cats are routinely fed at this site, where up to sixteen cats have been seen together.

The 'Nature Conservation Area (Upper Rock) Designation Order 1993' should therefore be amended to include a section stating that it is illegal to feed an exotic species within the Upper Rock Nature Reserve, given that at present, it is only illegal to '*feed any wild animal within the reserve*'[18]. Although this can and should apply to introduced animals such as cats, exotic species are not sufficiently specified.

3.13.2 Feral goats

There is currently a population of feral goats in the Royal Anglian Way area consisting of between twenty and thirty individuals, as well as a smaller population consisting of about a dozen individuals in the area below Rock Gun. These animals originate from several goats that were imported into Gibraltar illegally and kept just above the Upper Town area. The goats, although kept outside of the Nature Reserve, frequently made their way into the Nature Reserve limits, being frequently seen in the Bruce's Farm area. Whilst the Designation order clearly states, in section 5.(1)(f), that it is illegal to '*graze or permit to graze any domestic livestock*', the owners of the goats apparently made no attempt to stop this from occurring, to the extent that the goats eventually stayed within the Nature Reserve permanently.

3.13.3 Pets

It is clearly evident, when walking past houses within the Nature Reserve, that many people living within the boundaries of the Upper Rock like to keep pets within their homes. It is commonplace, for example, for people living within the Nature Reserve to keep dogs. Also, a number of residents have aviaries, as well as other pets. Whilst the 1993 Designation Order states that '*Any person resident in the Reserve or having the exclusive use of property in the area of the Reserve, may apply for a licence to take into the Reserve, an animal other than a wild animal*'[19], it is doubtful whether any of the residents in the Upper Rock Nature Reserve have a specific licence to keep pets within the reserve.

Some of the residents and workers of the Upper Rock keep chickens, pheasants and peacocks as pets. These are, in some cases, allowed to roam in areas of the Nature Reserve adjacent to the homes or places of work in which they are kept. For example, one frequently encounters peacocks and pheasants in the garden at Bruce's farm, and these birds belong to one of the neighbouring houses. Similarly, chickens and pheasants can be seen roaming freely at Bruce's Farm, the PSA Nursery, St. Michael's Cave, the area south of the Cable Car top station and on the road that leads to Farringdon Battery and the Upper Galleries. This is illegal, as section 5.(1)(f) of the Designation Order, which states that it is illegal to '*graze or permit to graze any domestic livestock*' applies to poultry[20]. These free-

[18] Section 5.(1)(i), pp.115 of L/N 51 of 1993.
[19] Section 5.(3), pp.115 of L/N 51 of 1993.
[20] Section 2.(1), pp.113 of L/N 51 of 1993.

roaming chickens, pheasants and peacocks are particularly worrying in that they occupy similar niches to our Barbary partridge and are therefore in direct competition with these birds. In addition, domestic fowl are known carriers of diseases that can be transmitted to similar species (such as the partidges), and some that are even dangerous to humans.

3.13.4 Flora

A number of introduced species of plants are to be found on the Upper Rock in a wild state, some of these fully naturalised, i.e., with a regularly occurring, self-sustained population. These include *Pelargonium inquinans, Lantana camara, Oxalis pes-caprae, Aloe arborescens, Senecio angulatus, Chasmanthe floribunda, Freesia refracta, Tecoma capensis, Carpobrotus edulis, Agave americana* and *Ailanthus altissima* (for more information on these see Chapter 8). Some species of exotic plants do not seem to pose a threat to the indigenous flora of the Upper Rock Nature Reserve. For example, healthy individuals of both *Eucalyptus camaldulensis* and *E. globulus* survive where they were originally planted, but it is unlikely that these trees will spread beyond these roadside sites, due to both the shallow depth of the soil on the Upper Rock and a seeming inability to establish themselves in this habitat through seed. Similarly, species such as *Pelargonium inquinans* and *Aloe arborescens* seem to have a limited dispersal ability within the Nature Reserve.

There are, however, some introduced species that give cause for concern. For example, it is illegal in South Africa to keep the exotic *Lantana camara* (which is native to the West Indies) in gardens (A. Abrines, *pers. comm.*), given the rapidity with which this species invades neighbouring habitats. Although *Lantana camara* is not found extensively within the Upper Rock it is encountered with increasing frequency in the area between the entrance to the Nature Reserve and Jews Gate, no doubt having spread from the gardens in the Mount area. The fruit that this plant produces is frequently taken by birds, which then deposit the seeds in their droppings. This plant therefore has the potential to spread all over the Nature Reserve in a short period of time, given the mobility of the birds that feed on these berries.

Another plant that is of considerable concern is the South African creeper Senecio angulatus, which also grows in and around Ince's and Upper Bruce's Farms. Its yellow flowers are clearly visible from town during December, when it can clearly be seen to be dominating the whole area. Furthermore, this species grows profusely just outside the boundary of the Nature Reserve, where it can be seen to be dominating over the local flora. The species is especially prevalent in the area behind the Rock Hotel. It is worrying to note that this species may spread into the Upper Rock Nature Reserve with ease in the near future.

The Designation Order states that it is illegal to introduce a plant that is not found naturally on the Upper Rock within the Reserve[21]. This includes the residences and built up areas. The authorities need to monitor the introduction of exotic plant species to gardens within these residences within the Upper Rock. Specific wording is necessary in the said legislation, such as has been done in the case of animals, in section 5.(3). It is reasonable for residents to be able to plant exotics in their gardens, as long as they pose no threat to the local flora and in particular do not clash with and spoil the character of the Nature Reserve. Measures should be taken to ensure that those species that are potential invasives are not be planted. These points are further emphasised in Chapter 8.

3.13.5 Peripheral Areas

At present, there is no legislation concerning the threat that activities in peripheral areas to the Upper Rock could pose to the Nature Reserve. This is rather worrying, given that some of the species that currently pose, or threaten to pose problems within the Nature Reserve have originated from houses or sites immediately outside the Nature Reserve boundary. This is the case, as illustrated above for example, with the domestic goats, and is probably also what has contributed most significantly to the rapid inflation of the domestic cat population within the Nature Reserve in recent years. The same can be said of *Lantana camara* and *Senecio angulatus*, both of which seem to have originated from the gardens immediately outside as well as within the Nature Reserve.

'Policy Z21' of 'The Gibraltar Development Plan' (1991) deals with areas that are peripheral to the Nature Reserve, where it states that:

'Within areas adjacent to the boundaries of the Nature Reserve new development will normally be restricted to:

(1) Essential infrastructure works,
(2) Limited low-density residential proposals,
(3) Tourism projects.

[21] Section 5.(1)(h), pp.115.

It is encouraging to see that the Development Plan recognises the importance of peripheral areas to the Nature Reserve. However, this should not be restricted to town planning alone, and wildlife conservation considerations should be included in light of the obvious sensitivities of the Nature Reserve.

3.14 Recommendations

1) There should be an active programme designed to eradicate feral domestic cats *Felis catus*, from within the Reserve, given that they are not native to the Upper Rock and pose a serious danger to the wildlife of the Nature Reserve. Sterilising cats and releasing them is not enough as these individuals will continue to hunt the native wildlife and in any case the subsequent release is illegal.

2) Section 5.(1) of the 'Nature Conservation Area (Upper Rock) Designation Order 1993' should be amended to include legislation regarding the feeding of exotic (i.e., non-native) species within the Nature Reserve, so that feeding is prohibited. Providing that it is enforced, this should ensure that cats are not fed within the Upper Rock, as currently occurs. Although the authors feel that this is already covered in the Designation Order, it is somewhat ambiguous in this respect, and clearer wording is required.

3) There should be separate terms in the legislation for indigenous fauna and introduced fauna, as the term 'wild animal' is quite ambiguous in this respect.

4) The feral goats on the Upper Rock must be removed, given that several young are born each year, and if the population grows further, this could result in habitat degradation and erosion. This also conflicts with plans to introduce large herbivores (*see* Chapters 10 & 13).

5) Residents who keep pets within the Nature Reserve should apply for a valid licence for these pets.

6) All chicken runs and poultry should be removed from the Upper Rock, as this goes against Section 5.(1)(f) of the Designation Order, and these birds could conceivably compete with our local Barbary partridge for food and territory, and also pass on diseases to our native birds.

7) Section 5.(3) of the Designation Order should be amended to include control over the introduction of exotic plant species into gardens belonging to homes within the Upper Rock. As part of this, a list should be legally adopted containing potentially invasive species that are not allowed to be grown within the Nature Reserve boundary. A proposed list of these plants is given in Chapter 8, section 8.12, which deals with invasive and potentially invasive exotic flora.

8) Gardens within the Upper Rock Nature Reserve boundary should be checked on a regular basis (e.g., annually) by a competent authority to ensure that no potentially invasive plants that may endanger the local flora are grown in these gardens. This authority should have the power to decide whether species grown in gardens are potentially problematic or not, regardless of whether or not they are actually listed as so, and should consequently have the power to add species to this list.

9) In cases where exotic plant species have already been introduced into the Upper Rock Nature Reserve, programmes should be initiated for the purposes of eradicating problematic species. These are described in Chapter 10.

10) Legislation should be created to control what animals or plants are kept in peripheral areas to the Nature Reserve. A buffer zone should be created around the reserve, to include the areas of the lower slopes below the western cliffs, and all vegetated areas between the Nature Reserve's boundary and the town area. This area should include the areas below Devil's Gap and extend behind the Rock Hotel, behind the Casino and include the Humphrey's Bungalows area where the Nature Reserve's boundary is met. It should also include the Lathbury Barracks Industrial Park as a peripheral area within this buffer zone. Special licences should be required in this buffer zone to keep pets, and a prohibition on the growth of certain species of plants as proposed in the list in recommendation 7 above.

3.15 Poisons

The 'Nature Protection Ordinance, 1991' (L/N 11 of 1991) and subsequent legislation concerning nature protection and the Upper Rock Nature Reserve, do not cover the use of poisons, herbicides, fungicides or pesticides. The indiscriminate use of these frequently affects and kills other species that are not targeted, and has the potential of eliminating protected species such as the northern raven *Corvus corax*.

The species most frequently targeted by poison in the Nature Reserve is the black rat *Rattus rattus alexandrinus*. This animal, although originating from Asiatic countries, can now be considered fully naturalised on the Upper Rock, and this subspecies survives mainly on berries, fruit and seeds occurring naturally in the Reserve. Occasionally, pockets of higher densities of this species are found where food supplies or discarded food items abound, and as we well know from our Barbary macaques, an animal will take advantage of an easy food source. The areas around Jews' Gate, St. Michael's Cave, the Ape's Den, Cable Car Top Station and Upper Galleries are the locations where on occasions the Tourist Board has received complaints of rat infestation. It is no coincidence that these areas hold the highest densities of humans within the Nature Reserve. It must be stressed that this problem is the making of man and often care taken in preventing or disposing of accumulations of rubbish can prevent rat problems occurring in the first place.

Usually it only takes the report of the sighting of a rat in a tourist site to ring alarm bells. During the winter months these animals often prefer the warmer temperatures of the caves and tunnels, and it is very often in these two places where these animals have been targeted. In such cases the Tourist Board inform the Environmental Agency, which then plants poison inside these sites, and lays the matter to rest. In such cases the rats will ingest the poison and will often wander about before dying. This may not necessarily take place inside the building, cave or tunnel that was being tackled, and sometimes the animal will die out in the open where it will be consumed by other animals, which will also die in the process. Even in the cases where the rat dies inside a site, there is a community of invertebrates that consume the body as part of the natural cycle of decomposition, and subsequently these smaller animals will die in the process. The point made is that poisons are an indiscriminate way of eliminating the problem, and one that obviously eliminates more animals than are targeted. All this is happening within a *Nature Reserve*. It is important in this respect to point out once again that some of the species that are vulnerable to poisons are protected by law.

It is unclear whether residents of the Nature Reserve use poisons within their homes. However, given that poisons are commonly purchased and administered by people who have problems with pests, it is likely that they do so. The use of poisons by private individuals within their residences in the Upper Rock Nature Reserve is not currently monitored. Since poisons can have an impact on animals other than pests, residents of the Upper Rock should be instructed to report infestations of pests to the management of the Upper Rock Nature Reserve rather than taking the matter into their own hands. The management of the Nature Reserve should then advise on the best ways to tackle the problem. In addition, the unauthorised use of poisons should be banned within the Upper Rock Nature Reserve.

There are adequate trapping methods that will only target specific species of a particular size and strength, and this means that only rats and possibly the occasional mouse will be caught. Moreover there are live trapping methods that will capture more than one individual within the same trap, and also traps that will kill the rat instantly. These are preferable to poisons. The results of the method employed are more easily monitored in this manner, and the density of the infestation can be quantified and analysed more accurately. In the case of poisons, only the occasional rat that is found dead will give any indication of the success of the method. There again, live trapping requires regular monitoring of the traps, but the benefits to the Reserve outweigh the minor disadvantage that the effort entails.

In the same way, the use of chemicals for the control of vegetation or treatment of wooden structures against fungi or termites, or chemical control of ants, etc. within the Nature Reserve must be regulated. Any chemical agent has the effect of attacking other non-target species, and adequate legislation needs to be drawn up to restrict the use of these agents within the Nature Reserve. This should apply to all persons using poisons within the Nature Reserve, including those under contract by the management authorities.

3.16 Recommendations

1) There should be a total prohibition on the use of poisons within the Upper Rock Nature Reserve, i.e., pesticides, herbicides and fungicides.

2) The use of live trapping methods for vermin should be encouraged.

3) There must be monitoring and analysis of the degree of any infestation problem, which, using the methods applied at present, cannot be quantified.

4) The use of herbicide or fungicide for specific target species should be authorised only under supervision by qualified personnel. Supervision should consist, not only of the chemicals and methods used, but also of the species targeted and other flora found in the area, which might be sensitive and in need of protection.

3.17 'The Authority'

The Nature Protection Ordinance makes repeated reference to 'The Authority', which is defined as *'Authority' means the Government or such undertaking as may be appointed by the Government from time to time to be the Authority*"[22]. During the years that Sights Management Ltd managed the Upper Rock, this company served as the Authority. Whenever nature conservation aspects were directly involved, this was usually in consultation with GONHS. The body that shall serve as the Authority needs to be identified. This should be the Board of Management or its equivalent (see Chapter 23).

[22] Section 2.(1), pp.113 of L/N 51 of 1993.

3.18 The Role of the Royal Gibraltar Police

The following information is based mainly on our analysis of an interview with P.C. Andrew Fortuna, Wildlife Liaison Officer with the Royal Gibraltar Police.

The Wildlife Liaison Officer is responsible for matters dealing with the relationship between wildlife and the law. In this respect, he is responsible for liasing with environmental and natural history organisations and authorities, and providing a point of contact between them and the police. In actual fact, the Wildlife Liaison Officer spends very little time on wildlife duties, and only acts in this role on some of the occasions when environmental and wildlife matters are brought to the attention of the police.

P.C. Fortuna was appointed to the role of Wildlife Liaison Officer in November 2002 approximately a year after the position had been vacated (the previous WLO, Mr Albert Yome, left the service), and only after insistence by GONHS to the Royal Gibraltar Police that the position should be filled. There was no official handover, and it was therefore impossible for PC Fortuna to liase with the previous WLO. He has only been able to do this through his relationship with Mr Yome within GONHS. Mr Fortuna was not briefed on matters relating to the Upper Rock Nature Reserve by his superiors prior, nor indeed after his appointment. Mr Fortuna does, however, have a sound knowledge of the 'Nature Protection Ordinance, 1991' and all legal notices related to this, and his working relationship with GONHS is a very good one.

Despite covering about 40% of Gibraltar's surface, the Upper Rock is not policed regularly. There is an occasional presence in the form of the odd patrol car or motorcycle, but personal observations during traffic surveys have shown that these are few and far between. Furthermore, Royal Gibraltar Police patrols during the nighttime are practically non-existent, and only occur if the police are following up on a report. Most patrols are mobilised to apprehend spotters related to drug and tobacco smuggling. Apart from their practices, these spotters are also in breach of the law in that they remain within the Nature Reserve after sunset (which goes against section 3.(3), pp.114 of L/N 51 of 1993) and that they frequently deposit large amounts of litter (which breaches section 8.(a), pp.117 of L/N 51 of 1993, as well as other more general laws on litter). However, the police do not generally address the matter relating to litter, even when these individuals have been apprehended.

It was highlighted to PC Fortuna that people not only remain within the Nature Reserve after the entrance at Engineer Road has been shut, but also regularly enter after sunset. It is of grave concern that the Upper Rock is not patrolled after the gates have shut in order to ask those who remain inside to leave, but it is even more worrying that people are rarely challenged when entering the Nature Reserve via Moorish Castle after sunset, where the barrier almost always remains open. The management of the Upper Rock Nature Reserve contracts the security guards at the gate, and they are responsible for ensuring that the Upper Rock remains secure throughout the night. However, it is also, or even primarily the police's job to enforce the law where this is being breached, as is clearly the case here.

The Royal Gibraltar Police regularly seeks cooperation with the Gibraltar Services Police on matters related to criminal offences and drug and tobacco smuggling taking place within the Nature Reserve. The Services Police did in fact voluntarily clean Douglas' Path a few years back, and placed a barrier at the southern entrance to the path in order to prevent spotters from entering with their mopeds. Unfortunately, however, the barrier was dismantled by spotters, after which the area fell back into a dilapidated state.

With regard to Barbary macaques, the police have only received reports when the macaques have posed a nuisance in residential areas outside the Nature Reserve, whence the management of the macaques has been informed. With regard to feeding, the police rely on persons coming forward to give a statement of the infraction committed and act as witnesses in the follow up. It was pointed out by us that this would prove futile, as by the time the authorities arrived at the scene of the infraction the culprit would be long gone.

3.19 Recommendations

1) The Wildlife Liaison Officer should have a role policing the Upper Rock Nature Reserve. Wildlife Wardens should be appointed, and these should liase closely with the WLO. The wardens would alleviate the WLO's responsibility, and he would then have time to address matters outside the Nature Reserve, both within and outside of his role as WLO.

2) A greater effort should be made by the Royal Gibraltar Police to ensure that no persons remain within the Upper Rock after sunset, and that the barriers at Moorish Castle are closed to all except for resident and other with permission to enter the Nature Reserve at night.

large psammodromus Julien Martinez / GONHS

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4. European Wildlife Directives and the Convention on Biodiversity

4. European Wildlife Directives and the Convention on Biodiversity

4.1 Natura 2000

The Natura 2000 Network is a network of protected areas set up under European COUNCIL DIRECTIVE 79/409/EEC on the conservation of wild birds and COUNCIL DIRECTIVE 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. These require action by Member States in the setting up of procedures that will enable the establishment of a Europe wide network of protected areas that will guarantee the survival of threatened plants, animals and habitats. The COUNCIL DIRECTIVE 92/43/EEC of May 1992, also known as the Habitats Directive, complements the requirements of the earlier EC Birds Directive which refers specifically to the protection of birds.

The Gibraltar Ornithological and Natural History Society contributed to the preparation of the main text of the Habitats Directive both directly and through its UK representatives in the Overseas Territories Conservation Forum of NGO's, and its contacts in UK with environmental bodies, namely the Royal Society for the Protection of Birds RSPB and Worldwide Fund for Nature (WWF-UK). The Directive was transposed into the laws of Gibraltar on 25th August 1995 (Nature Protection Ordinance, 1991, (Amendment) Regulations 1995; L/N 118 of 1995) by the then Minister for the Environment, the Hon. Joe Pilcher.

The 'Nature Protection Ordinance, 1991' (L/N 11 of 1991) already fulfils most of the obligations of the Directive, but the Directive requires the protection of particular habitats of importance, known as Special Areas of Conservation (SAC's), and/or species of importance and envisages the provision of funding towards these aims. In this respect, GONHS feels that the Upper Rock Nature Reserve meets the requirements of the Directive in holding particular species of global and national importance that should be considered by the Commission to be Sites of Community Importance (SCI's).

4.2 The Habitats Directive

The Bern Convention on the Conservation of European Wildlife and Natural Habitats ratified by the United Kingdom in 1982 is also of relevance in this context.

Its principal aims are:

- to ensure conservation and protection of all wild plants and animal species;
- to increase co-operation between States in these areas; and
- to afford special protection to the most vulnerable of threatened species (including migratory species).

The Convention thus protects over 500 wild plants species and more than 1000 wild animal species. It is open – that is, not limited to Europe – and is now in force in 45 member states. This convention was the inspiration for the 'EC Habitats and Wild Birds Directives' and had a direct influence on the UK's main conservation legislation, the Wildlife and Countryside Act 1981 (as amended).

The Habitats Directive, also known as 'The European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora 92/43/EEC 1992', identifies habitats and species of special interest within the European Community, and legislates for the notification of Special Areas of Conservation (SACs). The Directive (92/43/EEC) requires Member States to designate certain sites as SACs. From these national lists, Member States and the Commission will agree the Sites of Community Importance, which will become designated SACs. The UK forwarded 331 sites to Brussels as Sites of Community Importance or Candidate Special Areas of Conservation (cSACs). Together with Special Protection Areas classified under the Council Directive on the Conservation of Wild Birds (79/409/EEC), SACs will constitute the European Union's Natura 2000 network.

The Habitats Directive was transposed into Gibraltar law on 25th August 1995 (Nature Protection Ordinance 1991 (Amendment) Regulations 1995) as its obligation as part of the member state. A number of aspects have yet to be applied and several factors affecting this Directive have to be addressed by Gibraltar. This information, which was compiled by GONHS and presented to the Gibraltar Government, is being submitted by the Gibraltar Government to the Commission through the Minister of State for the Environment. A list of all requirements and factors affecting Gibraltar that affect the implementation of the Directive, can be seen below.

4.3 The Gibraltar Habitats Directive Report

The situation at present.

Abbreviations

GONHS	The Gibraltar Ornithological & Natural History Society
GOG	Government of Gibraltar
MOD	Ministry of Defence
JNCC	Joint Nature Conservation Committee
SPA	Special Protection Areas
SAC	Special Area of Conservation
CSAC	Candidate Special Area of Conservation
SCI	Sites of Community Importance
IBA	Important Bird Areas

Comments requested below:

Legal/institutional framework

i) Directive 92/43/EEC was transposed into the laws of Gibraltar on 25th August 1995 by Nature Protection Ordinance 1991. (Amendment) Regulations 1995.

An additional appendix was required to include some species, which were not already offered protection by the Nature Protection Ordinance.
No sites have as yet been designated.

Responsibility for implementation lies with the Government of Gibraltar (GOG), although there is Ministry of Defence (MOD) involvement in certain areas.

ii) The environment falls within the competency of the Government of Gibraltar as a defined domestic matter under the Constitution of Gibraltar.

4.3.1 Conservation of natural habitats and habitats of species (Natura 2000 network)

a) *Proposals for Sites of Community Importance*

i) The proposals have been prepared by GONHS using its inventories and databases.

ii) The proposals were submitted by GONHS to GOG. Because the sites include land held for the Crown by the MOD, the latter Ministry was consulted. A number of constraints were placed by MOD, which have held up the designation process to the point that the formal proposal has not yet been made. It was suggested that stricter conditioning of the designation was expected than within the UK. This has been found to be unacceptable in Gibraltar.

iii) MOD subsequently agreed to Government proposals in mid 2004.

iv) The recommended sites, based on the original data forms prepared by GONHS were submitted to the Commission through the Secretary of State.

b) *Protection and management of the Natura 2000 sites.*

i) In view of the fact that the sites have not yet been designated, no such measures have yet been prepared. However, this report on the Upper Rock in itself goes much of the way towards fulfilling the need for management plans for the terrestrial site. It is likely that the work to prepare the management plans for other areas will be done by GONHS, largely as part of its work in preparing a Biodiversity Action Plan, as the Habitats Directive encompasses the Territory of Gibraltar and it's Territorial waters.

ii) No formal measures exist. GONHS treats the sites as if they had already been designated and acts as a "watchdog" on steps that might cause deterioration/disturbance, using as a tool the provisions of the Nature Protection Ordinance wherever possible. This is done both informally and through its membership of the Development & Planning Commission. Habitat maintenance and restoration are carried out either as voluntary tasks, or incidentally as a result of other initiatives,

as in the restoration of the vegetation of the Great Sand Slopes (Cortes *et al*. 1999).

iii) No mechanisms are in place for the evaluation and authorisation of new activities affecting the sites.

c) *Financing*

i) This report in partially fulfilling the need to estimate the cost for Natura 2000 sites. Additional work of this nature is envisaged in the Biodiversity Action Plan being prepared by GONHS.

ii) No funds have yet been sourced, as the sites have not been designated. LIFE applications in 1995 were unsuccessful, partly because of non-designation of sites. Gibraltar has acquired Structural Funds, none of which have as yet been requested for Natura 2000 projects in view of non-designation of sites. However, preparation of this report is funded from this source.

d) *Surveillance*

i) Because the sites have not yet been designated, there are no tolls (databases, methodologies, etc.) as yet set up for surveillance of the conservation status of species and habitats. There is considerable surveillance in some fields (*e.g.* botany and ornithology), but this is NGO-led. These will need to be formalised in the future following designation.

ii) Surveys and censuses carried out by GONHS are limited due to limited funding.

4.3.2 Protection of species

a) *Measures taken for the strict protection of species*

i) There is strict legal protection of species under the Nature Protection Ordinance 1991. GONHS projects include captive breeding and release of lesser kestrel *Falco naumanni* and peregrine falcon *Falco peregrinus*.

ii) There is currently no control system for incidental capture and killing.

b) *Taking of wild animals*

i) Under the Nature Protection Ordinance, the use of poisons, gill and seine nets, mist-nets, rake nets, or the use of other indiscriminate methods of capture are either prohibited or regulated through licensing. Legal prohibition of taking of all species (including reverse-listing of plants).

ii) Derogations are only given in the case of control of the yellow-legged gull *Larus michahellis* and in certain situations culling of Barbary macaques *Macaca sylvanus*.

4.3.3 Other supporting measures and additional provisions

a) *Research efforts*

i) No specific research programmes are in place, pending formal designation and funding availability. Only NGO (GONHS) led research programmes exist currently not directly linked to the Habitats Directive.

b) *Introduction or reintroduction of Annex IV species*

i) Reintroduction of endemic Silene tomentosa (surprisingly omitted from Annex II but extinct in the wild in 1995) is being carried out by GONHS and Gibraltar Botanic Gardens (GOG funded) with moderate success. Non-native plant species are excluding native species. Notably, *Carpobrotus edulis x acinaciformis* affecting *Limonium emarginatum* in coastal habitats and *Chasmanthe floribunda* excluding several species including *Iris filifolia* in clearings in the matorral.

c) *Education and information*

i) There is increasing incorporation of local conservation issues in school national curriculum, including field visits, etc., and also NGO (GONHS) led work in the press, radio and television.

4.3.4 General questions

The planning process.

i) Planning is co-ordinated through the Development & Planning Commission which includes a representative from GONHS. This usually ensures that conservation of habitats and species is integrated into the formal planning procedures at this level. The Commission is serviced by the Town Planning Section of the Ministry for Trade, Industry and Communications. The Assistant Town planner is currently drafting a new development plan that aims to integrate the requirements of nature conservation (including the provisions of the Habitats Directive). However, these considerations are not integrated at inter-departmental nor Ministerial level.

ii) Very few human resources are directly available within the administration for the implementation of the Directive. Government contracts include personnel from a botanic garden and through contracts with GONHS to manage the macaques and the yellow-legged gulls; some additional basic practical work is carried out, but mainly on a voluntary basis. The Government Environment Department is staffed only by three people, a Senior Officer and two Administrative Officers, with some typing support. This requires reviewing and either the employment of additional staff or the contracting out of further activities.

4.4 Additional notes and comments

The Gibraltar Ornithological & Natural History Society (GONHS) is an NGO dedicated to research into and conservation of nature. It is consulted on environmental matters by both the Government of Gibraltar and of the UK and hold several Government wildlife management contracts in Gibraltar. In the absence of biologists, ecologists or conservationists in the employment of the Government of Gibraltar, the latter uses the expertise within GONHS to provide it with advice on matters relating to the natural environment. Much of this (including all the work on the Habitats Directive and the Nature Protection Ordinance) has been provided on a voluntary (non-fee-paid) basis.

In Gibraltar, the Nature Protection Ordinance of 1991 was the landmark in nature conservation equivalent to the UK Wildlife and Countryside Act. Drafted by GONHS and passed unanimously at the Gibraltar House of Assembly, it also confirmed the close working relationship of GONHS and the Government of Gibraltar, with GONHS still retaining its independent NGO status and sometime being critical of Government.

The Habitats Directive was transposed quite promptly. However, difficulties in ironing out the defence points of view expressed by MOD significantly delayed proper implementation of the Directive in Gibraltar. This was holding up the development of administrative and practical structures in the Territory to provide the necessary information on and protection of the habitats and species.

There has been similar difficulty to that experienced in UK over the occurrence of some of the habitats. Because of Gibraltar's size, some of the areas in question are very small and representation is hard to determine. Concepts such as "percentage of habitat" and "percentage of the national territory" have to be placed in perspective.

As in the UK, site selection has used the best available information, and adapting the definitions contained in the Interpretation Manual of European Union Habitats (EC 1994) to the specialised communities of Gibraltar, some of which have only just been described (Galán de Mera *et al*. 2000). But again, because of the small size of the Territory, the important habitats (including priority habitats) are in most cases very small in extent. Proposing a patchwork of small sites was not practical, nor would it be effective as a conservation measure. Therefore, these sites were linked into a terrestrial site and a marine site (GONHS 1994). Because of the presence of these habitats and of species found within them, and the potential danger posed to all of them by the intimate proximity of human activity, much of the Territory and Territorial waters of Gibraltar have been included in the proposed Natura 2000 sites.

Some endemics, including the plant *Silene tomentosa* and a number of sea slugs, were never included in the Annexes, as the EU did not consult Gibraltar experts during the preparation of the Directive. Gibraltar however treats these species as if they were included in the Directive's Annexes.

It should be noted that although the requirements of the Birds Directive (79/409/EEC) were included in the 'Nature Protection Ordinance, 1991' no SPAs were ever designated, and the proposal under the Natura 2000 system is also seen as covering this requirement for Gibraltar.

Because of the delays in designation of the sites, no financial provision has been made for implementing Natura 2000, nor have possible EU sources of funding been fully explored.

While GONHS has carried out inventories of a great deal of Gibraltar's biological resources, including vascular plants, molluscs, butterflies and moths, reptiles, birds, mammals, and many marine groups, there are significant gaps[1]. There are no inventories for terrestrial invertebrates (other than the mollusca and lepidoptera) or in non-vascular plants.

There are several important and specific factors that will have a bearing on the Habitats Directive. These are listed below.

1) The 'Nature Protection Ordinance, 1991', reverse-lists plants, listing only those that may be picked.

2) The Nature Reserve Regulations prohibit uprooting of all species within the Upper Rock Nature Reserve.

3) The Ordinance prohibits the taking of all wild animals except rats and mice and feral cats, dogs and pigeons. All wild amphibians, reptiles, birds and mammals (including cetaceans) are protected against intentional killing.

4) Members of GONHS carry out all monitoring and research on a voluntary basis.

5) The Nature Protection Ordinance allows licensed taking for similar purposes to the UK Wildlife and Countryside Act.

6) The licensing authority is the Governor of Gibraltar, under advice from the Gibraltar Nature Conservancy Council. In practice licences are issued by the Deputy Governor and the advice is channelled through the Minister for the Environment.

7) Licences have been granted for research (e.g. bird ringing), and conservation (e.g. taking plants into the botanic gardens for propagation and re-introduction).

8) Licences have also been granted for the control of the yellow-legged gull, a pest species, and on occasions for the exportation and culling of Barbary macaques to maintain sensible manageable levels. Culling has only been allowed in the case of macaques that have become a nuisance in built-up areas.

Introduction of non-native species is prohibited under the Nature Protection Ordinance. There are problems with introduced plants affecting diversity of native species (e.g., *Chasmanthe floribunda*, *Senecio angulatus* & *Pennisetum clandestinum*; *see* Chapter 8). Introduced animals also cause problems. For example, feral pigeons displace lesser kestrels *Falco naumanni* from nesting sites, released pet rabbits interbreed with the native form and chickens have been found running freely on the Upper Rock in the Princess Caroline's Battery area, Bruce's Farm area and recently chicken coops has been erected beside the Cable Car top station and at St Michael's Cave where the chickens wander amongst the tourists. There is a danger that these chickens could pass on diseases to the Barbary Partridge. There is, in addition, no doubt that these chickens will compete with the partridges for food.

GONHS is attempting a captive breeding programme of lesser kestrels with a view to setting up a second colony in Gibraltar additional to a long-established but numerically decreasing colony on the North Face of the Rock.

GOG and MOD are funding a project to restore vegetation of stabilised dunes on the east side of Gibraltar following the removal of corrugated iron sheets formerly used to collect rain water.

Human resources involved in Natura 2000 work at present are basically provided by

GONHS, on a part-time (unpaid) basis.

Following acceptance of the sites, more resources will be required and further documents, including management plans and a biodiversity action plan, will have to be prepared. This will complement the Upper Rock Nature Reserve management plan.

The Annex I habitats and Annex II species occurring in Gibraltar are listed at the end of the chapter.

4.5 The Natura 2000 network

4.5.1 Species

Annex II of the Natura 2000 Directive lists 'Animal and Plant species of community interest whose conservation requires the designation of special areas of conservation; SAC's'. These include three bat species, namely the lesser horseshoe bat *Rhinolophus hipposideros* (passage/accidental), and two resident species, the Schreiber's bat *Miniopterus schreibersii*, and the greater mouse-eared bat *Myotis myotis*. The resident species make use of the many caves and tunnels in Gibraltar to breed and roost, but have declined in recent years (A. Santana, *pers. comm.*). Their caves and feeding habitats require designation as Special Areas of Conservation (SAC's). Other species whose world status is as precarious as some listed in this Annex have been excluded from the directive, as there was no consultation on the appendices which led to several rare species with their only European location in Gibraltar being omitted. These include the endemic Gibraltar campion *Silene tomentosa*, thought extinct until 1994 (Cortés & Linares 1993). Species in Annex IV of relevance to the Nature Reserve, of community interest and in need of strict protection that are covered by the Nature Protection Ordinance include all bats, the horseshoe whip-snake *Coluber hippocrepis*, and the Gibraltar funnel-web spider *Macrothele calpeiana*.

There are species that occur in Gibraltar which need protection because they are of local interest, even if not included in the Directive, (see Table 1). Of particular importance are those species, sub-species or varieties that occur only in Gibraltar. These may have been excluded from the Directive due to lack of knowledge of Gibraltar's natural history on the part of those drawing up legislation in London or Brussels, or due to the fact that they are not recognized as separate species, but are considered as sub-species. This does not make them any less important in conservation terms. This importance is afforded to them in the 'Nature Protection Ordinance, 1991'.

Table 1. Species and subspecies of particular importance to Gibraltar, but excluded from the Directives.

Group	Species	Population	Motivation
Plants	*Silene tomentosa*	1	A,B
Plants	*Ononis natrix var. ramosissima*	251-500	A,B
Plants	*Saxifraga globulifera*	101-250	A,D
Plants	*Thymus wildenowii*	101-250	A,D
Plants	*Iberis gibraltarica*	1001-10000	A,D
Plants	*Limonium emarginatum*	1001-10000	A,D
Plants	*Cerastium gibraltaricum*	251-500	A,D
Mammals	*Macaca sylvanus*	101-250	D
Reptiles	*Hemidactylus turcicus*	V	A
Invertebrates	*Cecilioides spp.*	R	B
Invertebrates	*Zygaena fausta gibraltarica*	C	A

Population: **C**=common, **R**=rare, **V**=very rare
Motivation: **A** = National Red Data List, **B** = Endemics, **C** = International Conventions (incl. Bern, Bonn and Biodiversity), **D** = Other reasons
Species not found on the Upper Rock Nature Reserve

4.5.2 Sites

Annex I of the Habitats Directive defines the natural habitat types of community interest whose conservation requires the designation of Special Areas of Conservation (SAC's). Sites within Gibraltar that fall into these categories have been considered in accordance with the criteria set out in Annex III of the Directive. This is in order to assess the national level of relative importance for each natural habitat where 'national' refers in this context to the Territory of Gibraltar and its Territorial waters. Although the Member State is the United Kingdom, Gibraltar and the UK are found within different biomes. Therefore Gibraltar represents, in virtually all the cases, 100% of the habitat type or species in question, even if Gibraltar and the UK were taken together.

The habitat types described next are taken from the document prepared by GONHS entitled 'The Habitats Directive and Gibraltar' (1994).

4.5.3 Natural Habitat Types of Community Interest whose Conservation Requires the Designation of Special Areas of Conservation

Vegetated sea cliffs of the Mediterranean coasts (with endemic *Limonium spp)*

Location:

Sea cliffs from Sandy Bay to Europa Point and Rosia Bay. This includes the sea cliffs, which rise up to Martins Cave around Mediterranean Step's where *Limonium emarginatum*, Gibraltar sea lavender can also be found growing.

a) Degree of representativity of the natural habitat type on the site.

Representative of Mediterranean limestone sea cliff with perennial plant community including *Aeonium korneliuslemsii* and *Limonium emarginatum*, endemic to the Strait of Gibraltar.

b) Area of site covered by habitat in relation to the habitat in Gibraltar.

50%

c) Degree of conservation.

Poor to very good. Areas have accumulated rubbish and rubble, and others have been polluted by effluent from the refuse incinerator. The area within the Nature Reserve is unspoiled due to its inaccessibility and remoteness.

d) Global assessment.

The occurrence of an endemic makes this an area of global importance. It is also unique in landscape value together with the rest of the Mediterranean Steps.

Mediterranean Arborescent Matorral

Matorral with *Laurus nobilis*

Location:

The western slopes of the Rock of Gibraltar, within the Upper Rock Nature Reserve, especially the south-western and extreme north-eastern slopes.

a) Degree of representation of the natural habitat type on the site.

Representative of Mediterranean matorral, dominated by *Olea europea*, wild olive, *Osyris quadripartita*, *Rhamnus alaternus*, Mediterranean buckthorn and *Pistacia lentiscus*, lentisc with individual *Laurus nobilis*, sweet laurel and *Celtis australis*, nettle tree scattered within them, being most common in the stated areas.

b) Area of site covered by habitat in relation to the habitat in Gibraltar.

100%

c) Degree of conservation.

Fair. Existing trees and shrubs must be protected.

d) Global assessment.

Small areas of laurel-containing matorral, but such habitats are rare. The Upper Rock is important under the Birds Directive. *Macrothele calpeiana*, Gibraltar funnel-web spider and *Coluber hippocrepis*, horseshoe whip-snake occur in this habitat.

Thermo-mediterranean and Pre-Steppe Brush

All types

Location:

Parts of the western slopes of the Rock of Gibraltar, within the Upper Rock Nature Reserve, especially the area known as Rock Gun.

a) Degree of representation of the natural habitat type on the site.

Representative of pseudosteppe and garrigue. Nesting site for *Alectoris barbara*, Barbary partridge and an important stopover site for migrant passerines. Also a foraging site for *Macaca sylvanus*, Barbary macaque.

b) Area of site covered by habitat in relation to the habitat in Gibraltar.
100%

c) Degree of conservation
Good in the area although beginning to regenerate into arborscent matorral.

d) Global assessment.
Representative of limestone-based pseudosteppe and garrigue vegetation, together with importance for migratory birds.

Mediterranean Sclerophyllous Forests

Olea and _Ceratonia_ forests

Location:
The western slopes of the Rock of Gibraltar, within the Upper Rock Nature Reserve.

a) Degree of representation of the natural habitat type on the site.
The Upper Rock was historically covered by *Olea* and *Ceratonia* forest, which was removed during the 18th Century (Cortes 1994). Olea is now the dominant species of the scrub, and in areas has developed into woodland (Cortes 1979, 1994). *Ceratonia siliqua*, carob tree is re-establishing itself more slowly.

b) Area of site covered by habitat in relation to the habitat in Gibraltar.
100%

c) Degree of conservation.
Unspoilt in areas where woodland has already become re-established. The particular interest of the site is enhanced by the fact that it allows the study of recovery of an area of *Olea* and *Ceratonia* woodland.

d) Global assessment.
The importance of this area is the natural recovery of the woodland that is taking place in what is already a protected area. *Macrothele calpeiana* and *Coluber hippocrepis* occur in this habitat.

Chasmophytic Vegetation on Rocky Slopes

Calcareous sub-types

Location:
Northern and eastern cliffs of the Rock of Gibraltar, and the outcrops of the cliffs on the western side of the Rock.

a) Degree of representation of the natural habitat type on the site.
Extensive areas of mostly unspoilt chasmophytic vegetation representative of the habitat. Plant species of particular interest include *Saxifraga globulifera gibraltarica*, Gibraltar saxifrage, *Cerastium gibraltaricum*, Gibraltar chickweed, *Thymus wildenowii*, Gibraltar thyme, *Helichrysum rupestre*, wall helichrysum and *Iberis gibraltarica*, Gibraltar candytuft. The endemic species *Silene tomentosa*, Gibraltar campion, until recently presumed extinct (Cortés & Linares 1993) has been rediscovered in this habitat where the known world population is of two plants.

b) Area of site covered by habitat in relation to the habitat in Gibraltar.
60%

c) Degree of conservation.
Very good. Some sites more accessible and close to human habitation require monitoring.

d) Global assessment.
The chasmophytic vegetation of the Rock of Gibraltar is representative of areas of limestone in the Mediterranean, but has added global importance in the occurrence within it of taxa which are either endemic or with affinities to North Africa.

Other Rocky Habitats

Caves not opened to the public.

Location:
Scattered throughout Gibraltar.

a) Degree of representation of the natural habitat type on the site.
Largely unspoiled caves in limestone, some being roosts and breeding caves for *Miniopterus schreibersii*, Schreiber's bat, *Tadarida teniotis*, European free-tailed bat and possibly *Myotis myotis*, mouse-eared bat.

b) Area of site covered by habitat in relation to the habitat in Gibraltar.
40%

c) Degree of conservation.
Fair to excellent. Some caves contain debris and rubbish and need to be cleaned and closed, leaving access to bats. Bat numbers have declined drastically of late and all bat roosts and potential roosts need protection.

d) Global assessment.
All populations of bat species found in Gibraltar are globally important.

4.5.4 Conclusions

Within the areas considered to be Sites of Community Importance (SCI's) and requiring listing as Special Areas of Conservation (SAC's) six are found within the Upper Rock Nature Reserve, with their locations indicated in Fig. 1. These areas should have been considered by the Commission of the European Community as Gibraltar's recommendations under the Directive, which were published in a report prepared by the Gibraltar Ornithological and Natural History Society (1994), and have only just been submitted to the Commission through the Secretary of State for the Environment by the Gibraltar Government.

The Gibraltar Nature Protection Ordinance (1991) already allows for the designation of nature conservation areas. Amendments to the Nature Protection Ordinance will need to take place to accommodate the Directive requirements once the areas in question are designated their corresponding status.

A list of the percentage coverage of the habitat sites in question that were submitted can be found in Table 2. Although this document deals specifically with the Upper Rock, the whole environment of Gibraltar can not be excluded as all these areas have a particular influence and bearing on the broader picture.

Table 2. List and percentage cover of Habitat Classes found in Gibraltar.

Habitat Classes	**% Cover**
Shingle, Sea cliffs, Islets	22
Heath, Scrub, Maquis and Garrigue, Phrygana	60
Dry grassland, Steppes	8
Broad-leaved evergreen woodland	3
Non-forest areas cultivated with woody plants (including Orchards, groves, Vineyards, Dehesas)	2
Inland rocks, Screes, Sands, Permanent snow and Ice	5
Total Habitat Cover	100%

Other site characteristics: Site includes *Olea*-dominated maquis and clearings on the west side with some woodland with *Olea* and *Pinus* and scattered *Larus nobilis*. Garrigue.
Tall sea cliffs on North and East with smaller cliffs on West and South. Caves and tunnels present.
Underlying rock is mainly Jurassic Limestone.

4.5.5 Funding

Designation is, however, not enough, and proper enforcement of nature conservation is required. This includes the prevention of deterioration of habitats, which is a significant problem in Gibraltar at the moment. The Habitats Directive includes provision for co-financing of work to uphold its requirements. Apart from the specific requirements of the habitats, there is a need to strengthen research, monitoring and database consolidation. An estimate (as at end 2003), of what it would cost in the ideal situation to carry out all direct and supporting work in the habitats found within the Upper Rock Nature Reserve is given in table 3. Savings

in recurrent expenditure could be made if overall supervision and a management team were provided, as recommended in Chapters 23 & 24, rather than relying on separate action in each habitat type.

Table 3. Summary of cost of financing Habitats Directive requirements in Gibraltar. This table, including costs, has been amended to incorporate management recommendations (*see* Chapter 24, Action 15.2).

Habitat	Action	Cost
Vegetated Sea Cliffs	**Initial costs (non-recurring)**	
	Habitat/site restoration	£100,000.00
	Clearing of rubbish	£20,000.00
	Recurrent expenditure (p.a.)	
	Habitat management	£30,000.00
	Site supervision	£15,000.00
Matorral with Laurus	**Initial cost (non-recurring)**	
	Habitat/site restoration	£100,000.00
	Clearing of rubbish/debris	£30,000.00
	Recurrent expenditure (p.a.)	
	Habitat management	£40,000.00
	Site supervision	£35,000.00
Thermo-mediterranean	**Initial cost (non-recurring)**	
and Presteppe Brush	Habitat/site restoration, Rock Gun area	£100,000.00
	Recurrent expenditure (p.a.)	
	Habitat management	£30,000.00
	Site supervision	£30,000.00
Chasmophytic	**Initial cost (non-recurring)**	
vegetation	Surveying of site and remedial action	£30,000.00
	Recurrent expenditure (p.a.)	
	Habitat management	£20,000.00
	Site supervision	£20,000.00
Caves	**Initial cost (non-recurring)**	
	Habitat/site restoration	£20,000.00
	Protection of caves	£10,000.00
	Recurrent expenditure (p.a.)	
	Monitoring/Supervision/Conservation	£25,000.00

Total	Capital	Recurrent
Annual	£440,000.00	£245,000.00
0ver 3 yrs	£440,000.00	£735,000.00
Grand Total over three years		**£1,175,000.00**

4.6 EUROBAT

EUROBAT was set up as part of the Bonn Convention, also known as 'The Convention on the Conservation of Migratory Species of Wild Animals' and specifically under 'The Agreement on the Conservation of Bats in Europe (1994). This agreement recognises that endangered migratory-species can only be properly protected if activities are carried out over the entire migratory range of the species. To date, twenty-six European range states, from North, South, East and West, are signatories to this Agreement. The aims of the Bat Agreement are to protect all 37 species of bats identified in Europe, through legislation, education, conservation measures and international co-operation with Agreement members and with those who have not yet joined. This is one of the Multilateral Environment Agreements that applies to Gibraltar, and to which the United Kingdom is a signatory, as the member state, (*see* section 4.51).

4.7 The Biodiversity Convention

The European Community is a party to the Convention on Biological Diversity, better known as the 'Biodiversity Convention'. The United Kingdom Prime Minister signed this convention at the 'Earth Summit' in Rio de Janeiro in June 1992, and as a result the concept of a Global Biodiversity Forum was set up. Therefore, as part of the member state, Gibraltar has accepted the commitment to apply the convention in its territory.

Biodiversity is a portmanteau term that means 'biological diversity'. It is essentially the variation and variety of all life on earth, composed of millions of organisms of plants, animals and micro-organisms that inhabit the planet. The genes they contain and the intricate communities these species comprise is in effect what we commonly know as Nature; the product of four billion years of evolution (DDP Services 1995).

The aims of the Biodiversity Convention are to conserve biodiversity, to use it sustainably, and to ensure fair and equitable distribution of benefits resulting from the exploitation of genetic resources.

In January 1994 the Prime Minister launched 'Biodiversity': The UK Action Plan, where he announced that a Biodiversity Steering Group would be established, with representatives drawn from key sectors and chaired by the Department of the Environment which would oversee the following tasks: -

- Developing costed targets for key species and habitats;
- Suggesting ways of improving the accessibility and co-ordination of information on biodiversity;
- Recommending ways of increasing public awareness and involvement in conserving biodiversity;
- Recommending ways of ensuring that commitments in the plan were properly carried out;
- Publishing findings before the end of 1995

The United Kingdom, as the member state in the European Union with responsibility for Gibraltar, published these findings in their 'Biodiversity: The UK Steering Group Report' Volumes I and II `, HMSO (1995), where they referred to Gibraltar in 'Annex B' under the 'Dependent Territories Progress Report'

In this report, Gibraltar figures as ecologically significant and sensitive, stemming from its location on a major migration route, with very substantial flora for its area and important marine biological assets, but vulnerable because of its small area with a high population. They have recognised the sound, scientifically based work that has been carried out over a number of years and welcome the implementation of the 'Nature Protection Ordinance, 1991' and the creation of the Upper Rock Nature Reserve together with transposition of EU Directives. They also state that Gibraltar has implemented the Habitats Directive, which unfortunately is *not* fully the case, as a number of actions are still waiting to occur. What has happened is that the Habitats Directive has been transposed into the laws of Gibraltar under the heading of 'Implementation of the Habitats Directive', without any sites actually being designated as yet.

The report recognizes the excellent human resources backing the conservation efforts in the form of the Gibraltar Ornithological & Natural History Society and the partnership that exists between this organization and the Gibraltar Government, providing expert advice and preparing reports. It also mentions that Gibraltar is considered as a location for one of the global Geographical Observatories under a programme initiated by the Royal Geographical Society, and refers to the main problem Gibraltar faces, which is lack of funds dedicated to biodiversity conservation.

Finally the European Union, in its European Biodiversity Strategy (2003), is committed to halt all declines in biodiversity by 2010.

The implementation of the Convention takes into consideration policy decisions across a wide range of economic activities, including agriculture, fisheries, forestry and transport. Most of these sectors do not apply to Gibraltar itself but some, as in the case of fisheries, have wide political implications. Although there is no large scale commercial fishing activity, the fish stocks in Gibraltar's territorial waters were allowed, under a "fishing agreement" negotiated by the Chief Minister, to be exploited by a member state, even though as pointed out by GONHS, these stocks were unsustainable, and that in so doing the Spanish fishermen were contravening the 'Nature Protection Ordinance, 1991'.

The implementation of the Biodiversity Convention and all other environmental directives requires, primarily political will and secondly, the establishment of a fund raising mechanism; whether through direct Governmental funding or accessing Community funds such as LIFE or Structural Funds. The benefits to Gibraltar are potentially great, yet failure through the years to successfully access such funds, for a variety of reasons, has seen the environment suffer and this is reflected in the dilapidated state of the Upper Rock Nature Reserve. It is hoped that the current initiative under which this report is being prepared, will result in improvements in this area.

There are two aspects of the Biodiversity Convention that relate directly to the Upper Rock Nature Reserve. The first deals with energy and transport in which the European Community has developed a wide range of initiatives to deal with these problems. The Community is committed to achieving an 8% reduction on 1990 levels of emissions of six greenhouse gases by 2010, and on transport a package of measures addresses road transport emissions. The commitment by M. H. Bland Ltd to substitute diesel fuel to 'Biodiesel' in their fleet of tour buses is the first step in achieving these aims, and also one of the objectives of the management plan for the Upper Rock Nature Reserve.

The other aspect that is directly relevant but has been neglected as a potential source of Community funding is tourism. Tourism activities within the European Community have in the past often been concentrated in zones that may be the subject of intense seasonal influxes of visitors. Gibraltar is a zone that has seen a spectacular rise in the number of visitors over the last fifteen years. From 782,630 visitors in 1993 to a staggering 7,608,461 in 2002, (Statistics Office 2002). Sustainable development of the tourism sector depends on maintaining a high-quality natural and man-made environment. A number of initiatives have been developed in the European Community that aim to integrate environmental protection and tourism. With this in mind, a large part of the budget under the Community's action plan to assist tourism is earmarked for sustainable tourism projects, and the Community's Structural Funds have been applied to many projects that combine tourism activities with biodiversity conservation. Although the Biodiversity Convention has been adopted in Gibraltar as part of the member state, its recommendations have unfortunately not been implemented, and therefore sources of funding, such as Leader II (1994-1999), Gibraltar could have applied for, and would have ultimately benefited sustainable tourism programmes within the Upper Rock Nature Reserve, have not been tapped. Notwithstanding this, other sources of funding, essentially Structural Funds, have been used. For example, the road widening that took place at Cave Branch Road on the Upper Rock Nature Reserve and the preparation of this report benefited from European funding.

An example of the way these funds have been accessed by other member states can be seen in Portugal (EC 1998), where the Envireg fund, a part of the Structural Fund, has been used to co-finance integrated protection schemes to manage areas of scenic interest for tourism and promote rural tourism as part of the Community initiative of the Leader II (1994-1999) funds.

To quote from the report on the implementation of the Biodiversity Convention, (1998), "*Achieving the Community's biodiversity goals is only possible if the legal framework is properly implemented. Unless Community law is properly complied with and effectively enforced in all Member States, the Community's biodiversity strategy cannot be effective*".

We are fortunate that through the work of GONHS our legal framework is in place through the 'Nature Protection Ordinance, 1991'. The implementation of the same lets us down (*see* Chapter 2); there is practically no enforcement of these laws and without this, the implementation of these Directives will not achieve the goals and expectations. In Gibraltar, all environmental European Directives transposed by the United Kingdom as the member state and accepted and adopted by Gibraltar *should* be implemented. The Gibraltar Government has just recently reported back to the European Commission with the information that was prepared by GONHS *gratis*, as regards Natura 2000, the Birds and Habitats Directive. Acceptance by the Commission, which is expected, should now accelerate the implementation, with the designation of special areas of conservation (SACs), special protection areas (SPAs) and other recommendations listed within these Directives. It should also open up the possibility of accessing Community funds from the Structural Fund, Cohesion Fund and the revised LIFE Funds to establish the various programmes required for the implementation of the Directives, before we miss the boat altogether.

Ironically, the designation of the 'Marine Reserve' encompassing all Gibraltar's territorial waters and included in the 'Nature Protection Ordinance, 1991' and the Marine Reserve Regulations 1996, is also not being enforced, partly due to the Spanish Fishing conflict of 1997/98. At a time when Spanish politicians have designated their own marine reserve on

the other side of the Bay ('Párque Natural del Estrecho' in 2003), and are demanding that Gibraltar implement all environmental European Directives, especially those dealing with maritime and marine connections, Gibraltar should comply with European measures. We should apply our own existing marine legislation to protect our waters from the continuous onslaught of Spanish commercial and sports fishermen and divers, who are prevented from carrying out their activities within their own waters by the establishment of reserves. Although this has no direct bearing to the Upper Rock Nature Reserve, it primarily serves to highlight the problems that exist in enforcing environmental legislation.

Not long ago, Gibraltar was the benchmark in the region for environmental affairs. The GONHS was the template for some of the ornithological, environmental and botanical organisations, not only in the Cadiz province but also in other parts of Spain. The Society was frequently visited and consulted on many aspects of the environment and natural history, but many things have changed in the last decade. The tables have turned. Spanish politicians have become experts in European Community affairs and accessing Community funding. This has had a tremendous impact, especially in the environmental field where they have spent vast sums of money, much of it from European Community sources. Much of the funding has also come from the central and particularly the regional Government, the Junta de Andalucía, which now have strong and firm environmental policies, and a belief that improving the environmental product gets reflected in the general state of the region. Their environmental infrastructure is now very impressive, and the authors have witnessed this in the regional offices of the 'Delegación Provincial de Medio Ambiente' in Cádiz. They have established a network of reserves (*see* Chapter 19) all around the country and have created employment in the environmental field, including a special environmental police, the SEPRONA, 'Servicio de Protección de la Naturaleza'.

So where does this leave Gibraltar? Unfortunately, we now find ourselves very far behind. Obviously, we cannot expect to compare or compete on the environmental field with a large country. However, it must be said that we have fallen behind largely due to a lack of commitment on the part of the authorities, and we are now paying the consequences of this lack of investment of resources. Over ten years ago Gibraltar did manage to achieve some results through the designations of the 'Nature Protection Ordinance, 1991', and the Upper Rock Nature Reserve. Since then there have been recent definite moves to implement the Habitats Directive, this report was commissioned, and other steps, such as wider consultation, GONHS representation in the planning process and being otherwise consulted have also been welcomed. But this has to be followed with tangible results, consistent with the international instruments outlined in this chapter, including of course a facelift to the Upper Rock Nature Reserve.

Table 4. Birds listed on Annex 1 of Council Directive 79/409/EEC that are found on the Upper Rock.

Code	Name	Population				Site Assessment			
		Resident	Migratory			Population	Conservation	Isolation	Global
			Breed	Winter	Stage				
A079	*Aegypius monachus*				1-5i	A	A	C	
A111	*Alectoris barbara*	50p				A	B	A	A
A225	*Anthus campestris*				11-50i	A	B	C	
A243	*Calandrella brachydactyla*				1-5i	A	A	C	C
A224	*Caprimulgus europaeus*				6-10i	A	A	C	
A031	*Ciconia ciconia*				251-500i	A	A	C	
A030	*Ciconia nigra*				11-50i	A	A	C	
A080	*Circaetus gallicus*				251-500i	A	A	C	
A081	*Circus aeruginosus*				101-250i	A	A	C	
A082	*Circus cyaneus*				1-5i	A	A	C	
A084	*Circus pygargus*				101-250i	A	A	C	
A379	*Emberiza hortulana*				11-50i	A	B	C	
A098	*Falco columbarius*				1-5i	A	A	C	
A110	*Falco eleonorae*				6-10i	A	A	C	
A095	*Falco naumanii*		6-10p		11-50i	A	C	C	C
A103	*Falco peregrinus*	4-5p				A	A	C	B
A096	*Falco tinnunculus*	5p			51-100i	A	A	C	C

CONTINUE >>

Code	Name	Population				Site Assessment			
		Resident	Migratory			Population	Conservation	Isolation	Global
			Breed	Winter	Stage				
A078	*Gyps fulvus*				51-100i	A	A	C	
A093	*Hieraaetus fasciatus*				1-5i	A	A	C	
A092	*Hieraaetus pennatus*			1-5i	251-500i	A	A	C	
A246	*Lullula arborea*				1-5i	A	A	C	
A272	*Luscinia svecica*				1-5i	A	A	C	
A073	*Milvus migrans*				>10000i	A	A	C	
A077	*Neophron percnopterus*				51-100i	A	A	C	
A094	*Pandion haliaetus*				11-50i	A	A	C	
A072	*Pernis apivorus*				>10000i	A	A	C	
A302	*Sylvia undata*			11-50i	11-50i	A	B	C	

i = individuals; p = pairs.

Population: A: 100% > = p>15%. B: 15%> = p>2%. C: 2% = p>0%.

Conservation: A: Conservation excellent. B: Good conservation. C: average or reduced conservation.

Isolation: A: Population almost isolated. B: Population not isolated, but on margins of area of distribution.

C: Population not isolated within extended distribution range.

Table 5. Regularly occurring migrant birds not listed on Annex 1 of the Council Directive 79/409/EEC.

Code	Name	Population				Site Assessment			
		Resident	Migratory			Population	Conservation	Isolation	Global
			Breed	Winter	Stage				
A086	*Accipiter nisus*				101-250i	A	A	C	
A257	*Anthus pratensis*			51-100i	501-1000i	A	A	C	
A256	*Anthus trivialis*				50-100i	A	A	C	
A226	*Apus apus*		2000p		>10000i	B	A	C	C
A228	*Apus melba*		25p		251-500i	A	A	C	C
A227	*Apus pallidus*		2000p		1001-10000i	B	A	C	C
A087	*Buteo buteo*			1-5i	251-500i	A	A	C	
A431	*Calandrella rufescens*				11-50i	A	A	C	
A225	*Caprimulgus ruficollis*				6-10i	A	A	C	C
A366	*Carduelis cannabina*			11-50i	1001-10000i	A	A	C	
A364	*Carduelis carduelis*			51-100i	1001-10000i	A	A	C	
A363	*Carduelis chloris*	15p		51-1000i	1001-10000i	A	A	C	
A365	*Carduelis spinus*			11-50i	251-500i	A	A	C	
A268	*Cercotrichias galactotes*				1-5i	A	A	C	
A335	*Certhia brachydactyla*				6-10i	A	A	C	
A289	*Cisticola juncidis*	1-5p		11-50i	101-250i	A	A	C	
A113	*Coturnix coturnix*				11-50i	A	A	C	
A212	*Cuculus canorus*				6-10i	A	A	C	
A253	*Delichon urbica*		6-10p		1001-10000i	A	A	C	
A269	*Erithracus rubercula*	1-5p		251-500i	1001-10000i	B	A	C	
A099	*Falco subbuteo*				11-50i	A	A	C	
A322	*Ficedula hypoleuca*				251-500i	A	A	C	
A359	*Fringilla coelebs*	1-5p		101-250i	1001-10000i	B	A	C	
A438	*Hippolais pallida*				1-5i	A	A	C	
A300	*Hippolais polyglotta*				1001-10000i	A	A	C	
A252	*Hirundo daurica*				51-100i	A	A	C	
A251	*Hirundo rustica*				1001-10000i	A	A	C	
A233	*Jynx torquilla*			1-5i	51-100i	A	A	C	
A340	*Lanius excubitor*				1-5i	A	A	C	
A341	*Lanius senator*				101-250i	A	B	C	
A290	*Locustella naevia*				11-50i	A	A	C	

CONTINUE >>

Code	Name	Population				Site Assessment			
		Resident	Migratory			Population	Conservation	Isolation	Global
			Breed	Winter	Stage				
A290	*Locustella naevia*				11-50i	A	A	C	
A271	*Luscinia megarhynchos*				1001-10000i	A	A	C	
A230	*Merops apiaster*				1001-10000i	A	A	C	
A383	*Miliaria calandra*			1-5i	51-100i	A	B	C	
A280	*Monticola saxatilis*				1-5i	A	A	C	
A281	*Monticola solitarius*	30p			P	A	A	C	
A262	*Motacilla alba*			101-250i	501-1000i	B	A	C	
A261	*Motacilla cinerea*			11-50i	501-1000i	B	A	C	
A260	*Motacilla flava*				501-1000i	A	A	C	
A319	*Muscicapa striata*				501-1000i	A	A	C	
A278	*Oenanthe hispanica*				251-500i	A	B	C	
A277	*Oenanthe oenanthe*				251-500i	A	B	C	
A337	*Oriolus oriolus*				11-50i	A	A	C	
A214	*Otus scops*				6-10i	B	B	C	
A273	*Phoenicurus ochrurus*			501-100i	1001-10000i	A	A	C	B
A313	*Phylloscopus bonelli*				1001-10000i	A	A	C	
A315	*Phylloscopus collybita*			501-1000i	1001-10000i	B	A	C	C
A316	*Phylloscopus trochilus*				1001-10000i	A	A	C	
A267	*Prunella collaris*			11-50i		A	A	C	
A266	*Prunella modularis*			11-50i		A	A	C	
A250	*Ptyonoprogne ruprestis*			251-500i	1001-10000i	A	B	C	B
A318	*Regulus ignicapillus*			11-50i		A	A	C	
A249	*Riparia riparia*				51-100i	A	A	C	
A275	*Saxicola rubetra*				51-100i	A	A	C	
A276	*Saxicola torquata*			11-50i	101-250i	A	A	C	
A155	*Scolopax rusticola*			1-5i	1-5i	B	A	C	
A361	*Serinus serinus*	1-5p		11-50i	251-500i	A	A	C	
A351	*Sturnus vulgaris*			1001-10000i	P	A	A	C	
A311	*Sylvia atricapilla*	251-500p		501-1000i	1001-10000i	B	A	B	C
A310	*Sylvia borin*				501-1000i	A	A	C	
A304	*Sylvia cantillans*				101-250i	A	A	C	
A309	*Sylvia communis*				101-250i	A	B	C	
A303	*Sylvia conspicillata*				6-10i	A	A	C	
A306	*Sylvia hortensis*				51-100i	A	B	C	
A305	*Sylvia melanocephala*	251-500p			P	A	B	B	C
A286	*Turdus iliacus*				11-50i	A	B	C	
A283	*Turdus merula*	251-500p				B	B	B	
A285	*Turdus philomelos*			51-100i	501-1000i	B	B	C	
A282	*Turdus torquatus*				11-50i	B	B	C	
A287	*Turdus viscivorus*			1-5i	1-5i	B	B	C	
A232	*Upupa epops*					A	A	C	

i = individuals; p = pairs.

Population: A: 100% > = p>15%. B: 15%> = p>2%. C: 2% = p>0%.

Conservation: A: Conservation excellent. B: Good conservation. C: average or reduced conservation.

Isolation: A: Population almost isolated. B: Population not isolated, but on margins of area of distribution.

C: Population not isolated within extended distribution range.

Table 6. Mammals listed under Annex II of Council Directive 92/43/EEC that are found on the Upper Rock.

Code	Name	Population				Site Assessment			
		Resident	Migratory			Population	Conservation	Isolation	Global
			Breed	Winter	Stage				
1310	*Miniopterus schreibersii*	101-250i				A	B	C	
1324	*Myotis myotis*	11-50i				A	B	C	

i = individuals; p = pairs.

Population: A: 100% > = p>15%. B: 15%> = p>2%. C: 2% = p>0%.

Conservation: A: Conservation excellent. B: Good conservation. C: average or reduced conservation.

Isolation: A: Population almost isolated. B: Population not isolated, but on margins of area of distribution.

C: Population not isolated within extended distribution range.

Table 7. Species listed under Annex IV of Council Directive 92/43/EEC that are found on the Upper Rock.

Group	Species	Population	Motivation
Mammals	*Tadarida teniotis*	R	A,D
Reptiles	*Coluber hippocrepis*	C	D
Invertebrates	*Macrothele calpeiana*	R	B

Population: C=common, R=rare, V=very rare

Motivation: A. = National Red Data List, B = Endemics, C = International Conventions (incl. Bern, Bonn and Biodiversity), D. = Other reasons

Macrothele calpeiana

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5. The Face of the Upper Rock Nature Reserve

5. The Face of the Upper Rock Nature Reserve

The Upper Rock Nature Reserve does not receive the sort of maintenance that such a place requires if it is to continue being an important tourist attraction. Litter and graffiti abound, and roads and paths are often in a less than desirable state. As a result, the Nature Reserve has been criticised severely in the local press, particularly during the last two years. Criticism has come from opposition parties such as the Labour Party, the G.S.L.P./Liberal Alliance and the Independent Liberal Forum (now known as the Reform Party), as well as more independent organisations such as the Gibraltar Women's Association and the Gibraltar Taxi Association, and even features in the Gibraltar Chronicle written by their own reporters. All of these groups have been absolutely correct in stating that many parts of the Upper Rock are in a filthy state, and that considerable measures need to be taken if the image of the Rock that tourists take home with them is not to be one of rubbish, dilapidation and neglect. The photographs in Appendix 2 illustrate these problems extensively.

5.1 Litter

Litter poses one of the biggest problems to the Nature Reserve. Although roadsides are cleared of their litter regularly and effectively, those areas that fall outside the roads receive no attention. This has led to very embarrassing accumulations of litter in areas adjacent to roads and paths, which have been highlighted in the press due to the negative impact that this has on both our natural environment and tourists' perception of Gibraltar. Litter accumulates mainly around areas at which a large number of people frequently stop. This is exacerbated around locations at which macaques are found, as a result of illegal feeding (food packets and containers are frequently discarded after the macaques have been illegally fed). Equally, the area surrounding sites that tourists regularly visit are in a deplorable state. Other sites where litter abounds are areas that are used by 'smuggling spotters', who frequently take their take-aways and refreshments with them and consequently dispose of their containers in their immediate surroundings. Given that this sometimes occurs on a daily basis, the problem is a large one. Such areas include Douglas Path, O'Hara's and Spur Battery and the area immediately south of the Cable Car top station. This problem is caused partly by the lack of enforcement of laws that apply to the Nature Reserve, given that non-residents are not, by law, allowed within the Upper Rock after sunset.

An example of the way that litter accumulates off the sides of roads can be seen in Fig. 1.

Figure 1. Litter accumulates off the roadsides of the Nature Reserve, particularly at places where people frequently stop such as Hayne's Pumping Station, seen above.

If the present contractors are reluctant to clear these areas, then it might be an idea to hire another contractor to tackle these problems, whilst leaving the present contractor to

fulfil its current obligations. Since this litter is the result of accumulation over long periods, then this probably occurs relatively slowly and so clearing probably does not have to take place on a very regular basis. This means that these areas can be tackled only a few times a year, by either a fairly large work force that clears all areas at once or a small team that moves from site to site. It would be an idea, if all areas were to be tackled irregularly, for clearing to take place at critical periods, such as before the summer when the receding vegetation reveals litter accumulations or after the summer when the Nature Reserve has already received most of its visitors.

5.2 Graffiti

Graffiti is unfortunately a very prevalent feature of the Upper Rock. Walls, including those of historical structures and water tanks are most commonly affected, although even bare rock is not immune to this treatment. It is quite depressing to see that these areas often carry graffiti for years on end before anything is done about them, particularly when one considers the lurid content of much of this 'art work'. It is also extremely regrettable that, although it has occurred to a lesser extent (due mainly to inaccessibility), graffiti can also be seen within some of the caves of the Upper Rock. This is noticeable, for example, within the Goat's Hair Twin Caves that lie on the Mediterranean Steps.

Although it has come rather late, it is heartening to see that something has finally been done about the graffiti at Spur Battery, where such slogans as 'Smoke your joint with pride' provided a very embarrassing welcome to the many tourists who, whilst looking for parking in order to visit St. Michael's Cave, often visit Spur Battery. However, other historical sites that have been marred by similar artistic endeavours remain untouched by the management of the Nature Reserve. Notorious sites include Farringdon Battery, Douglas Path, Mediterranean Steps, O'Hara's Battery (where the immense graffiti lying below the gun can be read from Europa Point through binoculars), and in fact anywhere that vandals find accessible.

As has already been said, one particularly worrying aspect of much of the graffiti within the Nature Reserve is the sordid content of most of the material that these '*artistes*' seem to have a penchant for. The authors of this report remember one particular occasion when ex-US President George Bush (Sr.) was visiting Gibraltar for half a day, and would be ascending the Rock in the Cable Car before being escorted on a walk towards St. Michael's Cave by dignitaries. The roads along this route had been cleared of litter beautifully and were looking immaculate, except for one small but very embarrassing detail. One of the water tanks along this road had been tarnished with graffiti, including one item, whose title 'The Rocket' lay alongside a space shuttle that had been drawn in the likeness of a phallus. What makes this even worse is that the 'artist' had even signed his 'work'. We are sure that the sight of this must not have impressed Mr Bush particularly, and the many visitors who had actually *paid* to get into the Nature Reserve must not have been especially amused either (entry to the National Gallery in London is free, and the art is of a far superior standard).

O'Hara's Battery was in fact restored recently by military personnel from the UK. However, the largest 'mural' (that immense graffiti) was missed, and remains there to this day as highlighted in Fig. 2. It is also sad to see that Princess Caroline's Battery, a site of considerable historic interest, was affected by litter and graffiti for many years, and has only been cleared up once that very direct economic gains from these actions have been discernable to the management of the Reserve (this site is presumably to become another tourist attraction). Rather that focusing on a site only when this is set to become a direct money earner, the whole of the Upper Rock should receive the same attention, given particularly that these areas are equally visible to visitors.

Figure 2. The graffiti at O'Hara's Battery is visible from Europa Point.

5.3 Roads

The very heavy traffic that flows through the Nature Reserve on a daily basis can be very taxing on the roads, particularly those that are not designed to hold such a volume of vehicles. Due to this, some of the roads on the Upper Rock are in a state of deterioration, particularly those that lead upwards from St. Michael's Cave, through which traffic has only been allowed in recent years. Furthermore, repairs along these roads often take a very long time, and makeshift barriers erected to protect roads from further deterioration are often present for lengthy periods, such as has occurred at St. Michael's Cave or above the Governor's Lookout. These constitute quite a striking eyesore, and cannot make the Nature Reserve look very appealing to visiting tourists, as can be seen in Fig. 3.

Figure 3. Road works – this makeshift barrier has been present at St. Michael's Cave for over a year, where nothing has been done to improve the situation.

In addition to this, another striking example of the length of time that it takes to get roads repaired on the Upper Rock were the potholes along Queen's Road, which rather than being repaired straight away, were marked by painting a white or yellow square around them, as can be seen in Fig 4. These then stayed like this for a long period of time, so much so that they were eventually repainted after several months of inactivity. So boldly marked were these holes (which were less than difficult to spot in the first place) that visitors to the Nature Reserve were now alerted to the fact that roads were in a bad condition. These potholes were thankfully filled eventually (after a few months), but at a prime tourist site such as the Upper Rock Nature Reserve works should take place as soon as they are required.

Figure 4. Potholes along Queen's Road remained marked by a white or yellow, square perimeter for a long time before being filled.

An interview with Mr Brian Bagu of the Support Services Department made us fully aware of some of the issues that roads within the Nature Reserve are faced with, and these are discussed next.

Most of the roads on the Upper Rock were never designed to deal with such heavy traffic, particularly those along the upper reaches. Therefore, although monitoring of road conditions within the Upper Rock only began in 2003, it is possible that these have been subjected to deterioration with the large increase in traffic, and this has made many retaining walls unsafe. Although most of these retaining walls have subsequently been made safe, some still need some work, particularly the one above Royal Anglian Way, which, in the

opinion of the Support Services Department, may be eroding due to macaque and goat activity around the wall. In this sense, a shuttle service would be beneficial to the Upper Rock in that it would relieve pressures on the roads.

Repairs along the roads of the Upper Rock are particularly difficult, since the Nature Reserve operates a one-way traffic system. Sites will continue to operate regardless of whether repairs are taking place, and so heavy traffic will continue to flow through the roads of the Upper Rock, making work impossible. In addition, facilities to work at night do not exist, and so road repairs are faced with an impossible situation.

The railings that run alongside many of the roads are not in a good state with many of the railings being bent or dilapidated, and even those that continue to stand straight are less than attractive. In light of this, serious consideration should be given to a complete refitting of railings along roadsides on the Upper Rock. If this occurs, then the use of a railing that is both more appealing to the eye and more in line with the Upper Rock's natural heritage should be considered.

A worrying aspect of roadside management from a wildlife viewpoint is the clearing of roadside vegetation. Roadsides provide small, open areas amidst the thick maquis, and are of disproportionate importance to herbaceous plants that cannot survive in areas dominated by maquis vegetation. Thus, some orchid species (all of which are rare on the Rock) such as the two-leaved Gennaria, *Gennaria diphylla* and the yellow-bee orchid, *Ophrys lutea* grow regularly on roadsides within the Nature Reserve. This means that, although the regular clearance of roadside vegetation is important, the manner in which this is done, and its timing, is crucial to the continuation of these areas as an important habitat for plants. It is a common sight, for example, to see workers clearing roadside vegetation at the height of the flowering season during the spring, and this cannot be justified on any grounds (Linares 1997). It is advisable to cut back woody vegetation, as this will accommodate both traffic and floral considerations. However, the clearing of smaller plants and flowers can only be justified once most plants have set seed and dried up, during the early summer. In addition to this, the way in which plants are cleared leaves a lot to be desired. Frequently, plants are scraped away rather than cut and the removal of these plants' roots accelerates the erosion of roadside soil. What is more, even the soil is sometimes scraped or brushed off the roadsides, leaving only bare rock! These practices have sometimes caused roadside rocks to become loose and roll onto the roads. All of this causes the deterioration of what is an important habitat for plants within the Nature Reserve.

5.4 Sewerage and Disused Pipes

A number of disused pipes can be seen around the Nature Reserve. One prominent example is that near the beginning of Mediterranean steps, an illustration of which can be seen in Fig. 5.

Figure 5. Disused pipes are often not removed, marring the aesthetic appeal of the Nature Reserve.

This pipe is a particularly good example in that it has been disused for many years, and provides a sharp eyesore in what is a very beautiful garrigue habitat with a wide variety of flowering plants. Such pipes are concentrated mainly on the southern side of the Rock (around Mediterranean Steps and its surrounding area), Anglian Way, the area south of the Cable Car Top Station and Princess Caroline's Battery, although individual pipes are scattered around the whole of the Nature Reserve. Most if not all of these disused pipes once belonged to the MOD, although MOD argue that these are now the responsibility of the Government of Gibraltar, since they are responsible for all aspects of land once this has been accepted.

One particularly worrying matter has been the ongoing sewerage leak at Martin's Path, just below St. Michael's Cave. This has been caused by what seems to be a blockage of the sewerage system leading down from St. Michael's Cave, possibly due to a combination of inadequate pipe diameter, increased usage and a lack of maintenance. As a result of this, a

stretch of approximately thirty metres is covered in sewerage, making access along the path impossible. This is clearly a health hazard to those who try to use the path, and in addition chemicals contained in the effluent may affect the flora and fauna of the immediate surroundings. It is important to consider, for example, that Martin's Path is one of the only sites in Gibraltar where the sawfly orchid, *Ophrys tenthredinifera* is known to grow, and the sewerage could seriously affect sensitive species such as this. In addition, the leakage is located directly above the beautiful New St. Michael's Cave, whose immaculate formations could be adversely affected by seepage of chemicals contained in this sewage.

5.5 Paths

Paths on the Upper Rock are regrettably not in a good state. Maintenance of these paths does not exist, and as a result many of them are overgrown, surrounded by litter and in some cases dangerous to visitors. Given that during the day roads are used by the very heavy traffic, then paths are extremely important to those who wish to appreciate the natural aspects of the Nature Reserve in peace and tranquillity. All paths should therefore be cleared of their litter, and vegetation should be cut back to allow visitors to negotiate these trails easily. In addition, paths should also be signposted clearly, and should include panels with information on points of interest such as the difficulty of the terrain, the nature and wildlife of the area, length and estimated walking time, and rules to observe when on these paths. An example of such panels and signposts, taken from the 'Parque Natural los Alcornocales', is given in Fig. 6.

Figure 6. Information panel and path signpost in the 'Parque Natural los Alcornocales'. Such panels and signposts should be erected at the beginning and end of paths within the Upper Rock Nature Reserve.

The problems that concern these paths are highlighted next, together with suggestions for their improvements.

5.5.1 Mediterranean Steps

Mediterranean Steps is undoubtedly the most important, and equally the most worrying of all paths. Although it has long been a favourite trail amongst both locals and visitors, the path has fallen into a state of disrepair that makes some sections dangerous to visitors. Large boulders block the path at a few points, the result of occasional rockfalls. Visitors have to climb over or around these in order to follow the trail, and given that some of these areas border cliffs, serious accidents are certainly possible. In addition, some parts of the lower path have eroded away, leaving slippery inclines that are dangerous to walkers. The handrail that once existed along this stretch is also, sadly, gone. This is certainly one of the reasons why this path is not used as often as it once was.

Litter has also been allowed to accumulate, given that the cleaning contractors do not clean any area that falls outside of the roads. This is particularly noticeable within the Goat's

Hair Twin Caves, where plenty of graffiti also exists. As can be imagined, the last thing that a walker wants to see on a path through a Nature Reserve is an abundance of litter and graffiti. These problems can be tackled by either extending the contract of the present cleaning contractors or awarding a contract to other contractors to tackle areas that are outside the contractual duties of the present contractors.

The lookout point that overlooks the eastern side of the Rock, about halfway up the steps, once had two benches and a protective railing to ensure the safety of visitors enjoying the view. This is no longer the case. The benches have almost ceased to exist (only the foundations of these are now visible) and the railing has completely disappeared, leaving the viewpoint in a dangerous condition. This is illustrated in Fig. 7.

Figure 7. The lookout point that overlooks the eastern side of the Rock is in a state of severe neglect.

All sites along the steps that suffer from similar conditions should be tackled to ensure that walking along the path is safe. A lawsuit from visitors who have suffered an accident could cost the Government, who are ultimately responsible for the management of the Nature Reserve as much or even in excess of the repairs that are required at these sites. Similarly, all of the WWII buildings that are located on these steps should be repaired and maintained to provide walkers with sights of interest.

In addition to those points highlighted above, the clearing of encroaching vegetation along the path on an annual basis is essential if visitors are to enjoy the use of this trail.

5.5.2 Martin's Path

The path that leads from Jews' Gate to St. Michael's Cave is in a state of serious neglect. The trail is littered with fallen pine trees (those that died during the drought of the 1990s; *see* Chapter 9), and these prove difficult for the visitor to negotiate. In addition, the vegetation along this path is dense and encroaches heavily on the trail, making access even more problematic. Perhaps the most serious problem along this path is the sewage that leaks out onto the path. This has made the trail impossible to traverse, given that about thirty metres of path are constantly covered in sewage. This is both extremely inconvenient to those who wish to use this path and unhygienic to those visitors who suddenly come across it.

The maintenance of this path is particularly important in that it is a trail that can be used by pedestrians in order to avoid what is the busiest stretch of road within the Nature Reserve. Furthermore, it is of interest to those who wish to appreciate the natural aspects of the Upper Rock, such as botanists and ornithologists.

5.5.3 Inglis Way

Inglis Way is the second longest path on the Upper Rock, shorter only than the Mediterranean Steps. It cuts straight through the thick maquis that dominates the middle section of the Nature Reserve, and constitutes one of the only walks on the Upper Rock where the visitor can be away from roads and traffic for a considerable period of time. However, this path, like all other paths, is in a state of serious neglect. The vegetation that borders the path increasingly encroaches on the walker's space, and litter problems mirror those of the Nature Reserve in general. Even building materials such as plastic pipes have been deposited along and around the path, as can be seen in Fig. 8.

Figure 8. Plenty of refuse can be found along Inglis Way, even discarded building materials.

Some WWII fortifications are to be found along Inglis Way, but these are in a state of severe neglect, and should be repaired and maintained in order to provide the visitor with sights of interest along the path.

The last section of the Inglis Way path cuts across the Bruce's Farm firebreak, which is no longer maintained as a firebreak and is therefore extremely overgrown (*see* Chapter 9, & 10 section 10.5). This therefore restricts access to the walker, cutting the path short. This firebreak needs to be maintained for this reason, as well as for the more important reason of safety to tourists, and above all the residents of the Bruce's Farm residential area.

A few years ago a number of GONHS volunteers cleared some areas around the Inglis Way path, leaving the predominantly olive canopy but providing openings amongst the thick vegetation. These areas have developed beautifully, and now carry a far greater diversity of flora than they originally did. This has enhanced the appeal of the trail considerably, and has improved the situation for wildlife in general. Indeed, the Eurasian woodcock, *Scolopax rusticola*, a rare bird in this area, has wintered in this area on several occasions since clearing began. However, clearing of these areas needs to be maintained, otherwise the vegetation will gradually thicken again to form the impenetrable maquis that once dominated these now open patches.

5.5.4 Royal Anglian Way

Royal Anglian Way could conceivably be developed into one of the most attractive, and certainly most accessible walks within the Nature Reserve. The walk, if cleared of rocks, is an easy one, and the combination of beautiful views both of the Rock and the Bay, a pack of macaques and a series of historical structures would make this trail ideal for visitors who wish to get away from the roads. Unfortunately, Royal Anglian Way is in the bad state that characterises all of the paths and trails within the Upper Rock. The path and steps are in many places covered in rubble and large rocks, litter is as prevalent as throughout the rest of the Nature Reserve, railings are dilapidated and some sections of the trail are therefore unsafe for visitors. Furthermore, historical buildings and structures have been neglected, making some of the WWII fortifications look very shabby. Repairs and adequate maintenance is therefore required if visitors are to be expected to enjoy this trail.

5.5.5 Douglas' Path

Douglas' path still receives a relatively high number of visitors, and as such the accumulation of litter throughout the whole of this trail is quite alarming. The sides of the path are strewn with litter, and many of the historical buildings and structures have been vandalised (particularly with graffiti) or used as refuse tips and latrines. The problem of encroaching vegetation that most other paths are faced with are not encountered along Douglas' Path, given that the trail is still used regularly and so vegetation is kept away by the trampling and brushing of walkers.

The steps that lead towards the 'Moorish' lookout are in a state of severe disrepair, and are thus dangerous to visitors. The path and steps are crumbling away at many places, and the railing along the steps is damaged along most of its length, and at some places non-existent. The 'Moorish' lookout itself, which should be maintained as a tourist attraction, is used as a latrine on a regular basis and visitors are thus always encountered with a very foul smell. This, as well as the WWII fortifications which offer superb views along both the west and east sides of the Rock should be properly maintained with the respect that potential tourist sites and important parts of our heritage deserve.

5.5.6 Other Paths

In addition to those mentioned above, other, shorter paths exist within the Nature Reserve. These should be managed in a similar manner to the longer paths, with consideration given to their cleanliness and to the management of vegetation surrounding these paths. Furthermore, visitors who wish to appreciate the Upper Rock's wildlife without the hassle of heavy traffic would certainly benefit from an extensive system of paths and trails, and it may be an idea to create new paths in addition to those that already exist. These could include circle paths, where trails begin and end at the same point. If this were to occur, then an idea may be to publish a pamphlet that includes a map with all of the different trails on the Upper Rock to be handed to tourists as they enter the Nature Reserve. Pedestrian use of the Upper Rock should certainly be encouraged, and in this sense it would also be beneficial not to allow traffic through the roads that lead upwards from St. Michael's cave.

5.6 Structures

In addition to the problems highlighted above, some of the structures found within the Upper Rock are either unsafe or mar what are otherwise beautiful views and landscapes.

One particularly serious problem, as highlighted in Chapter 7, section 7.3 & 7.6, is Charles V Wall. This wall, which should be maintained as one of the most important historical assets of the Nature Reserve is in a state of neglect, with severely damaged railings making the walk up or down the steps along the wall dangerous.

One building which merits a mention due to its visual impact is the private kennel that is found at Princess Caroline's Battery. This shabby building is extremely unsightly, and has no place at a site that many tourists visit. Furthermore, the development of the actual Battery as a new tourist site means that, when this is eventually opened to tourists, all visitors will have to pass directly beside the extremely unattractive kennel. Their first impression of the site would not therefore be a positive one. In light of this, we recommend that the owner or occupier of the kennel be relocated to premises outside the Upper Rock Nature Reserve. A photograph of the building can be seen in Fig. 9.

Figure 9. The kennel at Princess Caroline's Battery is extremely unsightly, and should be relocated outside the Nature Reserve.

Some of the military installations within the Upper Rock are less than attractive. This is particularly the case with the aerials in the Rock Gun and Middle Hill area (some of which have already been brought down), which can clearly be seen at a distance from the Rock, and which break the Rock's impressive outline and shape. The worst of these are the two relatively new, large, iron aerials that sit at the very top of Rock Gun, on the crest of the Rock. Although it is acknowledged (although not fully accepted) that the MOD considers its priorities to override environmental or heritage considerations, it is unfortunate that these structures have such a noticeable impact on our Rock.

However, other MOD-owned eyesores do have some more achievable remedies. MOD cables run along railings that line many of the roads and cut down the centre of the firebreaks at St. Michael's Cave and Bruce's Farm (as can be seen in Fig. 10), making both roadsides and the seasonally colourful firebreaks look unattractive. A small effort is all that is needed in order to relocate these cables, perhaps beneath the soil or below the walls that line most of the roads, in order to make the Upper Rock look more attractive. This was done several years ago along the stretch of Queen's Road above Jews' Gate, where new MOD cables were placed in a culvert in the gutter east of the road. Furthermore, any cables that are no longer in use should be removed. In fact, the railings themselves are unattractive, and an effort should be made to replace these with railings that are more 'in character' with the Nature Reserve.

Figure 10. The cables that run down the centre of firebreaks at St. Michael's Cave and Bruce's Farm make these seasonally beautiful open areas look unattractive.

Another problem regarding aesthetics is the thoughtlessness with which the garage at Jews' Gate, which is allocated to the Gibraltar Tourist Board, has been located. This sits directly below a tourist attraction, and one at which practically all visitors to the Nature Reserve stop. Not only is the garage unsightly, but the almost constant excess of noise that emanates from the works that take place at this garage (with equipment such as drills and a noisy compressor) must prove very frustrating to those visitors who wish to admire the spectacular views that the location offers peacefully, as well as to researchers lodging at Jews' Gate. It would therefore be advisable to relocate this garage to an area outside the Nature Reserve, where its activities will not have an impact on visitors' and locals' enjoyment of the site. One good place to locate this garage would be at the new industrial park at Lathbury Barracks, where it would be located only metres away from the Jews' Gate site, without actually having an impact on the Nature Reserve itself.

The monument that stands on the lookout at Jews' Gate could be improved dramatically. Visitors to the GONHS' field centre at this site unfailingly comment on the ugliness of the so-called 'Pillars of Hercules', in fact a less-than-impressive structure composed of cheap-looking, composite material. This could for example be replaced with a well-maintained gun (given that this site was formally a battery) or even a cafeteria. The impressive views that this site offers, together with its very large number of visitors make it ideal for a circular cafeteria with large windows, which could even rotate to offer the customer views in all directions (although this would prove very expensive to install!). In fact, Spur Battery would provide an even better location for this sort of venture, as the views that it offers are even more spectacular. Access could however be a problem (as well as the number of visitors who visit this site, compared to Jews' Gate at present), but one must consider in this case that more cars can park on the road that leads up to Spur Battery than at Jews' Gate, and that this would also produce fewer problems in terms of traffic congestion.

A drinking fountain sits next to the 'Pillars of Hercules' monument at Jews' Gate. However, visitors who try to drink from this fountain quickly find that there is no water supply and so the fountain does not produce any drinking water. This should either be repaired or removed, as at the moment the fountain only serves to highlight the state of neglect into which most features of the Upper Rock Nature Reserve have fallen.

The Scouts' camp at Governor's Lookout could also be improved to make it look less unattractive. This applies in particular to the perimeter fence that surrounds the camp (as the access to the camp itself is prohibited to visitors to the Nature Reserve). At present, the fence looks very haphazard due to the constant, makeshift repairs that seem to take place, no doubt due to vandals who create breaches in the fence in order to gain access to the camp. This has two solutions. Firstly, a new fence that is more resistant to vandalism (but still friendly to wildlife) should be erected to replace the one that currently stands. Second, as has been said before, the Upper Rock needs to be policed more regularly, either by the Royal Gibraltar Police or by wardens to ensure that vandalism does not take place to the extent that it does now.

Finally as is mentioned in Chapter 8, some of the gardens belonging to houses within the Upper Rock, although perhaps attractive in their own right, are out of character with the Nature Reserve due to their layout and composition. As discussed in Chapter 8, a policy could be implemented whereby gardens have to conform to the general character of the Nature Reserve. Alternatively, fences surrounding these gardens can be covered (in an attractive manner) so that the garden and its plants do not have a visual impact on the aesthetics of the Upper Rock.

5.7 Picnic Sites

At present, no official picnic sites exist within the Upper Rock Nature Reserve. This is in contrast to most nature reserves anywhere else in Western Europe, and is a problem that needs to be addressed, particularly if the Upper Rock is to be enjoyed by a greater number of walkers. Formerly, the area around Governor's Lookout was popular with local families, who would frequently used it as a picnic site during weekends. However, even then, facilities for picnics such as wooden tables and benches were not provided, and users of the site had to provide their own tables and chairs. The creation of a number of picnic sites within the Nature Reserve would go a long way towards encouraging pedestrian use of the Upper Rock, particularly amongst locals who at this moment in time do not make as much use of the Nature Reserve as they perhaps should.

5.8 Recommendations

1) The litter problem on the Upper Rock needs to be addressed seriously. As well as a tighter enforcement of litter control laws, serious thought should be given to how cleaning firms are to be contracted in the future. It is strongly recommended that the cleaning of all parts of the Upper Rock (including paths), and not only the roads, should be one of the conditions to be met by contractors in any future negotiations. If the management of the Upper Rock is contractually tied to one cleaning firm that will only clean the roads, then it should consider hiring another contractor to clean all areas that fall outside of the roads. Although many of these areas are not readily accessible and are therefore difficult to clean, litter accumulates slowly and so cleaning probably only has to be carried out several times a year at each site.

2) Signs should be erected at tourist sites and popular stopping areas that should both educate on the impact of litter to the Nature Reserve and warn of the fine that is brought upon anybody who is caught littering.

3) An effort should be made to paint over all the graffiti that is currently found within the Nature Reserve, as these constitute a very serious blemish to the visual appeal of the Upper Rock. Since graffiti seems to be a popular pass-time, then this will have to take place on a semi-regular basis. A more effective way to control this would be to police the Upper Rock adequately. Since the Royal Gibraltar Police seem reluctant to do this intensively, then wardens should be employed for this purpose (amongst others).

4) The monitoring of road conditions that the Support Services Department has begun very recently is greatly welcomed. It is hoped that this will lead to a recommendation of a reduction in traffic through the Nature Reserve, as the structural damage that has occurred at several places has no doubt come about as a result of this.

5) The roads along the upper reaches of the Nature Reserve were clearly not designed to withstand the volume of traffic that they are currently traversed by. It would therefore be a good idea to restrict traffic along these roads once again (as occurred prior to the mid-1990s). This would be beneficial in several ways. First, it would relieve the roads from the immense pressure that they are currently under. It would also benefit walkers, with whom these roads were formally very popular. Finally, the wildlife of the Upper Rock would benefit greatly from areas with little or no traffic. Booted eagles, *Hieraaetus pennatus*, (as well as other birds of prey) sometimes roosted along the upper reaches of the Nature Reserve in good numbers, but this is now rarely the case due to the increase in traffic.

6) Roadsides should only be cleared during the period after plants have set seed, so these practices should take place during the early summer.

7) Care should be taken to ensure that the correct methods are employed in the clearing of roadsides. Soil should by no means be brushed off, and plants should not be scraped off but rather cut back so that their roots are not removed.

8) Some roadsides should be cleared up to a distance of about four metres from the road. This will ensure that cars are not scraped by overhanging vegetation and will substantially reduce the risk of fire. It will also ensure the continued survival of plant species that rely on such areas, whilst having little impact on the maquis habitat. In addition, litter control on roadsides will be far easier as a result. Such roadsides could include Cave Branch Road, and parts of Queen's Road and Signal Station Road.

9) All disused pipes within the Nature Reserve, be they property of the Government of Gibraltar or the MOD, should be removed promptly, as these tend to spoil otherwise beautiful landscapes and views.

10) Paths should be clearly signposted, and information panels should be placed at the entrance to each path. These panels should include information such as the length of the path, its difficulty, history, what is likely to be seen (in terms of both heritage and natural history) and where the path takes the rambler.

11) The boulders, rocks and rubble that currently abound over some parts of the Mediterranean Steps should be cleared to facilitate access to walkers.

12) Repairs should be made in areas where the path along Mediterranean Steps has eroded, and a handrail should be situated adjacent to the path over sections of the path where a fall over the edge could result in injury or death.

13) Litter and graffiti along all paths should be removed.

14) Serious repairs should be made to the lookout point half way up the Mediterranean Steps that overlooks the eastern side of the Rock. This should include the construction of new benches to replace those that have fallen into neglect and a railing around the perimeter of the lookout to prevent accidents.

15) Historical buildings and structures along Mediterranean Steps should be repaired and maintained, as these provide sights of interest to visiting walkers. These could include Perspex plaques with information on the history of the structures and of the path in general.

16) The overgrown vegetation that encroaches on all paths, particularly those that have fallen into disuse, should be sensitively cut back and cleared to ensure easy access to walkers.

17) All dead pine trees that have fallen across Martin's Path should be moved to one side or removed.

18) The sewerage system that runs along Martin's Path should be repaired or replaced to keep sewage from overflowing onto the path. Any material left on the path should be cleared so that visitors can once again enjoy the use of this trail.

19) All materials that cause an impact on the aesthetic appeal of the Inglis Way trail should be removed.

20) WWII fortifications along Inglis Way should be repaired and maintained in a similar manner to that recommended for those along Mediterranean Steps.

21) The firebreak at Bruce's Farm should be cleared and maintained in the manner described in Chapter 11.

22) Some habitat management should continue along Inglis Way. This was initially carried out by volunteers, who cannot be expected to then go back and clear vegetation every time this is needed - the clearing of vegetation is a difficult job.

23) Rocks, boulders and rubble along the Royal Anglian Way should be cleared.

24) Railings along Royal Anglian Way should be repaired to ensure the safety of visitors.

25) Historical buildings and structures should be repaired and maintained along Royal Anglian Way, complete with information plaques, as these would be of interest to visitors.

26) Historical buildings along Douglas' Path should be repaired and maintained. Some of these offer magnificent views towards both sides of the Rock, and would no doubt be appreciated by visiting tourists (who still visit this path regularly) if they were in prime condition.

27) The steps along Douglas' Path, as well as the railings that line them should be repaired in order to ensure the safety of walkers.

28) All other paths on the Upper Rock should be managed in a similar manner to the main paths.

29) The maintenance of paths and trails on the Upper Rock is extremely important given that, at the moment, visitors can only get away from the heavy traffic and enjoy a peaceful walk by using these paths. In fact, the management of the Nature Reserve should consider extending the current network of paths, possibly to include circular trails, where the walker begins and ends at the same point.

30) Pedestrian use of the Upper Rock should be encouraged both amongst tourists and locals who use the Upper Rock. A pamphlet with a map illustrating all of the different paths and trails that are found on the Upper Rock should be produced and handed to visitors entering the Nature Reserve.

31) The railing along Charles V Wall should be replaced with a new railing in order to ensure safety to visitors.

32) The kennel at Princess Caroline's Battery is extremely unattractive and should be

removed. The owner or occupier of this kennel should be granted alternative premises that fall outside the boundaries of the Nature Reserve.

33) All military cables, aerials and pipelines on the Upper Rock should be removed by the MOD as soon as these are no longer in use. This includes cables that run alongside roads and down firebreaks.

34) Cables that are still in use should be hidden from the public eye. These could be located below the ground or below the retaining walls that line most of the roads.

35) The metal railings that line most of the roads on the Upper Rock are not attractive, and should be replaced gradually. New railings should have a more 'natural' or 'rustic' look. A perfect example of the type of railing that should be used lines the road that leads down towards the Ape's Den. These are thick and sturdy, and fashioned as if they were constructed of wood, even though they are comprised of synthetic material.

36) The garage at Jews' Gate should be relocated, perhaps to the new industrial park at Lathbury Barracks.

37) The monument at Jews' Gate should be replaced with some other attraction that provides visiting tourists with a better 'first impression' of the Nature Reserve.

38) The drinking fountain at Jews' Gate should be either repaired or replaced.

39) The fence that surrounds the scout camp at Governor's lookout is tacky, and should be replaced.

40) There should be some sort of control over what residents of the Nature Reserve grow within their gardens, as described in more detail in Chapter 8.

41) A few picnic sites (perhaps two or three) should be created within the Nature Reserve in order to provide further amenities to visitors and to encourage pedestrian use of the Upper Rock. One such picnic site could be located at Governor's Lookout, where the fairly gentle slope and presence of shady stone pines, *Pinus pinea* makes the site ideal. Another picnic site we recommend is the large, flat area at Princess Caroline's Battery. Picnic sites should be furnished with wooden tables, seats and dustbins, and signs urging the public to deposit its litter in the bins should be erected. Shade is also important to picnickers, and in this sense the presence of stone pines at picnic sites is ideal. Picnic sites could therefore be located at sites with pines, or alternatively pines could be planted at picnic sites. It is important that these picnic sites are close to roads and easily accessible, as litter is bound to accumulate in these areas and they must therefore be cleaned on a regular basis.

References

• **Linares, L. (1997)** Clearing of the firebreaks in the Upper Rock Nature Reserve. *Unpubl.*

6. Geology and Caves

6. Geology and Caves

Gibraltar is composed of several different types of sedimentary rock. Fossiliferous limestone dating back from the Jurassic period, some 200 million years ago, forms the main structure of the Rock of Gibraltar (Rose & Rosenbaum 1991). This shows striking evidence that this limestone mass overturned, with the older rock now forming the main ridge. Other sedimentary deposits found around Gibraltar are composed of mudstones and sandstones. These sediments were formed in what was once a tropical ocean called Tethys. During these 200 million years the Tethys Ocean contracted. Tectonic plate movements brought the continents of Europe and Africa closer together, therefore crumpling the mountain chains bordering the Mediterranean Sea. This produced an arc of mountain chains known as the 'Arc of Gibraltar' and is composed of the Betic Cordillera running along the mountain chain near Alicante, down through the Sierra Nevada and Sierra de los Filabres curving through the mountains on either side of the Strait and forming the southerly arc encompassing the Rif mountain chain of Morocco. In the process, the deposits lying between the two, mainly composed of limestone like that that now forms the Rock of Gibraltar, were overturned and thrust 100km towards the west, fracturing and faulting in the process. A tectonic plate that is split along the Strait area by the 'East Azores Fracture Zone' separates the two parts of this curve.

The thrust sheet forming the area of the Strait is composed of several geological units of which the Rock of Gibraltar is classified under the 'Tariquides' unit (Didon, in Rose and Rosenbaum, 1991). This type of rock is only found at Gibraltar, the mountain of Jebel Musa on the African side of the Strait, and a small outcrop south of Algeciras, which is being quarried. The uniqueness of the geology of the Rock of Gibraltar in relation to the surrounding countryside is a determining factor in the variety of flora that can be found here and signifies the importance Gibraltar has in contributing to the diversity of flora and fauna of the Strait area.

The collisions between the thrust plates closed up the Mediterranean Sea at both the eastern end, about 20 to 15 million years ago, and the western end between 6.7 and 5.2 million years ago. Intense evaporation took place, largely drying up the Mediterranean basin. This dry period eventually came to an end when the Atlantic Ocean broke through. Some authors (e.g., Hsu, in Drooger, 1973) believe that this event occurred several times before eventually filling the basin, but Hsu (1983) then states it to have been one cataclysmic event that produced an immense waterfall that took approximately 100 years to finally flood the Mediterranean basin and convert it back to a sea. Since then, major changes in the relative sea level have taken place. These changes were caused by the upheaval of the Rock, and also by changes in the polar ice cap during the ice ages that have resulted in the formation of several raised beaches and wave-cut platforms, a feature that is unique in the region. These changes in sea level have also resulted in numerous caves being formed through the action of the sea and the erosion of the rock by groundwater flowing to the sea (Rose & Rosenbaum 1991).

6.1 Geological Features

The Upper Rock Nature Reserve is located above the 100m above sea level mark. It is bordered to the west by the limestone cliffs that rise above the lower slopes and form the boundary between the limestone of the Upper Rock and the shale series found along much of the lower slopes. To the north, the limits are set by a series of impressive cliffs known as the North Face, which rise vertically from sea level up to 411.5m at Rock Gun Battery. The cliffs along the eastern side of the Rock drop vertically down to the talus and wind blown sand slopes, and reach their highest points at Spyglass Battery (424m), and O'Hara's Battery (416m). To the south, the Rock slopes steeply down toward the raised beach of Windmill Hill Flats.

The Reserve runs approximately north to south for nearly 2.5km, forming a sharp-ridged crest along its eastern border. An east west cross section of the Rock shows the features of an escarpment, with the western side sloping steeply at angles of approximately 18° to 39° to the edge of the reserve along the limestone cliff edge, and the eastern side dropping vertically down to the sand slopes. Most of the rock found within the Reserve is composed of two series of limestone. The older rock found on the upper reaches is composed of fossiliferous limestone, whereas the younger rock below is known as the barren limestones. This is due to the overturning of the Rock in its early development. Small outcrops of shale are found around the Jews' Gate area, where the shale series found along the Lower Slopes curve into. Another outcrop can be found in the Governor's Lookout area.

The bedding plane of the limestone on the Upper Rock corresponds closely to the angle of the western slope, and one can see the strata from the main ridge at the Cable Car Station

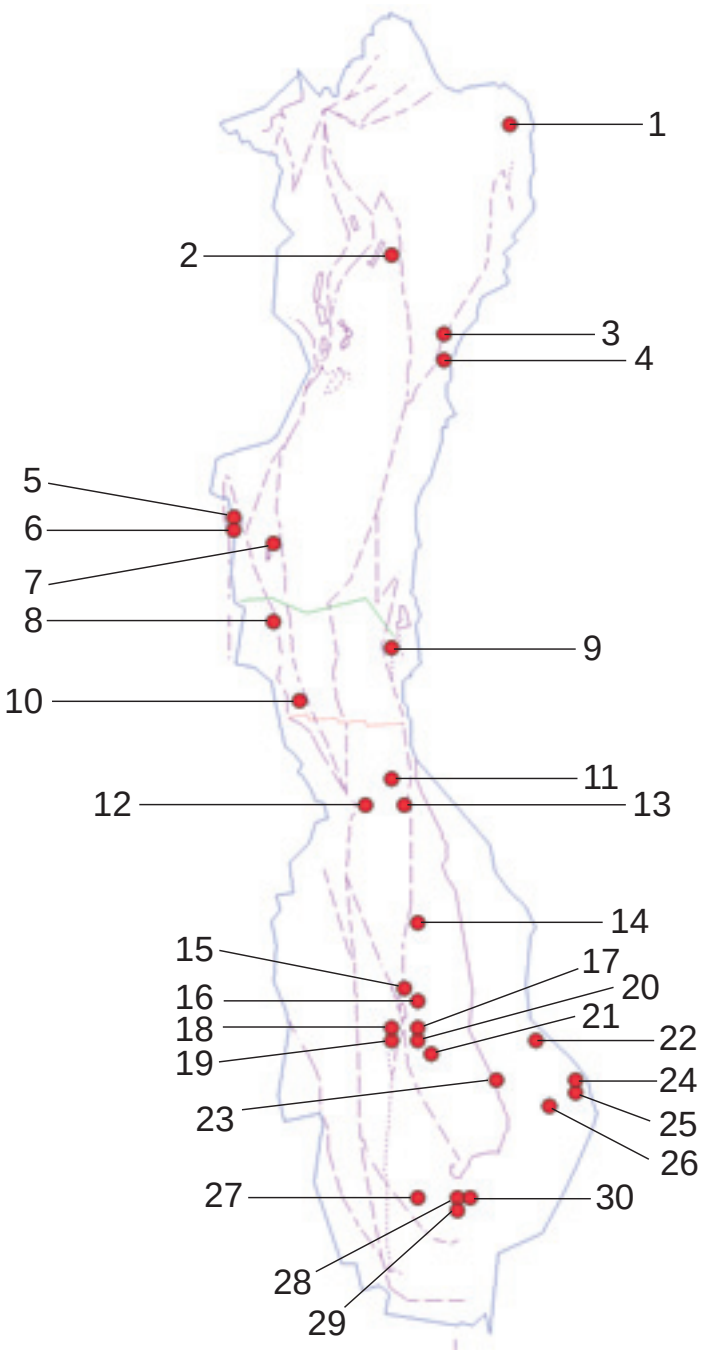
if you look towards the north. The rocks found along the main ridge show evidence of fracturing caused by the action of ice during the numerous glaciation periods. This has loosened blocks of limestone that lie on top of each other, held by gravity at the angle of the western slope, in line with the bedding plane. Because of this, major rockfalls on the eastside of the Rock originating from the ridge area are rare, and even those that are held by chains along the upper St. Michael's road along the main ridge will not pose a threat for some time to come.

6.2 Caves

Caves have been forming for thousands of years, as weakly acidic ground water has flowed down the cracks and fissures of the fractured Gibraltar limestone, reacting with and dissolving the rock. This has resulted in numerous caves around Gibraltar, with some located below sea level and formed during the ice ages when the level of the sea around Gibraltar was much lower, or when the landmass rose above the level of the sea (Rose & Rosenbaum 1991).

Some of caves within the Nature Reserve show evidence of occupation by early man. Testimony of this can be found in the results of many excavations carried out by enthusiastic military personnel in the 19th century, which prompted some renowned archaeologists to visit and excavate some of our caves in the 20th century. Amongst these were Abbe Breuil, Dorothy Garrod and G. Waechter. The former two investigated the site of the Neanderthal skull at Forbes Quarry and also the Mousterian rock shelter at Devil's Tower Cave. The latter accomplished a comprehensive excavation of Gorham's Cave at Governor's beach using the archaeological methods available at the time. No consideration was given to the caves located on the Upper Rock. This was possibly due to military restrictions in force during the two World Wars. These restrictions continued into the 1960s, during which time access was permitted to the local population only during daylight hours. It was during this period that the Gibraltar Cave Research Group was formed. This group had a major impact on the knowledge we now have at our disposal. One of the members of this group, George L. Palao, recorded in an unpublished map of 1966-68, over 107 caves, some of which have since been excavated and surveyed. Since then, other speleological enthusiasts have discovered a few more. In this chapter we will only be dealing with some of those that are found in a natural state within the Upper Rock Nature Reserve, or have been discovered within main cave systems or in tunnels that can be accessed within the Reserve. Fig. 1 shows the position of most the caves found within the Upper Rock Nature Reserve.

Courtesy Gibraltar Tourist Board



1. Rock Gun Cave.
2. Poca Roca Cave.
3. Transmitter fissure
4. Shed Cave
5. Ronald's Delight
6. Devil's Gap Cave
7. Ince's Cave
8. Pete's Paradise Cave
9. Bellman's Cave
10. Ape's Den Cave
11. Mount Misery fissure
12. Hayne's Cave
13. Bray's Cave
14. Douglas Cave
15. St. Michael's Guard
16. Old St. Michael's Cave & Leonora's Cave
17. St. Michael's Roof Passage
18. Old Lower St. Michael's Cave
19. New St. Michael's Cave
20. Spur Road Cave
21. Stone Pine Cave
22. Martin's Guards
23. Spider Cave
24. Martin's Cave
25. Fig Tree Cave
26. Goat's Hair twin Caves
27. Gibbon's Cave
28. George's Bottom Cave
29. Levant Cave
30. Tina's Fissure

Figure 1. Some of the main caves found within the Upper Rock Nature Reserve.

Many of the caves within the Upper Rock Nature reserve are important for their wildlife, archaeological deposits and touristic value. Five are located in the area of Mediterranean steps. Eight can be found around and within the St. Michael's Cave complex. Another four are situated between Levant and Spur Batteries. A few are located along a fault line from Anglian Way to Spyglass and another fault area around the Ape's Den to Ince's Farm and Devil's Gap. The rest can be found at the northern of the Rock, around Middle Hill, Rock Gun and near Governor's Lookout.

During the process of tunnelling operations by the military, some caves were accidentally discovered. These obviously do not bear any archaeological deposits and have very little value to wildlife. They do however reveal some stunning formations, of which the ones found in New St. Michael's Cave are a prime example. A summary of some of the caves with biological, historical, archaeological and touristic value is included and is based largely on the valuable contribution that Mr. George Palao of the Gibraltar Cave Research Group and his colleagues made in the 1960s. In addition, one of the author's (C. Perez) experience in this field during the 1970s-80s has helped in the writing of this chapter.

6.2.1 The Mediterranean steps series

• Martin's Cave: The most important cave in this area is Martin's Cave. This cave was named after a gunner of the Royal Artillery in 1821. According to Palao (1969), the cave was first explored in 1840 by Captain Webber-Smith of the 48th Regiment. In 1867 Captain Frederic Brome also visited and excavated part of the cave. He unearthed two ancient swords of the 12th –13th century, together with a number of human remains including pottery, stone axes and flints. A number of bones were also retrieved, which included birds and reptiles. To commemorate his visit there is an inscription close to the entrance wall that reads, "This cave was explored by authority in June and July, by J. F. Brome Esq.".

In 1957 a further excavation was carried out by the Gibraltar Archaeological Society under the leadership of the archaeologist Mrs. Celia Topp. They excavated around a platform in front of a set of columns that had been disturbed due to the laying of cables by the Army during WWII. In this area they found two neolithic sherds, one with carvings of concentric arcs on the exterior and the other bearing some impressions on the surface and possessing a lug around the rim. Several worked flints and cherts were unearthed together with shells and beach pebbles. There was a later excavation into the inner cave, but no record of the findings exists.

Cpl. J. Acock, who found bone points and blades of jasper, carried out the last known excavation in 1962-63. However, no formal record of this excavation remains (Palao 1969). This cave is situated 170m above sea level at the end of the Mediterranean steps path, before the climb begins. The ledge below the entrance to the cave has been undercut by wave action, forming a wave cut platform at what was once at sea level. This feature corresponds to the Gunz glaciation (Palao 1969). Sandy deposits here and to the south of the cave, together with a shell breccia deposit 16m above the cave entrance are further evidence of this.

Martin's Cave has a large entrance facing the Mediterranean. Access to the cave is gained along a narrow ledge of sandstone and conglomerate. Inside is a large chamber with the floor sloping down westwards. There are several columns and some small stalactites and stalagmites. At the end of the chamber the floor levels off into a muddy pool formed by water percolating through fissures and dripping from the formations above. The roof is quite dry in places, without the classic build-up of calcite deposits. The rest of the cave shows evidence of a time when the climate was much wetter, producing the formations found along the walls of the slope and nearer the entrance, which have now dried up. Cpl. J. C. Marshall (*in* Palao 1969) said that 'during and after rain one can hear torrents of water gushing in the roof of the cave'. Cpl. Marshall also stated that the cave was home to hordes of common bats, which 'all of a sudden disappear and then return at a later date'.

In the 1960s the cave held a very important breeding colony of bats, with an estimated 5000 Schreiber's bat *Miniopterus schreibersi*, and 1000 mouse-eared bat *Myotis myotis* (Palao 1969). From the 5th to the 12th November 1966, the Cave Research Group recorded hundreds on the roof and caught two, yet by the 19th November only small groups were present and a week later none were seen. On the 24th March 1967 the Gibraltar Cave Research Group recorded the presence of a noctule bat *Nyctalus noctula*, inside the cave (Palao 1969). Protection for the bats was provided by a strong metal gate that was installed by the military, presumably as part of the fortifications during WWII, as there are numerous power cables littered within this cave. This gate permitted little disturbance to the bats for many years, especially when the Upper Rock was in MOD hands.

With the transition of the Upper Rock to the Gibraltar Government, the number of visitors to this area increased. Vandals forced entry into the cave, breaking the gate and disturbing the colony of bats. There is also evidence that fires were lit inside the cave to force the bats out of their hiding places. With so many disturbances, the colony dramatically decreased in numbers by down to 10% or less of the original number. Therefore, during the late 1990s the GONHS's Mammal section, under the auspices of Mr. A. Santana, embarked on a project to seal off the entrance to the cave to visitors by installing a new gate. Some of the bats moved up to a tunnel at the top of Mediterranean steps where G. Palao recorded some 200 individuals, but this colony, which only consists of Schreiber's bats, now numbers a few dozen at most. This is augmented by wintering Schreiber's moving down from Malaga province to hibernate in this tunnel. Evidence of this has been found from two ringed individuals, one of which came from a cave close to the town of Benabarra in Malaga province (J. Cortes, *pers. comm.*).

Several interesting plants and ferns grow in the shade and cool environment that the cave entrance has to offer, including the maidenhair fern *Adiantum capillus-veneris*. In the sum-

mer fruit flies aestivate in the caves on Mediterranean steps. The walls of the cave turn black with millions of individuals covering the entire surface close to the entrance, an incredible spectacle worth seeing. It is possible that this formed part of the food resource for the bats that lived within, and is probably also of immense benefit to the many spiders living around the entrance. Hibernating moths also use the caves in the area during the winter.

• Fig Tree Cave: A small cave, only 80m to the south and level with Martin's Cave. It is located 3m above the path, and has a narrow and low opening, widening into a small chamber barely 1m high, and 2m by 3m with a narrow passage at a 40º angle ending in a muddy pit. The cave floor is composed of damp earth, and there is evidence of a small excavation although there is no record of such. This cave has a small invertebrate fauna similar to that found in Martin's Cave.

• Goat's Hair Twin Caves: Located at 190m above sea level, these two caves lie side by side 30m above the path leading to Martin's Cave. They have both been formed along vertical fractures, and water percolating along these has dissolved most of the rock. Both caves have a large, triangular entrance tapering off some 15m towards the end of the cave. This indicates the likelihood of marine erosion, as there is also a wave-cut platform and evidence of sand conglomerate outside the entrance that could indicate a past sea level. A small population of 300 Schreiber's bats was recorded in the 1960's, but in the last 20 years none have been seen in these caves. This cave holds similar wildlife to Martin's Cave, including a type of gelatinous, black fungus. The southern cave was excavated by the Gibraltar Cave Research Group in 1969 with some of the finds on display at the Gibraltar Museum, but the northern cave is still intact, although it is full of litter.

• Spider Cave: This is a very small cave located near the summit of Mediterranean steps at around the 400m mark. It stands at the southern bend of the last flight of steps near the top. It is formed within a solution cavity in a fracture leading down from Lord Airey's Battery. The cave was widened to provide shelter and accommodation to the military during WWII so that now very little remains of the original formations. Nevertheless, Palao recorded up to 100 Schreiber's bats during the late 1960's. However, none have been seen there in recent times. The cave lives up to its name, with a good community of spiders found within, including the Gibraltar funnel-web spider *Macrothele calpeiana*.

One of the Goat's Hair Twin Caves, which has still to be excavated

6.2.2 The St. Michael's series

• Old St. Michael's Cave: Of all the caves in Gibraltar, the most famous and frequently visited cave is St. Michael's Cave. The site was inhabited by neolithic man, and was also known to the Romans, who gave an account of this cave. Captain Fredric Brome, who was the Governor of Prisons in 1876, carried out the first excavations and employed the prison inmates for this task. He discovered various artefacts and implements providing an insight to man's early presence in this cave. Further evidence of the inhabitants of this cave came when the Gibraltar Scouts discovered a neolithic earthenware pot in one of the recesses between the pillars, on a clean-up operation of the cave in the 1970s.

This cave has two natural entrances; a roof passage located above the main chamber with a drop of approx. 25m that was sealed off, for safety reasons, and the entrance, that now consists of the main exit from the cave located beside the bar and shop area. The natural entrance of the cave is extensively fractured a few metres in to the north, possibly due to the blasting that took place when building the roadway. The cave widens and slopes south steeply to open into a magnificent chamber with a splendid backdrop of columns, called the Cathedral Cave. The area immediately in front of the Cathedral Cave was converted into a stage and the slope terraced to accommodate the seating area. The roof is approx. 25m high and is covered in stalactites along the fractures in the rock. To the southwest the cave drops vertically down another 10m, across which is located a bridge leading to the visitors' main entrance.

St. Michael's Cave provided cover during air raids. A further exit was required during this time, so this one was tunnelled through during WWII, with a further tunnel to reach the lower level where an operating theatre was being set up. In the process New St Michael's Cave was discovered. The passageway beneath the bridge provides spectacular views of the formations along this stretch. A section of one of the collapsed columns has been polished to reveal the beautiful structure of the rings that form this formation. Floodlights have been installed all around the cave to enhance the appearance of the structures with coloured lighting and this also provides the illumination for many of the functions that take place within this cave. To the east of the slope where the public seating is located is a small passage, which leads to a further series of the cave named Leonora's Cave.

• Leonora's Cave: Leonora's Cave is found within the Old St. Michael's Cave, to the east of the central area of seating above the main chamber. It is not known who discovered the cave but there is an engraving with a date hewn on a rock immediately in front of the entrance. Access is gained from the seating area 6m down a small scree slope, under a recess of the eastern wall of the Old St. Michael's Cave. Here the discoverer must have noticed either a slight breeze of air through a crack in a wall of columns signifying the continuation of a cave, or the hollow sound behind these columns. Whatever the reason, the result was that a gap was widened through these columns enabling access to the rest of this system. Leonora's Cave is a relatively small cave, but has wonderful formations that have not been affected by excessive visitor pressure, as has happened in the Old St. Michael's Cave. This is obviously due to this system not forming part of the touristic aspect of the cave and therefore being out of bounds to the public, and also because the chambers containing the formations lie well away from the entrance where the excessive dust found in the main chamber of Old St. Michael's Cave will not affect them.

• New St. Michael's Cave: This cave was discovered as a result of a tunnelling operation in 1942 that was initiated to provide access to the lower level of Old St. Michael's Cave, where an operating theatre was being constructed. In the process of blasting operations, the engineers noticed, when the dust had settled, that all the rubble had disappeared down a hole in the ground. Further investigation revealed the system now known as New St. Michael's Cave. Since the discovery, the Royal Engineers, as the custodians of the cave, installed a lighting system and improved the safety of the cave with a network of ropes in the chamber known as the boxing ring. They also provided ropes around the lake and along difficult areas. They allowed public access only under supervision of one of their guides, normally a Royal Engineer. However, in the 1970s, some local residents were included in the guide unit.

In the late 1980s the responsibility of the cave passed on to the Gibraltar Tourist Office (now the Gibraltar Tourist Board) and they now control maintenance and provision of guides through their cave co-ordinator Mr. Ernest Vallejo. The cave itself is a prime example of the wonders that water can produce, percolating and dissolving limestone over thousands of years to create remarkable formations, coloured in shades of yellows, whites and browns, reflecting the light of the torches and leaving visitors spellbound.

The cave runs north to south for a distance of approximately 370m. The entrance is located beneath a trapdoor 20m from the tunnel entrance. Here, the visitor descends a flight of steps and arrives in a small debris-strewn chamber. From here, a small crawl and a 3m descent brings one into the wet and live surrounding of the initial part of the cave. Immediately, one is aware of the constant flow of water down the sides of the walls. Curtain formations and flowstones are also immediately noticeable. A small passage opens up into the Great Rift or boxing ring, a large chamber with an intricate network of ropes to ensure the safety of visitors. Here, formations are scarce and the pattern of large blocks of rock cemented together by the precipitation of calcium carbonate indicates a more recent history than the rest of the cave.

Below this, a narrow passage drops down into another small chamber that is rich in formations and includes a pool of water. The cave now proceeds south through three magnificent stalagmite halls each bearing the most outstanding flowstones, curtains, helictites, stalagmites and stalactites that can be found in the surrounding region. As if this was not enough, the visitor is presented with beautiful reflections of the formations on this exceptional lake present within this cave. Incredibly, you can traverse the lake by walking along a narrow rim of up to 20cm around the edge of the lake. This rim is the result of deposits of calcium carbonate floating on the water and adhering to the edges of the lake over millennia. The final chamber, known as the southern chamber, narrows considerably at its southernmost point close to where is found a perfect palette. This unusual formation is reminiscent of a painter's palette, at an angle of 45º. The development of this formation cannot be explained. Three other perfect palettes can also be found in Pete's Paradise Cave. Due to the presence of lighting installation within the cave there are colonies of green algae growing on the walls close to the light bulbs. Other flora or fauna have not been discovered within this cave.

• Lower Old St. Michael's Cave: The entrance to this cave lies close to that of New St. Michael's Cave, near the west wall of the operating theatre area. Here, situated beneath a trapdoor, the entrance to the cave winds vertically down a narrow shaft of loose fractured rock known as the Corkscrew. Once at the bottom, a passage continues north and the rock walls are more stable. This opens up into a small chamber with several formations called the Grotto. An even narrower passage, which only very small-chested persons can negotiate, known as the Letterbox, continues to another small chamber. This second chamber is called the Prison because of the several columns reminiscent of a prison window. The air at this stage is dank and the cave narrows considerably with no further passages. The cave contains a small series of formations, but due to the small nature of the series it has none of the fabulous formations found in New St. Michael's Cave. There does not seem to be any evidence of any flora or fauna in this cave.

• St. Michael's roof passage: The roof passage lies 60m to the south of the natural entrance of St. Michael's Cave, and some 20m up the slope. Here the entrance is enclosed within a concrete compound and was covered with iron bars which have now rusted away. There are some calcite formations and an opening, along which is a small narrow ledge from where you can observe the Old St. Michael's Cave some 25m below. This exposed drop is extremely dangerous and the roof passage should be sealed off to prevent accidents.

• Spur Road Cave: This cave lies south of the Roof passage to the Old St. Michael's Cave. It has a small entrance, which opens into a chamber of 10m by 6m and 2m in height. There are relatively few formations, most of which show signs of having been broken for souvenirs. This chamber was used as a dump in the 1970s and the floor was covered with bottles and tins. At the southern end is a small opening or crawl that leads into another smaller chamber, again with no complete formations. The floor in the two chambers is composed of soft earth and does not seem to have undergone any excavation. The narrow entrance and small chamber would have provided early man with ideal living conditions and protection from predators. This and the following cave would seem to be the most promising candidates for an excavation that would provide an insight into the living conditions of early man in the St. Michael's series of caves.

• Stone Pine Cave: This cave lies just 20m south of Spur Road Cave. In appearance it is a replica of the previous cave except that it only contains one chamber. It also has a small entrance and an earthen floor, which again does not seem to have been excavated.

• St. Michael's Guard Cave: This small cave lies some 14m north of the Roof Passage. Its entrance is located 13m above the main entrance to Old St. Michael's Cave, and can be found by following some water pipelines that run along here. The entrance is 1_m tall by 1m wide and runs south for 7m. A passage slowly narrows at the end with the roof meeting the floor of the cave. There are no formations whatsoever and the walls are relatively dry. The walls around the cave entrance have been painted over and some graffiti can also be seen.

6.2.3 The Levant Cave series

• Levant Cave: Levant Cave was discovered during tunnelling operations to accommodate the command centre for the 9.2" guns. The cave runs on a north to south axis, along the same fault where New St Michael's Cave is located, and rumour has it that a very narrow passage connects these two caves (G. Palao, *pers. comm.*). The tunnelling has widened most of the cave, but there remain several areas with some beautiful formations of the kind found in New St. Michael's Cave.

• Gibbon's Cave: Further east along the tunnel where Levant Cave is located, another much smaller cave was discovered and named Gibbon's Cave. This cave was virtually destroyed through tunnelling action but some holes containing formations can be found along the walls of the tunnel. None extend very far, but they do offer refuge in the winter months to numbers of black rats *Rattus rattus alexandrinus*, as was observed in the 1970s.

• George's Bottom Cave: Obviously named after George Palao, the precise sequence of events that led to this remains a mystery that we have not dared to investigate. On the 27th November 1965 an expedition of the Gibraltar Cave Research Group, searching for new caves, came upon a small hole on the slope just below Spur Battery at a point 310m above sea level. The entrance was obstructed by a large boulder, but along the sides a fresh breeze emanated from the hole, indicating a potential cave. With the use of heavy lifting equipment, the boulder was subsequently removed and the entrance was revealed. This is only 90cm high by 1m wide and opens slightly once you crawl in. The cave opens out into numerous chambers and fissures on six different descending levels, the lowest of which could connect to Levant Cave (Palao 1969). Most of the chambers in this cave are difficult to manoeuvre in, and in places only allow for crawling space. Formations are plentiful and include curtains, columns, straws, helictites and corals, the last of which dominate parts of the chambers over which one has to crawl on one's hands and knees. There are a few soil deposits within this cave. These can mainly be found near the entrance and in the lower levels where it has collected down the numerous fissures present. Only recent remains of rabbit *Oryctolagus cuniculus*, and black rat *Rattus rattus alexandrinus*, and small invertebrates have been found in this cave.

6.2.4 Other caves

• Poca Roca Cave: This cave is located 210m above sea level, at the northern end of the Nature Reserve. It is found just west of Signal Station Road within the compound of the old Isolation Hospital, which is now a residential area. Located behind the buildings is a small vertical cliff that measures about 4m at its highest point. This spans north to south in a shallow arc, and the main entrance of this cave is situated along the central portion. The first reference to this cave comes in a manuscript by Capt. John Drinkwater (*in* Palao 1969) where he stated that 'there are several caves on different parts of the Hill in which water possessed petrifying qualities. One on Middle Hill called Poca Roca, was fitted up, previous to bombardment for the Governor's reception'. The Governor at the time was General O'Hara, who commanded Gibraltar from 1784-1790. It was left up to Lieutenant Holloway of the Engineers to fit the cave up as the residence of the Governor, an account of which is recorded in his diary on the 7th August 1789. However, it was never used as such, and eventually it was converted to a powder magazine (Palao 1969). The main chamber of this cave was converted into a bakery during WWII and evidence of the bread racks still remained there in 1975.

In 1869, Lieutenant Alexander B. Brown R.A. published a paper on the geology of Gibraltar where he mentions that a large fissure was uncovered near the entrance. This fissure contained numerous bones of small animals and some large ones including ibex *Capra pyrenaeica*, red deer *Cervus elaphus*, and rodents, similar to ones found during the excavations into the Galleries (Palao 1969). The cave has been excavated several times in the last two hundred years and has revealed artefacts dating to an occupation by neolithic man. It had undergone major changes to the main chamber before Captain Frederic Brome started excavations in 1867. Busk (1868) believed the entrance could have been widened by marine action, and he believed that the cave connected to the eastern face above Catalan Bay. He based his assumption on Capt. Brome, who stated that the back chamber was filled with the same sand as that which formed the wind blown sand of the eastern slopes.

In January 1966 the Gibraltar Cave Research Group surveyed the cave. This was followed by a small excavation of the lower level chamber of the cave in 1966 by two of its members, George Palao and Luis Payas. They uncovered deposits of charcoal throughout the entire length of the excavation together with deposits of red and yellow ochre. Evidence of human occupation came from fragments of pottery, together with remains of edible terrestrial and marine shells in all the layers. A quantity of bones was unearthed together with the

skull, vertebrae and a complete hoof of an ibex.

The survey of the cave revealed that the Main Chamber is 23m long by 12m wide. This is the chamber that was modified to accommodate the Governor, and most of the formations here have been destroyed. There is an extension to the main chamber, but this is choked with boulders. A flight of concrete steps leads down to the Lower Chamber, which is 23m long and 6m wide. Half of this chamber has also been built within, but there still exists a magnificent flowstone at the eastern end. From here, a small passage 20m long by 2m high, which seems to have been widened due to the presence of drill holes, leads to a small cavern 5m long and 6m wide. Here, on the floor of the cave, are the sand deposits that Brome and Busk referred to as similar to the eastern sand slopes (Palao 1966).

• Pete's Paradise Cave: The Gibraltar Cave Research Group discovered this cave on the 26th February 1966, while practising abseiling down the western cliffs near the Ape's Den (G. Palao, *pers. comm.*). The cave is located 16m below Queen's Road, just south of the 'Moorish wall'. The entrance is composed of a narrow fissure of 6m in width by 1m in height. This opens slightly into the initial chamber, which has a very low roof and an earthen floor. Here, an initial excavation took place, which uncovered numerous sherds of the type found in Poca Roca Cave. Also found were an engraved bone bead and several tools composed of chert, together with small mammal bones. This was followed by another excavation during the 1970s, results of which are unpublished. This cave was also surveyed by the Palao team, who registered the formations to be '…of exceptional value' (Palao 1969).

There is little standing room inside this cave, and the chambers with the important formations are accessed from the entrance chamber via a narrow crawl 8m long, 50cm high and 60cm wide. Here, Palao named four chambers, each of which contains unique and beautiful formations, the likes of which are nowhere to be found in other caves in Gibraltar. The Nun's Chamber contains a fresh water trough within a large rimstone pool of 45cm in depth. This is filled by precipitation flowing down a flowstone immediately behind the pool. The Rimstone chamber is composed of a set of terraced rimstone pools, the levels of which vary according to the annual rainfall. There are some stalactites and columns in this chamber and a set of beautiful curtain formations.

Beyond this, one arrives at the Pearl Chamber, a small 6m by 4m area, which contains a small shallow rimstone pool that contains unique cave pearls. These are tiny beads of calcite that have formed when the calcium carbonate has adhered to small grains of sand and coated the grain annually with layer after layer. Some of the pearls measure up to 3cm in diameter whereas many more are very tiny and have fused with the cave floor. The last of the chambers, the Hall of Pillars, is according to Palao (1966), 'the most beautiful section'. Here the chamber measures 12m by 8m and is surrounded by magnificent columns, with a pool of water within another rimstone of 35cm in depth. The value of this cave is tremendous, since it also contains three of the four perfect palette formations in existence in Gibraltar. The fourth can be seen in New St. Michael's Cave, near the end of the Southern Chamber.

• Bray's Cave: This cave is located 10m below St. Michael's Road and 35m south of the viewing platform at the northern end of Douglas Path. There is no record of the discovery of this cave, possibly because it really is very small and was not considered noteworthy. The cave is in reality a rock shelter, where the front wall extends north to south some 8m in length and 5m in height with the top overhanging to form the shelter. At the southern end there is a small crevice where some formations can be found, including a few curtains and some stalagmites and stalactites. The cave floor here is composed of calcite from the percolation of water through the fissures. There is a possibility that the cave could extend beyond these formations and that these have blocked the continuation of the cave. The rest of the rock shelter was covered in a combination of damp earth and small rocks and stones that had accumulated here over the centuries. The excavation in 2002 revealed an Iron Age burial site, which is unique in the region together with remains of Ibex and other small mammals.

6.3 Threats to Cliffs

Threats concerning the geology of the Upper Rock Nature Reserve can come in various forms.

1) The outline of the Rock must be protected as it represents the unique silhouette of our homeland. In this respect no other buildings (either large or small), monuments or erections other than the ones in place should be granted planning permission, as this would break the skyline and disrupt the shape of our Rock. This should apply equally to the MOD areas of Rock Gun, Middle Hill and Spyglass (*see* L/N 51 of 1993 6. (1), pp.116).

2) Buildings and erections that break the outline of the Rock and do not serve any purpose and have no historical or touristic value should be removed forthwith. In this respect, work has now begun on the removal of aerials within the MOD Aerial Farm around Middle Hill, which posed an eyesore to this beautiful part of the Rock, and some of the wooden towers have already been dismantled.

3) Up to 80% of the boundary of the Upper Rock Nature Reserve is composed of cliffs. Some of these are relatively small (30m to 50m in height), whereas others rise from the base of the Rock near sea level to 400m in height at Rock Gun on the North Face of the Rock. Although the Jurassic limestone is a very stable rock, there are areas along the top ridge where the rock has fractured. Also, in some places along the North Face, the rock composition is unstable and brittle, due to the emanations of the old Refuse incinerator mixing with rainwater to form weak acid, which partly dissolved and weakened the structure of the rock. This presents the problem of rockfalls in the areas immediately below these, and ways of tackling this threat that do not prejudice the geology and the living environment have to be found. First of all, there should be a safety zone/perimeter fence erected at an adequate distance away from the cliff base that should guarantee the safety of persons and buildings close by. In the case of the base of the cliff sloping away, a catchment area should be excavated around the base of the perimeter, as this would hold falling rocks and prevent them from rolling down the slope.

4) Cliff 'stabilisation' is really not an option. No matter how much work is done and money is spent on this, the topography of Gibraltar is such that rockfalls are bound to occur. Firstly, it would not be feasible to stabilise all the cliffs. The size and surface area is considerable and the aesthetic appeal of these cliffs, as well as their important fauna and flora (which merit 'Natura 2000' designation) would be lost. A prime example can be found at Camp and Little Bays, where cliff stabilisation has taken place. The problem of Camp Bay was compounded by the tunnel that was driven through an unstable section of rock close to a shale boundary. Likewise, Little Bay area is the remnants of a rock quarry. Therefore, loose rocks were likely to abound. The cliffs there have now lost a lot of their character due to the rock surface being coated in a mass of concrete, whereas in other areas stabilising metal rods have been drilled into the cliff, destroying the natural appearance and in the process also destroying many cliff loving plants in a unique habitat. It is only natural that the Government has to protect itself from lawsuits in this day and age, where health and safety regulations have reached new heights. However, one must look at the other side of the coin and not try to prevent any and every possibility at the expense of destroying the natural habitat and aesthetic value that our cliffs have. This would not occur in a Nature Reserve that contains globally important cliffs in any part of the world.

Obviously, prevention is better than the cure and in this respect the authorities should be extremely careful when granting planning permission to buildings that are to be constructed close to the base of cliffs. This applies equally to buildings at the base of slopes above which cliffs are situated. Prime examples of the risks involved are to be found at the Both Worlds development, above which the MOD have installed a series of strong metallic nets to prevent rockfalls. Another area where rockfalls occur frequently is at Catalan Bay, where an unstable area of cliff to the south of the entrance to William's Way tunnel has rendered the Government's asphalt plant below unusable. This area has now become the catchment for rockfalls, but due to the instability of the cliff it would be a wise measure to construct an embankment and erect strong metallic nets close to the roadway to prevent large rocks rolling across this.

5) The south corner of Catalan Bay village has been the area to suffer the majority of rockfalls, originating from the cliffs of the Upper Rock, in recent history. Here the slope is contiguous with the south side of the village, affording no protection whatsoever, except for the roadway, which offers little in the way of a catchment area. The angle of the slope in this area is too steep and the velocities attained by rocks rolling down the slope too great to be retained at this point, as they would bounce over and continue downhill into the buildings in the village. Even the presence of palm trees and acacias on the slope is insufficient to break the fall and velocity of some of these rocks, and therefore it would again be wise to erect a similar rockfall defence on the sand slopes as that found at the southern end within the MOD area.

6) To achieve full protection of the cliffs, the boundary of the Nature Reserve should run along the base of the cliff line surrounding the Upper Rock.

6.4 Threats to caves

1) There was no adequate protection for the caves of Gibraltar considering the natural, archaeological and touristic value they have. Ever since their discoveries, caves have been robbed of their archaeological treasures, most of which have been deposited in the British Natural History Museum. This used to take place in the 1800s and early 1900s after which legislation, first under the 'Gibraltar Museum and Antiquities Ordinance, 1982' (L/N 20 of 1982) and subsequently under the 'Gibraltar Heritage Trust Ordinance, 1989' (L/N 12 of 1989) and its subsequent amendments, currently under review, prohibits unauthorised excavations. Every effort should be made for the return of these artefacts and their deposition in the Gibraltar Museum.

2) Many of the caves in Gibraltar have had pieces of stalagmites and stalactites broken off and taken as mementoes, and the walls of many caves abound in graffiti, some dating back over one hundred years. Pete's Paradise Cave is a prime example of the vandalism that some of the caves have endured. This cave was only discovered in 1966 and contains some unique examples of formations. However, many of its formations have been broken off, cave pearls have been removed and some of the rimstone pools have been broken, whilst others have had the muddy deposits on their beds disturbed, allowing the water to filter through and disappear. Legislation is in place under the 'Nature Conservation Area (Upper Rock) Designation Order, 1993' (L/N 51 of 1993), which states, "No person shall damage or deface any structure including any natural structure in the reserve". This should be sufficient to dissuade any vandalism, but enforcement is paramount.

3) Refuse deposition within caves is an escalating problem. Those caves which provide easy access to visitors, especially those found along Mediterranean Steps and St. Michael's area are found in an appalling state with rubbish accumulating over the years. Some of these caves still contain the remnants of rusting debris from the occupation of the military during WWII, with the additional refuse of constant visitations since. This effect was compounded when the Upper Rock was opened to the public, and has not improved since the handover to the Gibraltar Government, because there has never been an adequate management plan.

4) Access to caves is not controlled in any way. Anybody can visit the caves on the Upper Rock Nature Reserve except those in MOD areas and those found within the tunnels. Mr. Ernest Vallejo and his team of approved guides manage access to new St. Michael's Cave, and bookings can be made through the Gibraltar Tourist Board, which is ultimately responsible for the cave. A limit is imposed as to the number of visitors per guide for health and safety reasons, and this is closely adhered to. Visitor numbers to Old St. Michael's Cave are not controlled and statistics are therefore unavailable. Visitor pressure is enormous bearing in mind that nearly all the tourists that enter the reserve visit the cave. Although the opening hours of this cave are from 09:30hrs to 18:00hrs, there is no limit as to how many visitors can access the cave throughout the day and no limit on the numbers present within the cave at any one time. Entry is not allowed half an hour before closing time to allow visitors to exit the cave, and the cave is checked every evening to ensure that nobody remains behind. These uncontrolled numbers of visitors throughout the years has resulted in a major deterioration of the cave. Most of the formations are now 'dead'; i.e., the formations have no water flowing over them or percolating down from the roof of the cave to formations below, and have therefore stopped growing. This is mainly the result of smoking and dust and fine silt (disturbed by the feet of hundreds of thousands of visitors to the cave over the years) being deposited on the wet surface of the formations and preventing the entry of water through narrow fissures, stemming their flow until the formation dries out and dies. This problem is compounded by the amount of rubbish found in recesses in the cave and along dark unlit sections where visitors frequently deposit this. Adequate cleaning and availability of more litterbins would improve this situation, and certainly a limitation on visits would be a step in the right direction. The numbers permitted daily should be assessed by the Board of Management based on the impact these visitations have on the cave, and there should be restoration works and cleaning programme that would affect the formations to restore the same back to their former glory.

6.5 GONHS

It is worth mentioning that a small group of agile and experienced persons form the speleological and rock climbing group of GONHS. This autonomous group is based at the Governor's Cottage on Mediterranean Road and have surveyed most of the caves to be found on the Upper Rock. They frequently participate in rock climbing and have several training areas around their base. Their contribution to GONHS is extremely valuable since they are able to survey inaccessible areas of cliffs for all types of wildlife. They were also actively involved in the environmental impact assessment on the cliff stabilisation project of Little Bay, and were recently involved in active measures to ensure the conservation of one of our pairs of the peregrine *Falco peregrinus*. As such, they are a fundamentally important asset to the aims and objectives of the management of the Upper Rock Nature Reserve.

6.6 Recommendations

1) All caves along Mediterranean Steps should be cleaned of all refuse and debris.

2) Access to Martin's Cave should be restricted on the grounds that the bats should be allowed to re-establish themselves as breeding colony and a winter roost.

3) A panel should be erected outside caves informing the public of the historical and natural heritage each contains. This should include a warning against refuse deposition and vandalism/graffiti, and there should be a separate sign indicating this and fire hazards before the approaching walk towards the area where the caves are located.

4) There should be a cleaning campaign of all the St. Michael's series of caves. In the Old St. Michael's Cave this requires not only the removal of refuse, debris and obsolete lighting cables and ancillary equipment, but a concerted effort to 'mop up' the inside of the cave and remove all the excess dust, dirt and fine earth. Since expertise on cave restoration does not exist on the Rock, advice and assistance should be sought from outside Gibraltar. Given that works are likely to require special, expert attention, it is possible that an external workforce may also have to be sought. These are potentially huge tasks that may require tackling in several stages.

5) There should be an information plaque on the road above Bray's Cave, indicating the position of the cave and containing a summary of the archaeological wealth unearthed there. This cave requires the removal of the debris of the excavation, which was dumped further down the slope. The cave shelter itself must be rendered safe since large crevices between boulders and rocks, the result of the excavation, pose a danger to the public.

6) A Cave Management Committee should be appointed, and should hold responsibility for all the caves of Gibraltar. This could be constituted of employees of the management of the Nature Reserve, organisations or bodies with an interest in caves and amateurs with a long-term interest and association to the caves. The Committee should thus be composed of members such as GONHS (flora and fauna) Heritage Trust, Gibraltar Museum (historical and archaeological heritage), MOD (caves located within their land), Cave Research Groups (support and liaison with projects, surveys, excavations, etc.) Ministries of the Environment and of Heritage (regular maintenance, signposting, information plaques/panels and finances for caves outside the Upper Rock) and the Upper Rock Nature Reserve Management (access, regular maintenance, signposting, information plaques and the financing of all of the above from the entrance fees into the Reserve).

7) The Committee should regulate access to caves of a sensitive nature, e.g., bats breeding or roosting, archaeological excavations in progress, or caves located within MOD property.

8) The Committee should ensure that all cavers and visitors to caves designated in a high-risk category are covered by adequate personal and unlimited liability insurance.

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7. Heritage

7. Heritage

The presence of man on the Rock of Gibraltar reaches from as far back as the Neanderthals to the present day. Throughout this period the Rock has been visited by Phoenicians, Carthaginians, Greeks, Romans, Visigoths, and colonised by Moors, Spaniards and the British. Vestiges of the occupation by some of these civilizations can be seen around Gibraltar, but only a few, though quite notable, are to be found within the Upper Rock Nature Reserve. These assets form part of the historical wealth of the Nature Reserve, and as such must be conserved and protected for future generations. They should, however, also be developed for their touristic, educational and scientific value. In this respect all historical heritage must fall under the management plan of the Upper Rock Nature Reserve. Some of the most important of these sites are listed next under their corresponding period or locations, together with a brief history of how these constructions came into being.

7.1 Caves

The caves on the Upper Rock Nature Reserve are covered in Chapter 6, and immediate and remedial action for the caves is dealt with there. Only St Michael's Cave has been developed as a tourist site, and this includes a display of a family of 'early man' residing within this cave. Some other caves are in a pitiful state and all have as yet not been cleared of refuse, preserved, developed or incorporated into a management plan.

7.2 Moors

Tarik Ibn Ziyad invaded the region and landed successfully at his second attempt near Gibraltar in the spring of 711 AD. He marched westwards and took the ports of Algeciras and Tarifa, followed by Gibraltar. Arab Chroniclers recorded that the Rock of Gibraltar, '*Mons Calpe*' was renamed 'Jebel Tarik', (Tarik's mountain) after the location close to where he had landed, and this name was corrupted to the name we now know as Gibraltar (Jackson 1987).

In 1068 AD the Arab governor of Algeciras was ordered to build a fort on Jebel Tarik. The Moorish Castle was built and the fort was held until 1146 when the Almohades took over from the Almoravides. In 1160 Abdu-l-Mumin was so impressed by Jebel Tarik's strategic importance that he ordered the building of a fortified city, which he called Medina-al Fath (Jackson 1987). It is difficult to determine how much of the city was built, but most must have been included within the castle walls. During this period, the engineer and mathematician Haji Ya'ysh built a windmill at the top of the Rock (Jackson 1987). No evidence of this construction remains at this site.

The only other historical structures attributed to this period are the 'Moorish' wall, which runs from Genoese Battery along the southern part of Ince's Farm up to the top of the Rock near the Cable Car top station, and a 'Moorish Tower' on the ridge along Douglas Path. However, it has since been revealed that these two constructions may be attributed to the Spanish and British periods (C. Finlayson, *pers. comm.*). The 'Moorish' wall it seems, was the first attempt at the construction of the Charles V Wall that now lies further south, and the 'Moorish Tower' was probably built during the very early British era.

The Tower of Homage (the most noticeable and well-known part of the Moorish castle) and its walls lie on the fringes of the Upper Rock Nature Reserve. Therefore, access to this site is included as part of the payment for entry into the Nature Reserve. A refurbishment programme is presently being carried out at this site by the Gibraltar Tourist Board, under the supervision of the Gibraltar Museum. Tourist access will not be allowed until the works are completed. The site will be extended to include those used presently as the prison, once these facilities are transferred to the new location at Lathbury Barracks. This is welcome news, but continued efforts for restoration should also include those other historical monuments and buildings found within the Upper Rock Nature Reserve.

The 'Moorish' wall, which experts have recently determined to have been constructed within the Spanish period (C. Finlayson, *pers. comm.*) shows evidence that it was once higher than it presently is. For the sake of this document we will continue to call it the 'Moorish' wall, as it is commonly known locally and in all publications so far. The whole stretch of wall seems to have been partly dismantled and used as building material for the Charles V wall, only a few hundred metres to the south. The height along most of the wall is approximately 2m, but nearer the top of the rock the wall almost disappears, as most of the material must have been removed, possibly to build the signal tower at the location where the wall ended. Along its length the wall is totally concealed by the tall vegetation and the visitor is totally unaware of its whereabouts except where the roadway has breached this, and there is but one plaque with a few lines of information that reveals its presence.

There is also a building along the 'Moorish' wall, just above Charles V Road that George

Palao refers to as a 'Visigoth' building, in his account of bat populations in Gibraltar (Palao, *Unpubl.*). This building seems to be of the same age and construction as the 'Moorish' wall, has a pitched roof and very thick walls and might have been a water cistern, although an outlet on the west-facing wall would not seem to indicate this. The entrance to the building is raised above the floor, which is damp and muddy, and the walls are covered in graffiti. The surprising thing is that since this building is not visible from the roadway, not many people know of its location or have ventured inside, and the graffiti that is found there seemingly dates back to the 18th or 19th century, with etchings of the mast sailing ships and man-o-wars of that period.

The 'Moorish Tower' located on Douglas Path has also been determined by experts to have been constructed during the British period, and not by the Moors (C. Finlayson *pers. comm.*). For the purposes of this document it will remain under the Moorish section as it was popularly regarded as Moorish. It is situated at the top of the steps leading up from the viewing platform on St. Michael's Road. It is a small round tower some 2m in height, which can accommodate two standing individuals, and is rugged in its construction. Unfortunately the tower is used as a toilet and for depositing refuse, and there is no information panel at this location indicating the history of this tower.

7.3 Spaniards

In 1462 the Count of Arcos, Rodrigo Ponce de Leon and the Duke of Medina Sidonia captured the Rock of Gibraltar from the Moors and left the Guzmans in possession (Jackson 1987). The town of Gibraltar grew, and with this growth came extensions to the mole. In 1502 Gibraltar received a Royal Warrant granting it new Royal Arms to replace those of Medina Sidonia. The Royal Arms depict the Castle and Key, and can be seen on the Southport Gates. They also form part of the Gibraltar flag.

In 1540, Corsairs landed after dark near Europa Point and raided the town enslaving many of the citizens. Pleas by the residents to improve the defences were answered twelve years later. Charles V, King of Spain and emperor of the Holy Roman Empire sent an eminent Italian military engineer, Giovanni Battista Calvi, to see what could be done. He built the wall known as Charles V wall, to the south, in order to protect the town, but the city was still vulnerable to attack along the Upper Rock. Therefore, another Italian engineer by the name of Fratino extended the wall, just a few hundred metres south of the 'Moorish' wall, to the top of the Rock (Jackson 1987).

During Philip IV's reign, Gibraltar's fortifications were modernised and several gun batteries were built to protect the town. Of these, two were located on the Upper Rock with San Domingo on the site of Ape's Den at the lower end of Charles V Wall, and the other on the site of Genoese Battery, at the lower end of the 'Moorish' wall. Only the foundations of these batteries remain at these two sites.

During the Spanish period many churches and chapels were established. One of these, Nuestra Señora de Guadalupe, was located at Signal Station on the location of 'El Hacho'. There appear to be no remains of this church at this site (Chichon 1983).

7.4 British

On the 4th August 1704, Admiral Sir George Rooke and Prince George of Hesse-D'Armstadt took possession of Gibraltar. The Spanish population fled and based itself on a hill where they founded the town of San Roque. The fortifications were reinforced for the counter offensive and a stable population based mainly on military personnel slowly grew. Thus the British occupation of Gibraltar was firmly established and remains to this day.

Among the many fortifications that were mounted in Gibraltar, some batteries were established towards the northern end of the Rock overlooking the Spanish lines. Willis's Battery, named after a Captain Willis, was built where Princess Royal Battery now stands, and the Salto del Lobo Battery where Princess Caroline's Battery is located (Jackson 1987). No evidence of these batteries remains at these sites, but some of the magazines that are located on Willis's Road form part of a tourist attraction called 'A City Under Siege'. Colonel Green established another battery at a point 200m below Rock Gun, now known as Green Lodge Battery. The cannonballs from this gun reached much further than Willis's Battery owing to its height, so the gunners then installed a new gun at the highest point of the northern end of the Rock thereby establishing Rock Gun Battery.

In 1782 renewed activity within the Spanish lines prompted Eliott to find new ideas from his garrison to counter the Spanish efforts. One such idea came from Warrant Officer Ince, who suggested mounting a gun battery on the notch, which was located half way up the North Face. In order to achieve this, tunnelling was commenced, and after mining approximately 15m an aperture was drilled to provide ventilation. It was then realized that these would make for excellent gun emplacements. Mining continued and the area below the notch was hollowed out allow-

ing for five guns, which together with Lieutenant Koehler's invention of the depressing gun proved successful in countering the Spanish offensive. This set of tunnels is now known as the Upper Galleries and constitutes one of the main tourist sites run by the Gibraltar Tourism Agency.

In the late 1700's, the Governor of Gibraltar, General Charles O'Hara had a tower built at the southern end of the ridge of the Rock in the belief that he should be able to see Spanish ships as they left the port of Cadiz. This proved a total failure, but the tower remained in place until 1888 when the captain of the HMS Wasp fired a shell through it. It was subsequently totally demolished in the 1900's and O'Hara's Battery with its 9.2-inch gun was established there.

Throughout the nineteenth century the Royal Engineers constantly strengthened and modernized the fortifications in Gibraltar, including those gun emplacements and batteries on the Upper Rock. Another two relics of this period, Healy's Mortar and the Lime Kiln on Willis's Road, can also be seen on the Upper Rock. Healy's Mortar can be found close to the Ape's Den. It was excavated from solid rock and was designed to propel over 1000 stones weighing 1lb each to the enemy forces attacking Ragged Staff. After several trials, where many of the stones fell short and showered the town, it was decided to abandon the venture (Ellicott 1975).

7.5 World War II

In 1938, on the advent of WWII, the Governor of Gibraltar, General Sir Edmund Ironside began strengthening the Rock's defences, especially those facing north, against the possibility of a land-based attack (Jackson 1987). Naval guns were deployed at Princess Charlottes Battery and 9.2-inch guns around the southern end of the Rock to defend the Strait of Gibraltar. Anti-aircraft gun batteries and searchlight emplacements were also located all around the Upper Rock together with machine gun pill box emplacements to guard the batteries, and these included magazines and accommodation in the form of Nissen huts, usually inside tunnels, for the personnel manning these guns. . The location of the main gun emplacements and other WWII buildings and constructions can be seen in Fig. 1.

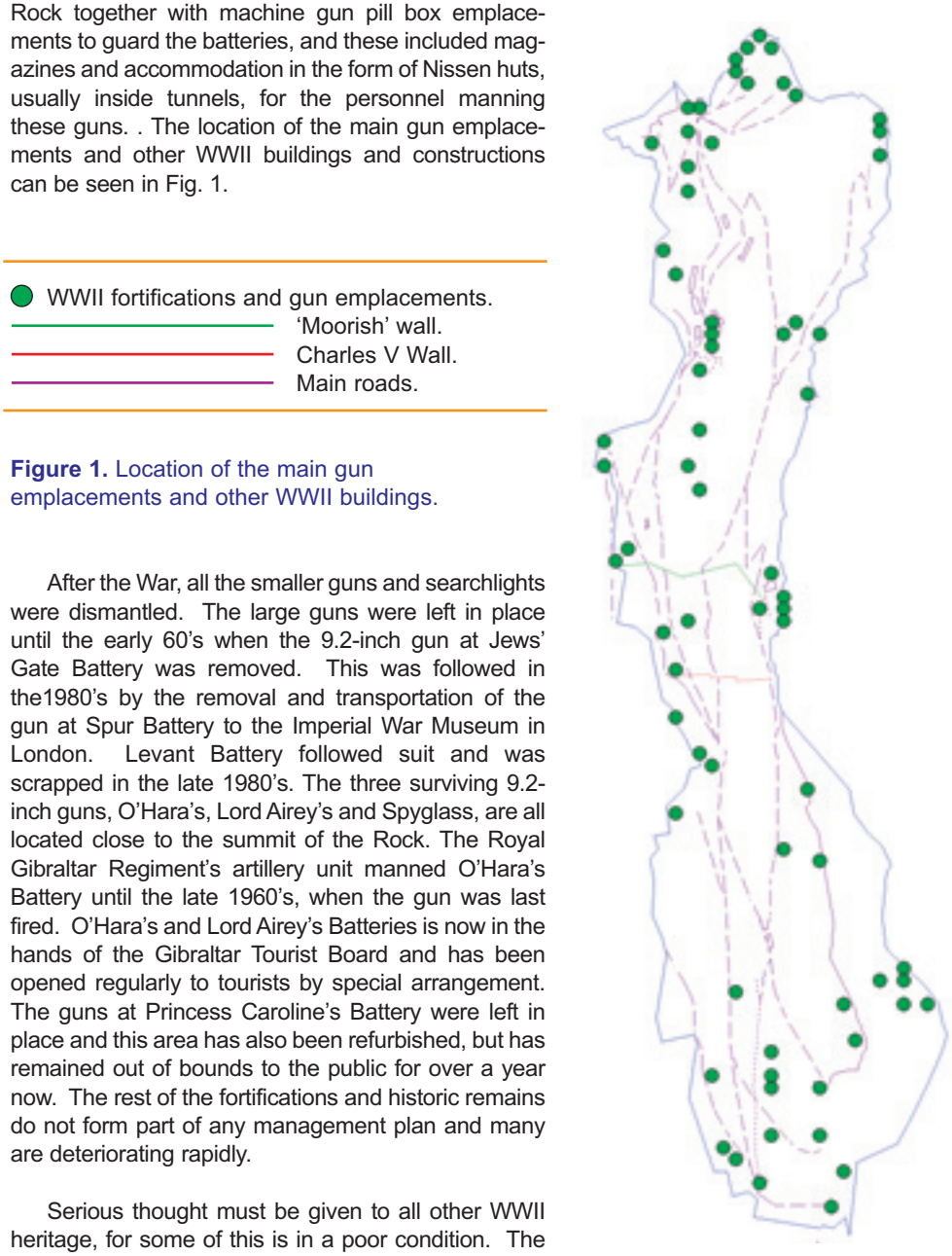

Figure 1. Location of the main gun emplacements and other WWII buildings.

After the War, all the smaller guns and searchlights were dismantled. The large guns were left in place until the early 60's when the 9.2-inch gun at Jews' Gate Battery was removed. This was followed in the1980's by the removal and transportation of the gun at Spur Battery to the Imperial War Museum in London. Levant Battery followed suit and was scrapped in the late 1980's. The three surviving 9.2-inch guns, O'Hara's, Lord Airey's and Spyglass, are all located close to the summit of the Rock. The Royal Gibraltar Regiment's artillery unit manned O'Hara's Battery until the late 1960's, when the gun was last fired. O'Hara's and Lord Airey's Batteries is now in the hands of the Gibraltar Tourist Board and has been opened regularly to tourists by special arrangement. The guns at Princess Caroline's Battery were left in place and this area has also been refurbished, but has remained out of bounds to the public for over a year now. The rest of the fortifications and historic remains do not form part of any management plan and many are deteriorating rapidly.

Serious thought must be given to all other WWII heritage, for some of this is in a poor condition. The

most significant areas where these other gun emplacements and WWII remains can be seen are along the walk up Mediterranean Steps, along Douglas Path and the area immediately south of the Cable Car top station. These three areas are the most frequented by visitors, locals and tourists and to say the least, the state in which they can be found is embarrassing (for recommendations see 8).

To begin with, the area to the south of the Cable Car Top Station is steeped in history. The 'Moorish' wall ends here, and there was possibly was some sort of lookout post or tower similar to that on Douglas Path. After this, in the 19th Century a signal tower was built to communicate with shipping, obviously on clear days. Finally, the military installed an anti aircraft gun battery on the site of the top station with ancillary buildings, smaller guns, accommodation and magazine on the adjacent area. All the tourists who venture on the Cable Car to the top of the Rock visit this area. What they find there is appalling. Although the contracted cleaning company cleans the access road, refuse litters the whole place, especially around the nooks and crannies surrounding the buildings and in particular on the east and west side slopes where people have thrown their rubbish. This is noticeable in the summer months when the vegetation dries and exposes the refuse, which unfortunately also coincides with the peak season for tourism. Recently, a chicken coop has been located there and chickens run about in plain sight of the tourists.

Douglas Path starts 30m up O' Hara's Road on the eastern side where Douglas Cave, after which the path is named, is located. The cave was mainly hollowed out and a shed is located there. The Gibraltar Services Police refurbished this path in the late 1990's, after it had fallen into misuse and disrepair. They installed a railing to prevent access to 'spotters' (lookouts for tobacco and drug smugglers), on mopeds who littered the place, but this was soon dismantled and the place reverted back to its shameful state.

Figure 2. Railing dismantled at entrance to Douglas Path.

A few metres into the walk there is a small tunnel where accommodation and supplies were kept for the gun that was located outside. The path continues to wind its way north reaching a most magnificent set of gun emplacements with one facing west and the other east, the last accessed through the Rock. Both provide splendid views of the Bay and the eastern side respectively and on the whole the battery is in good condition with its original paintwork. Unfortunately spotters have frequently used this area and evidence of this can be seen in the accumulations of refuse and graffiti found in this place.

7.6 Water Catchments

As part of our recent heritage we consider it would be a good idea to preserve one of the water catchments in its natural state. This is not new for there was the intention of clearing the catchment area by the ticket office at Jews Gate precisely for that purpose. However, we feel that this catchment was developing a good cover of natural vegetation and moreover is relatively featureless and does not provide the same impact as the one a few metres further down the road. Here, the topography of the catchment, with the large rocky outcrops painted in white, displays better the efforts that were undertaken to provide water, and the adjacent lay-by provides ample parking for the tourists. Of course, ample information in the way of graphic panels would enhance this site and provide yet another example of our heritage to the visitors.

7.7 Recommendations

1) Details of remedial action and a management plan on the caves of Gibraltar are dealt with in Chapter 6.

2) The 'Moorish' wall is obscured from view by the dense vegetation that grows on either side of it. The vegetation could and should be cleared 30m either side of the wall, obviously taking due care and under supervision by supervisors who are knowledgeable in the Upper Rock's botany and habitats, thereby revealing the wall and at the same time providing a necessary firebreak in this densely vegetated part of the Upper Rock Nature Reserve. This will also reveal the small building just above the Charles V Road, with its interesting graffiti and the 'Moorish' archway on the wall by Ince's Farm. This graffiti should be protected by covering the walls in transparent perspex and information plaques should be provided on the 'Moorish' wall where this is

breached by one of the four roads that cut through it. In the same way the 'Moorish tower' on Douglas Path should be provided with an information plaque and be cleaned and restored. Access along the path, which is in a dangerous state, must be improved. Railings need replacing and the steps, many of which are crumbling away, must be repaired. The Moorish castle is at present undergoing restoration works.

3) Charles V Wall, a strong construction that has lasted over four hundred years, needs attention. The stairway running along the length of the wall has deteriorated due to constant use and exposure to the elements. Restoration works should commence using appropriate materials that will blend with the wall. The railings along some sections running up the stairway on the wall are missing and are loose in others. This was reported to the Tourist Board as far back as 2002 (Perez 2002). There is no point in disclaiming responsibility with a sign saying 'This staircase and handrail can be dangerous and unsafe. Use is entirely at your own risk'. The staircase and handrail have been unsafe for well over two years now and continue to be dangerous, yet nothing has been done to remedy this situation. There is a moral and legal obligation for the Tourist Board to maintain the condition of the Nature Reserve in an appropriate manner particularly when visitors are charged for entry, and principally when aspects of health and safety are involved. The railings must be replaced immediately and the steps closed to the public until such works commence.

Figure 3. Disclaimer at the top of Charles V Wall.

4) The firebreak along the north side of the wall is cleared annually of vegetation, revealing the full extent of this majestic wall. However, the southern side has grown very high, obscuring most it. This could also be removed to the same extent as the northern side. In addition, plants that can have a destructive effect on the structure of the wall, i.e., woody shrubs, should be removed from the wall itself. The information on the plaques along the wall should be extended to include more details as has been done on the plaque at the top of the wall.

5) The Upper Galleries remain the most significant heritage construction of the early British period. Thankfully, this site has been developed and maintained as a prime tourist attraction by the Gibraltar Tourist Board. It was refurbished in the 1990's by Sights Management and has since been improved upon. Yet the exterior of the site is in a pitiful state, with most of the concrete structure and viewing point suffering considerable deterioration. Accumulations of refuse can be seen in the summer once the vegetation dries and exposes the same. The ticket office, which lacked an aesthetic appeal, has thankfully been considerably improved. The roadway at the top of this hill was subsiding and has finally being tackled by the Support Services, Highways Section. Unfortunately, the plans for the wall did not progress through the Development and Planning Commission (DPC), where they would have been reviewed by representatives from the Heritage Trust, GONHS and the Heritage and Planning Division. Due to a lack of consultation, a horrendous supporting wall has been built, that does not blend in with the character of the area or any other wall within the Upper Rock. Furthermore, it obstructs the view. It is understood that Government buildings and structures do not require the approval of the DPC. The authors consider that within the Nature Reserve every project should require the consideration of the DPC, including Government structures. Even then, the road still remains closed, since the area of the platform is relatively unsafe and will require extensive repairs. One would have thought that all works would have been carried out at the same time, thereby consolidating the work effort and reducing the disruptive effects to the tourism (see Chapter 20 on Tourist Sites).

Figure 4. The horrendous supporting wall on the approaches to the Upper Galleries.

6) Toilet facilities were non-existent at the northern end of the Rock and this was of particular concern especially for the workers at the ticket office and visitors to this site. This problem has finally been addressed by the Gibraltar Tourist Board.

7) The 'City Under Siege' exhibition on Willis's Road was heavily criticized during the summer of 2002. The displays were unkempt, with some of the models dirty and bleached by the sun, and the place was strewn with refuse. The site was subsequently closed, cleaned and refurbished. Sites on the Upper Rock should not be allowed to reach this state of neglect whereby adverse publicity from visitors and members of the public could result in a decrease of tourists, and a negative response from tour operators declining to visit Gibraltar on this basis.

8) Many of the batteries, gun emplacements, searchlight positions and other associated buildings of the WWII period are now covered with encroaching vegetation. Most of their structure is deteriorating and corroding, with a few in a dangerous state. Only two sites have received any attention, namely O'Hara's Battery and the combined Princess Caroline's and Princess Charlotte's Batteries. O'Hara's Battery, which until the late 1960's was manned by the Royal Gibraltar Regiment, has undergone several refurbishments. On one occasion this was carried out by a private company who planned to develop the site into a tourist attraction. This was then carried out again when the site was in the hands of Sights Management, and recently in 2002 by visiting military personnel, at the request of the Gibraltar Tourist Board, as part of their initiatives to help out with special local projects. This site offers spectacular views from the top of the Rock but is open to the elements and in particular the salt-laden winds and humid levanter cloud which regularly shroud the gun during easterlies. This has the effect of quickly corroding the metal around the gun with subsequent maintenance required periodically. Unfortunately this maintenance does not take place and the gun is deteriorating rapidly. The other two guns at Lord Airey's and Spyglass batteries have received no refurbishment at all and are therefore in a very poor condition, (see Fig. 5). The three heritage bodies, namely the Gibraltar Museum, the Gibraltar Heritage Trust and the Heritage and Planning Division should identify and create an inventory of all WWII heritage and then consider which of these structures merits restoration on the grounds of historical significance, and in particular cases, touristic value. In such cases a site or structure would benefit from sustainable tourism development programmes.

Figure 5. Lord Airey's Battery rusting away.

9) A serious consequence of the lack of wardening is the proliferation of paintings and graffiti that can be seen on most walls and historical heritage around the Rock. During the last refurbishment that took place in 2002, the military overlooked a huge graffiti display painted on the south facing concrete base of the gun. This is still there and can be seen in its full 'splendour' from the southern end of the Rock, especially Europa Point and from any passing cruise ship in the Strait. The management should remove this and other graffiti around the Nature Reserve.

Figure 6. O'Hara's Battery, sporting the largest graffiti that can be seen on the Upper Rock.

10) All that remains of Spur Battery is the gun emplacement and a few derelict buildings. The area affords magnificent views across the Strait and Gibraltar Bay but has been in a state of total abandonment and has suffered from constant vandalism with shocking graffiti, (see Chapter 5). In mid 2002 the Gibraltar Tourist Board enhanced this site and all the graffiti was painted over. In less than six months graffiti once again appeared on the walls at this site. There are at present no plans to develop this fabulous area, which is within easy reach of all tourists visiting the cave. The views from the walls surrounding the battery are spectacular, but access is difficult. The management should build a viewing platform that would better serve visitors until such time as a development plan for the area is formulated.

Figure 7. Spur Battery. New graffiti a few months after the site was painted.

11) Levant Battery is in a similar state, but access to this site is difficult, hence the area has not suffered as much at the hands of vandals. This Battery, located further down than Spur Battery again affords wonderful views of the southern end of the Rock and the Straits and should therefore be developed and improved as one of the viewpoints for persons walking the Mediterranean Steps route.

12) The Princess Caroline's Battery, together with Princess Royal and Princess Anne's Batteries lie at the northern end of the Rock on one of the few level areas which exist in the Nature Reserve. It has therefore frequently been used as a picnic and recreational area by the local population, but has not formed part of a maintenance or management plan, with the resulting consequence of accumulations of refuse, together with vandalism and graffiti. A series of refurbishments to improve the area was attempted by the Gibraltar Tourist Board. This was to little avail, since shortly after the place resumed the ram-shackled state it was previously in. In an attempt to improve this situation the Gibraltar Tourist Board has embarked on a serious refurbishment programme, including the installation of CCTV cameras to curtail the acts of vandalism and graffiti. The site is at present closed to the general public and will be opened in due course once the development and management programme of the Lower Galleries, which will run in conjunction with these batteries, is completed (P. Canessa *pers. comm.*). We encourage this, but are concerned that delays will lead to more degeneration and vandalism, as is already the case.

13) The small area south of the Cable Car Top Station could be quickly refurbished with an anti aircraft gun, supplied with replicas of the paraphernalia of the period together with life-size models depicting the soldiers and equipment of the time. This, together with an interpretation centre detailing the historical heritage and natural history of this area, selling appropriate literature and souvenirs and converting the most southerly point into an observation platform would enhance this area and entice the tourists arriving on the Cable Car into the Nature Reserve.

Figure 8. Engineer road water catchment should have a panel explaining the former role of this structure.

14) The Douglas Path area should be cleaned, and should form part of the pathways management plan.

15) Information panels about the former role of the water catchment area on Engineer Road adjacent to the lay-by should be provided, instead of the incongruous welcome sign that is currently found there.

16) The Board of Management of the Upper Rock Nature Reserve should be ultimately responsible for the repairs, maintenance and cleaning of Historical Heritage in consultation with the Gibraltar Museum and the Heritage and Planning Division, or by the establishment of a committee, which would report back to the Board of Management, composed of persons with interest in the subject and related matters; i.e., Museum, Heritage Trust, Heritage and Planning Division, GONHS, Tourist Board, MOD. The committee should The committee should:

(a) develop a works programme to assess the condition of all historical structures on the Upper Rock Nature Reserve.

(b) with the development programme and management plan, to include reparation and periodic maintenance of all historical heritage, this programme to take into consideration the natural heritage of the area.

(c) to focus on ways of enhancing some of these historic sites and developing the same with tourism and in particular interpretation in mind.

Tower of Homage

References

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8. Introduced Flora

8. Introduced Flora

Of the 363 species of vascular plant that occur within the Upper Rock Nature Reserve in a wild state (Linares 2003), 24 species have been introduced from exotic environments. Many of these species were originally introduced from other parts of the former British Empire. Thus, for example, South African plants (which are native to an environment that is very similar to that of the Mediterranean) stand out. Many of these introduced species pose little or no threat to local flora; they have poor reproductive and dispersal abilities and find it difficult to establish local populations. However, a number of introduced species of plants are to be found on the Upper Rock in a wild state, i.e., with a regularly occurring, self-sustained population. Furthermore, a few of these species pose a very real threat to our local flora.

The 'Nature Conservation Area (Upper Rock Nature Reserve) (Protection and Regulation) Regulations 1993' (L/N 52 of 1993) includes sections dealing with the introduction of faunal and floral species that are not indigenous to the Upper Rock. Section 5.(1)(h) of L/N 52 of 1993 states that it is illegal to 'introduce any animal or plant which is of a kind which is not ordinarily resident or is not a regular visitor to Gibraltar in a wild state or does not grow in the wild in Gibraltar, as the case may be'. Why then are introduced plants to be found within the Upper Rock Nature Reserve?

Firstly, many of these species had established populations within the Nature Reserve boundary prior to the 'Nature Conservation Area (Upper Rock) Designation Order 1993' (L/N 51 of 1993), when the Upper Rock was designated a Nature Reserve. Also, some populations of exotic flora within the Upper Rock have their origins in the gardens belonging to those people who live within the Nature Reserve. Even some of those species that were already established within the Upper Rock prior to its designation as a nature reserve have had their populations augmented by individuals spreading from gardens.

It is interesting to note that, whilst it is illegal to introduce a plant which is not found naturally on the Upper Rock into within the Reserve boundary[1], no legislation has been drafted to ensure that the introduction of exotic plant species to gardens belonging to houses within the Upper Rock is controlled, such as has been done in the case of animals, in section 5.(3) of L/N 52 of 1993. It is considered reasonable by the authors of this report for residents to plant exotics in their gardens, as long as they pose no threat to the local flora. However, more care should be taken with regard to what species are planted in the Gardens within the Nature Reserve, as, at present, there is no control over this whatsoever. Perhaps it would be wise to draft a list of potentially problematic species, and ban the growing of these in gardens within the Nature Reserve.

At present, there is also no legislation concerning the threat that activities in areas peripheral to the Upper Rock could pose to the Nature Reserve. This is rather worrying, given that some, or even most of the species that currently pose, or threaten to pose problems within the Nature Reserve have originated from houses or sites immediately outside the Nature Reserve boundary. This is the case for example with such species as *Lantana camara* and *Senecio angulatus*, as shall be seen further on. In light of this fact, legislation should be provided to ensure that a buffer zone exists around the boundary of the Upper Rock Nature Reserve, where the growing of certain species of garden plants is restricted.

Several introduced species that have become naturalised both within and around the Nature Reserve stand out, either because of their appearance or because they pose a serious threat to local flora (and by implication to local fauna as well) (GONHS 1994), or both. The table on the following page gives a brief account of some of these more prominent and/or problematic species, as well as an assessment of the problems that they may pose. After this, a more detailed account of each problematic species is given, including their identification and their distribution within the Nature Reserve, followed by an identification of 'problem areas' for exotic invasives within the Nature Reserve.

[1] L/N 51 of 1993. Section 5.(1)(h), pp.115.

Table 1. List of the most prominent introduced flora of the Upper Rock Nature Reserve, particularly those invasive species that pose a threat to local flora. A basic assessment of the threat that each species poses is given along with the account.

Species	Account	Threat
Chasmanthe floribunda	Bulbous annual. Grows in some open areas of Upper Rock. Dominates over indigenous species of open ground. Spreads to nearby areas.	P
Carpobrotus acinaciformis x edulis	Creeping succulent. Restricted range within Upper Rock. Poses severe threat to local species where it is widespread.	PP
Ailanthus altissima	Dangerously invasive tree found within PSA gardens. Spreads rapidly.	PP
Senecio angulatus	Creeping invasive that covers local trees and bushes. Large stands within and around Upper Rock. Spreads rapidly and dominates extensively.	VP
Tecoma capensis	A bushy creeper found in PSA and lower Rock gardens. Dominates over and covers local bushes, but does not spread rapidly.	SP
Freesia refracta	Small annual. Widespread within Upper Rock. Threat to local flora probably minimal.	NP
Pelargonium inquinans	Only found at a few sites within Upper Rock. Limited dispersal abilities. Poses minimal threat to local flora.	NP
Opuntia ficus-indica	Large succulent. A few stands exist within Upper Rock. Can form extensive stands that dominate over local flora. Similar O. vulgaris is far less common.	P
Agave americana	Large succulent. Spreads slowly to nearby areas, where can form relatively dense stands. Limited distribution within Upper Rock	SP
Aloe arborescens	Large succulent. Spreads slowly and vegetatively. Forms large stands that dominate over local flora. Localised within Upper Rock.	SP
Oxalis pes-capre	Small annual. Extremely widespread and common on Upper Rock, where naturalised. Almost spread to its full capacity. Initial effect unknown, but excludes native species.	P
Plumbago auriculata	A few bushes on Upper Rock, mainly around Upper Rock gardens and Jews' Gate. Limited dispersal abilities.	NP
Lantana camara	Small to sometimes large bush. Spreading into Upper Rock from peripheral gardens. Seeds spread by birds, giving it strong dispersal ability.	PP

Threat: NP = not problematic
SP = slightly problematic
PP = potentially problematic
P = problematic
VP = very problematic

8.1 Senecio angulatus L.

Figure 1. *Senecio angulatus* in flower.

Description

Commonly known as the Canary Creeper, this climbing perennial has flexible branched and twining hairless stems that can reach heights of over 10 metres on the shrubs and trees where it attaches itself. The leaves are broad and triangular, quite thick and succulent. The flowers, which are out from late November till the end of January, (with a less intense flowering also in June and early July), are 2 cm in diameter, bright yellow and form bunches of up to 12 together in the form of a disc (Cullen *et al.* 2000).

Range

Native to coastal regions of Natal in Southern Africa.

Locally this plant has been a favourite of many gardeners for its ability to cover extensive areas of walls and fencing. It can be found on the East Side of the Rock opposite the entrance to Catalan Bay where the house 'Rockfall' was situated. The plant is also found extensively from the north side of the Casino along the lower Rock all the way to just below Devil's Gap, and around the 'Royal Naval Hospital' at North Gorge.

Within the Upper Rock Nature Reserve this plant has spread from the residential area around Bruce's Farm and now covers an extensive area, which includes the northern part of the old PSA nursery and Upper Bruce's Farm. There is also a small stand above the entrance to St. Michael's Cave.

Threat

Very problematic. The species reproduces vegetatively producing numerous shoots that cover the ground and the surrounding vegetation, reducing the amount of light reaching other plants and thereby restricting and eliminating the competition. This plant is a very aggressive invasive species that has spread from nearby gardens in the Rock Hotel to cover large areas of the Lower

Figure 2. Map showing the distribution of *Senecio angulatus* within the Upper Rock Nature Reserve.

Rock. Here the plant has smothered large olive trees and other shrubs and has spread quickly. Large areas below Devil's Gap Battery have also been colonised with many of the disused chicken runs covered by the vines of the species.

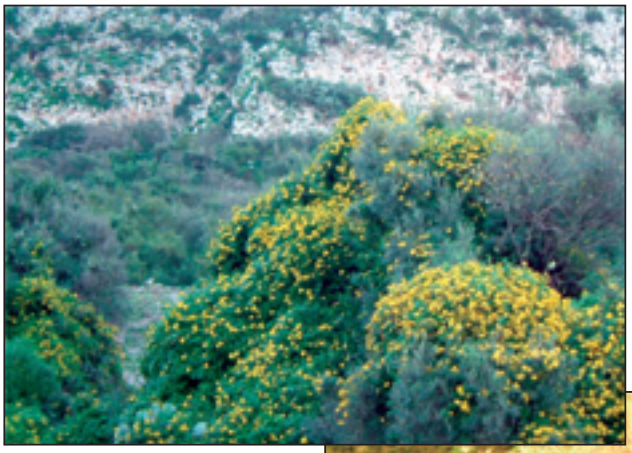

Figure 3. *Senecio angulatus* smothering native wild olives (*Olea europea*) and surrounding shrubs.

Figure 4. *Senecio angulatus* has spread extensively behind the Rock Hotel and Casino area, threatening local flora.

This problem is also apparent on the Upper Rock where again the species has spread from the gardens along Lower Bruce's Farm, across the road to cover a large area of the old PSA nursery and Upper Bruce's Farm. The plant has also recently spread from the entrance to St. Michael's Cave covering just a small area to date.

Figure 5. *Senecio angulatus* has spread extensively within some parts of the Upper Rock.

Senecio angulatus produces large quantities of wind-blown seeds with a pappus of soft, feathery hairs. The seeds germinate readily within gardens, although it is unclear whether they do so in the wild (Cortes & Abrines 1994). However, a large quantity of seeds that were collected from both garden and wild locations during the winter of 2003 were planted at the Alameda Botanic Gardens and none of these germinated, signifying that the spread of this species through seed dispersal is probably minimal at the very most.

Action

This plant needs to be eliminated from all areas in Gibraltar as its invasive characteristic poses a threat to native species on the Rock. The peripheral areas along the Lower Rock pose a threat to the Upper Rock Nature Reserve for the spread of the species has been very rapid and the only barrier preventing the spread at the moment is the line of cliffs forming the perimeter to the Reserve. Volunteers of GONHS are already tackling the area in the old PSA nursery, but the area in question is extensive and will take many years to clear unless the pertinent authorities address the problem and a concerted effort is made to eliminate this and other potentially aggressive species from the Upper Rock Nature Reserve. The Bruce's Farm firebreak should be cleared annually as this would prevent the spread of the species, and the small patch by St. Michael's Cave should be cleared before the situation in this area gets out of hand. Furthermore, the planting of this species in gardens within the Nature Reserve should be prohibited.

8.2 *Chasmanthe floribunda* (Salisbury) Brown

Figure 6. *Chasmanthe floribunda* in flower.

Description

This bulbous, annual plant can grow up to a metre or more. It has long, tapering leaves, about 200mm to 650mm in length and 25mm to 55mm in width. The leaves have a conspicuous false midrib. Flowers are arranged in a spike of 20 to 30 orange-red flowers in two rows (Walters *et al.* 1986). The plant grows well in open areas, where it can form large stands.

Range

Chasmanthe floribunda is native to South Africa.

As with most of the plants in this chapter, *Chasmanthe floribunda* is a popular garden plant locally. Thus, it can be seen growing mainly in areas with gardens. It is common, for example, in some parts of the South District where plants have spread from private gardens, forming small populations.

Chasmanthe floribunda has a widespread distribution within the Upper Rock Nature Reserve. Populations are concentrated around areas where gardens exist, such as Bruce's farm, Ince's Farm and Tovey Cottage, but small stands of this plant can also be found at a distance from these areas. The largest stands occur on the firebreak immediately to the north of St. Michael's cave, where many individuals can be seen.

Figure 7. Map showing the distribution of *Chasmanthe floribunda* within the Upper Rock Nature Reserve.

Threat

Chasmanthe floribunda poses considerable problems within some parts of its local range. This plant spreads well from areas where it has been planted, and so stands can be found outside gardens throughout the Nature Reserve.

Figure 8. *Chasmanthe floribunda* spreads from gardens where it has been planted within and around the Upper Rock Nature Reserve. Here, it can be seen growing outside a garden in the Bruce's Farm residential area.

Judging by its dispersal abilities, *Chasmanthe floribunda* seems to produce fertile seeds that germinate well. Although most of the patches of this species within the Upper Rock are not large, some large, dense patches occur in open areas where this species has been able to spread easily. Nowhere is this more apparent than on the Firebreak to the north of St. Michael's cave, where extensive stands of this plant occur.

Chasmanthe floribunda seems to out-compete indigenous bulbous plants. This is evidenced by the exclusion of native flora, especially bulbous and rhizomatous species, in areas that have been colonised by this invasive species (Cortes & Abrines 1994). Given that this species can cover large areas, as shown by Fig. 9 and 10, the threat that it poses to local flora is very real.

Figure 9. The St. Michael's Cave firebreak holds impressive stands of *Chasmanthe floribunda*. This picture shows the extent of spread that has occurred below the road leading to the cave.

Figure 10. *Chasmanthe floribunda* growing on the firebreak, above the road leading to St. Michael's Cave.

Action

No action is currently being taken to eradicate this species from within the Nature Reserve. Given the threat that the spread of this species poses to local flora, measures should be taken to ensure that feral populations of this species within and around the Nature Reserve boundary are eliminated. This would involve clearing areas where this invasive species grows and uprooting the bulbs to ensure that stands of this plant cannot regenerate. It is also advisable to prohibit or restrict the growing of this plant in private gardens within the Nature Reserve.

8.3 *Lantana camara* L.

Figure 11. *Lantana camara* in flower.

Description

An evergreen shrub, about 1m to 2m, with a rounded appearance, often spreading. Stems are downy, often with small, recurved prickles. Leaves are bristly above and downy or hairless below. They have an oval shape, and are toothed. Flower heads are flattish, and the inflorescence consists of flowers of several colours, mainly white, yellow and pink (Cullen *et al.* 2000).

Range

Lantana camara is native to the West Indies, but it is widely naturalised in the tropics generally (Cullen *et al.* 2000).

In Gibraltar, *Lantana camara* is a popular garden plant. Large numbers can be seen, for example, in the Gardens of the South District. Individuals that have seeded from these gardens can also be found in this area, as they can in other areas where this species is grown.

It is from the gardens of the South District that this species has found its way into within the boundary of the Upper Rock Nature Reserve, in and around the Jews' Gate area, where a growing number of individuals of this species can be found. Large bushes of *Lantana camara* can also be found within the PSA nursery, where they were purposefully planted.

Figure 12. Map showing the distribution of *Lantana camara* within the Upper Rock Nature Reserve.

Figure 13. A large bush of *Lantana camara* growing within the PSA nursery, a site that holds an abundance of introduced flora.

Threat

Lantana camara is a noxious weed in Hawaii and many other areas in the tropics (Cullen *et al.* 2000). The planting of this species in gardens is discouraged in South Africa, due to it's invasive ability (A. Abrines, *pers. comm.*).

In Gibraltar, *Lantana camara* has not caused any problems yet. However, seeds germinate readily (Cortes & Abrines 1994) and the species is spreading at an alarming rate in some parts of the Upper Rock, particularly below Jews' Gate where an increasing number of individuals are encountered. *Lantana camara* has the potential to spread extensively, given that it produces berries that are a favoured food-source of local birds, which probably play a role in seed dispersal. The reason that this species has not spread faster and more extensively is that it is likely that this species does not fare well during the summer drought.

Action

As with most invasive species, no action is currently being taken to control the spread of this species within the Nature Reserve. It is advisable to begin to clear and uproot individuals of the species whilst they have still not spread extensively, as this would both reduce the workload and avoid any adverse effect that *Lantana camara* may have on the local flora if it is allowed to spread.

8.4 *Opuntia ficus-indica* (L.) Miller

Figure 14. *Opuntia ficus-indica*, a cactus native to South America, has become naturalised on the Rock. Here it can be seen with *Senecio angulatus* and the native *Ephedra fragilis* outside a garden within the Upper Rock Nature Reserve.

Description

A fleshy, spiny, branching perennial that forms tree-like growths up to 3-4m in height. Branches consist of several joints or pads that are thick, green, flat and oval shaped. These are about 300-450mm long. This cactus produces fairly large, bright yellow flowers that are visible from June to July. The fruit of this plant is edible (Linares *et al.* 1996).

Range

Opuntia ficus-indica is a native of South America.

In Gibraltar, this species has become fully naturalised (Cortes & Abrines 1994). Most large stands of *Opuntia ficus-indica* are found outside the Upper Rock Nature Reserve, the largest population occurring in the Hole-in-the-wall area above Europa Advance Road. However, this plant is found at a number of locations within the Nature Reserve, primarily around areas with gardens such as Bruce's Farm, Ince's Farm and Devil's Gap. It is especially abundant on the cliffs of the western edge of the Nature Reserve.

Figure 15. Map showing the distribution of *Opuntia ficus-indica* within the Upper Rock Nature Reserve.

Threat

Opuntia ficus-indica is a popular garden plant, and it quickly spreads into surrounding areas. Where it forms large stands, this tough and dominating species quickly excludes local flora. Although its distribution is limited within the Nature Reserve, the several patches that occur seem to be spreading steadily. On the cliffs around the Devil's Gap area, this species is already extremely well established and widespread, as can be seen in Fig. 16.

Figure 16. Large stands of *Opuntia ficus-indica* occur on the cliffs of the western periphery of the Upper Rock Nature Reserve, where this species has become firmly established and poses a threat to local flora.

Opuntia ficus-indica already poses a threat to the indigenous plants of these cliffs. There is also a very real possibility that this species may spread into other areas in the lower reaches of the Nature Reserve, as it already seems to be doing at some sites.

Action

So far, no action has been taken to control the spread of this species within the Nature Reserve. Those stands that grow on the cliffs will no doubt prove very difficult to clear, given the inaccessibility of the sites at which they grow. However, in other more accessible areas where this species grows, a concerted effort to eradicate these populations should be made before this plant spreads more extensively, making its control more difficult.

8.5 *Carpobrotus acinaciformis x edulis*

Figure 17. *Carpobrotus acinaciformis x edulis*, a succulent creeper from South Africa, is found at a number of sites within Gibraltar, and it grows profusely at many of these sites. It was introduced into some of these areas to stabilise sand slopes.

Description

Carpobrotus acinaciformis x edulis is a stabilised hybrid of *Carpobrotus acinaciformis* (L.) Bolus and *Carpobrotus edulis* (L.) N.E. Br. that is unable to reproduce sexually (Ernst J. van Jaarsveld, *pers. comm.*). The plant has long stems of about 1.5m, with short lateral branches. The leaves are curved and green, and are broadest at or above the middle. Flowers are

up to 120mm in diameter, and petals are of a bright purple colour, or rarely yellow or white. *C. acinaciformis* grows with great vigour in sandy soil, and is commonly used to prevent erosion (van der Spuy 1971). This is also true of this hybrid.

Range

Carpobrotus acinaciformis and *C. edulis* are native to the Cape Province, South Africa.

In Gibraltar, this hybrid occurs mainly outside the Upper Rock Nature Reserve boundary. It has been grown primarily as a sand and scree stabiliser on the North Front, east sand slopes, Europa Advance Road, Europa Point and cliffs on the south west of the Rock, but it is also a garden escapee in various locations in the Upper Rock (Cortes & Abrines 1994, who give this plant as *Carpobrotus edulis*).

Figure 18. Map showing the distribution of *Carpobrotus acinaciformis x edulis* within the Upper Rock Nature Reserve.

Threat

At many sites outside the Nature Reserve boundary, *Carpobrotus acinaciformis x edulis* causes substantial problems to local flora. Once it has formed a reasonably sized patch, it quickly replaces and excludes local flora (Cortes & Abrines, 1994). This is evident, for example, on the east side sand slopes, where large stands of this plant occur. This can also be seen at Windmill Hill flats, where the only indigenous plant that grows through the dense mats that it forms is *Ephedra fragilis*. In fact, in an area of the Windmill Hill flats where a large stand of *Carpobrotus acinaciformis x edulis* was recently cleared, a large diversity of local flora can now be seen growing (*pers. obs.*).

Figure 19. *Carpobrotus acinaciformis x edulis* poses a severe threat to indigenous flora where it forms large stands. Here, it can be seen growing on slopes on the east side where it has been planted to stabilise scree and sand, and where much displacement of local flora has occurred.

Within the Nature Reserve, only two small patches of this species exist, and they do not signify a threat to indigenous flora at present. The patch at Princess Caroline's Battery is restricted by concrete surroundings and cannot spread any further, but the patch at Governor's Cottage could eventually cause problems if not tackled.

Figure 20. *Carpobrotus acinaciformis x edulis* within the Upper Rock Nature Reserve, at Princess Caroline's Battery.

Carpobrotus acinaciformis x edulis does not set seed, and so propagation is local by means of runners (Cortes & Abrines 1994).

Action

At present, *Carpobrotus acinaciformis x edulis* is only being removed by the MOD in the Windmill Hill flats area. Within the Upper Rock Nature Reserve, no action is being taken to control this problematic species. As previously mentioned *Carpobrotus acinaciformis x edulis* can only spread by means of runners. This is significant in that it cannot spread beyond the patch or mat that it forms. This, combined with the small amount of this plant growing within the Nature Reserve means that control is relatively easy.

Note

The identity of the species of *Carpobrotus* that grows on Gibraltar has long been subject to debate. Although initially identified as *C. acinaciformis* by Linares (L. Linares, *pers. comm.*), the species found on the Rock was later re-identified as *C. edulis* (*see*, e.g., Linares *et al.* 1996). The authors of this report found that most of the characters exhibited by the *Carpobrotus* spp. of Gibraltar correspond to those of *C. acinaciformis* according to Walters *et al.* (1989) and van der Spuy (1971), with only a few features being more similar to descriptions of *C. edulis*. However, Akeroyd (1994) argues that plants found in Gibraltar belong to *Carpobrotus edulis* L. *var. rubescens* Druce (a purple flowered variety), and that these are often mistaken for *C. acinaciformis*, which Akeroyd had never recorded in the Mediterranean (Akeroyd & Preston 1990). In fact, the identity of this plant has now been established. Ernst J. van Jaarsveld of the National Botanic Garden at Kirstenbosch in Cape Town, South Africa recognised this plant as a stabilised hybrid of these species, and commented that this plant is very vigorous and often causes problems as a weed.

8.6 *Oxalis pes-caprae* L.

Figure 21. *Oxalis pes-caprae* in flower.

Description

This plant is a bulbous, stemless perennial of about 200-400mm. The bulb has a vertical stem that rises to the soil surface, and this bears numerous stalkless bulbils. Leaves are numerous and consist of 3 heart-shaped leaflets. These are bright green, often with dark purple spots. Flowers consist of five petals, and are a deep golden-yellow colour (Cullen *et al.* 1997) although some are double-flowered.

The species only reproduces by bulbils in Europe, as only the short-styled variant was introduced to this region, and therefore fertile seed does not set (Cullen *et al.* 1997).

Range

Oxalis pes-caprae is a native of the Cape Province of South Africa.

In Gibraltar, this species is widespread and abundant, growing mainly in open ground (Linares *et al.* 1996). *Oxalis pes-caprae* is found growing throughout the Upper Rock Nature Reserve, and so a map showing its distribution has not been produced. However, its distribution is patchy, with some areas, such as for example the Rock Gun area having a far lower density of the species than other areas. The areas that are most affected seem to be roadsides and cliffs. On non-cliff habitats, *Oxalis pes-caprae* seems to do best in areas that have recently been disturbed by humans. Thus, the recent intensive clearing of roadsides seems to have caused a proliferation of this species in some areas.

This species seems to do particularly well in areas with little soil. Thus, it is often the first plant to be seen growing on cliffs and in areas of rocky debris, such as tunnelling deposits.

Figure 22. *Oxalis pes-caprae* grows well on walls.

Threat

Being a South African plant, *Oxalis pes-caprae* flowers between December and May (Linares et al. 1996). This means that when most local plants begin to flower, this species is already receding. However, this is not exclusively the case. Many local species of open areas flower before this period and competition between these species and *Oxalis pes-caprae* is inevitable. Furthermore, although *Oxalis pes-caprae* recedes in the spring, their bulbils remain in the soil, and it seems that many indigenous bulbous species, such as for example orchids may be excluded from areas where a high density of bulbils are present (Linares 1994).

The problems caused by *Oxalis pes-caprae* within the Nature Reserve are aggravated by the new way in which roadsides are being cleared. When roadsides are cleared vigorously, to the extent that even the soil in between rocky crevices is swept away (*pers. obs.*), *Oxalis pes-caprae* is the first plant to re-colonise the area, to the exclusion of native flora possibly from the odd bulbils that are left behind. Furthermore, the raking and stripping of roadside vegetation assists the distribution of bulbils into nearby areas.

Figure 23. *Oxalis pes-caprae* is particularly successful in areas that have been disturbed by humans, such as recently cleared roadsides, to the exclusion of indigenous flora.

Action

Currently, no action is being taken to control populations of *Oxalis pes-caprae* within the Upper Rock. The extent of its distribution within the Upper Rock Nature Reserve means that populations of *Oxalis pes-caprae* cannot be eradicated or perhaps even reduced. However, a serious effort should be made to try to limit its spread. This would primarily involve a change in the way that roadsides are cleared. Local flora should not be pruned and trimmed as vigorously as it currently is, and soil should certainly not be swept away from these areas. The measures adopted to limit the spread of *Oxalis pes-caprae* require no extra costs, but rather a change in roadside clearing practice.

8.7 *Ailanthus altissima* (Miller) Swingle

Figure 24. *Ailanthus altissima* is a tall tree that is native to China.

Description

Ailanthus altissima is a narrow deciduous tree that can reach up to 20-30m in height. It has yellow-grey, deeply fissured bark. Leaves are about 450-600mm in length, and carry from 11 to 25 leaflets. The leaflets are lanceolate in shape and have two or three coarse teeth near the base. Flowers are white, and have small petals (Cullen *et al.* 1997).

Range

Ailanthus altissima is native to China.

In Gibraltar, this species is fully naturalised, having spread from gardens by means of suckers and seeds. It is particularly noticeable in and around the gardens of the South District, but is also found in other areas, such as the sand slopes on the east side of the Rock (Cortes & Abrines 1994).

Within the Upper Rock Nature Reserve, *Ailanthus altissima* occurs in the PSA nursery, where the species is spreading mainly by means of suckers. This species also occurs in a part of the Mount garden that lies just outside of the Nature Reserve, and could easily spread into the southern lower Rock from here.

Figure 25. Map showing the distribution of *Ailanthus altissima* within the Upper Rock Nature Reserve.

Threat

Ailanthus altissima spreads quickly by means of suckers and seeds, and is an aggressive coloniser. Where it does spread, it excludes native trees, such as can be seen in the Mount Garden (Cortes & Abrines 1994). In the PSA garden, this species is spreading quickly, and could conceivably become the dominant tree in many parts of that garden. Furthermore, the danger of this species spreading to different areas of the Upper Rock is a very real one, particularly at sites with a considerable soil depth. Areas immediately surrounding the PSA nursery for example are particularly vulnerable.

Figure 26. *Ailanthus altissima* spreads by means of suckers and seeds. Here, suckers can be seen growing in the PSA nursery.

Action

At the moment, no action is being taken to control the population of *Ailanthus altissima*, although a group of GONHS volunteers are discussing the possibility of tackling the problem. However, effective eradication of this species is difficult without the necessary resources to tackle the problem effectively. This species needs to be dug up in order to be eradicated effectively. There has been some success in reducing the problem in the Botanic Gardens at the Alameda. Mature trees have been cut and the stumps killed by treating with SBK. This has been followed by regular strimming any seedlings or new growth from surviving suckers and/or spraying these with glyphosphate. In any event, considerable man-power is needed if an effective eradication campaign is to be successful at both the PSA nursery and the Mount.

8.8 *Tecoma capensis* (Thunberg) Lindley

Figure 27. *Tecoma capensis* in flower.

Description

Tecoma capensis is a shrub or woody-based herb, sometimes climbing. Leaves consist of 7-11 leaflets arranged opposite to each other. Leaflets are elliptic or almost circular. The inflorescence consists of a raceme or raceme-like panicle. Corolla are 35-50mm, 6-7mm wide at mouth, tubular, slightly curved, orange-red and mostly hairless. Lobes have marginal hairs. Fruit are 70-110mm x 7-12mm and slightly wrinkled (Cullen *et al.* 2000).

Figure 28. Map showing the distribution of *Tecoma capensis* within the Upper Rock Nature Reserve.

Range

Tecoma capensis is native to South Africa and southern Mozambique.

In Gibraltar, *Tecoma capensis* can be found growing in many gardens, particularly in the south district. Here, individuals sometimes propagate into areas immediately outside of gardens by means of runners (Cortes & Abrines 1994, where this species is given as *Tecoma capensis*). Within the Nature Reserve, *Tecoma capensis* grows mainly within and around gardens, such as in the Bruce's farm area, St. Michael's cabin and the Ince's Farm area. A stand also grows in the area below Jews' Gate, originating from adjacent gardens.

Threat

Seed setting in Gibraltar of *Tecoma capensis* is limited, and there is no evidence of successful germination in the wild (Cortes & Abrines 1994). Furthermore, propagation by means of runners only ever results in the extension of stands, and so there is no evidence of true naturalisation of this species in Gibraltar (Cortes & Abrines 1994). This species does not, therefore, pose a large threat to local flora. However, where stands do occur, they can quickly smother and cover native vegetation. This has occurred to a large extent, for example, at the PSA nursery (Wheeler, R., *pers. comm.*). Clearing of stands of *Tecoma capensis* that occur outside of gardens is therefore important.

Figure 29. A stand of *Tecoma capensis* growing within the Upper Rock Nature Reserve. Stands such as these often smother indigenous flora.

Action

Some stands of this species growing at the PSA nursery have been cleared by GONHS volunteers. Manpower is required to ensure that stands that occur outside gardens are cut back and eliminated. Garden owners should be responsible for ensuring that stands of this plant, or any other exotic, do not spread beyond the garden boundary.

8.9 *Aloe arborescens* Miller

Figure 30. *Aloe arborescens* in flower.

Description

Aloe arborescens is a succulent with stems of 2-3m, each bearing a rosette of leaves. Leaves are numerous on each rosette, widely spreading and curved downwards towards their apices. Leaves are 500-600 x 50-70mm, lanceolate, dull green and with pale, firm teeth on the margins. The inflorescence is usually simple, with flower stalks of 35-40mm and bracts of 15-20mm. The perianth of about 40mm is cylindrical, slightly constricted above the ovary and orange-red (Walters *et al.* 1986).

Range

Aloe arborescens is native to parts of southern Africa, from South Africa north to Malawi.

In Gibraltar, large stands of this species grow where they have been planted, such as in gardens, along Europa Advance Road and the east side. A few stands of *Aloe arborescens* occur within the Upper Rock. For example, there are several stands around Mediterranean Road, where the largest population occurs, and also around Bruce's and Ince's farms. The full range of *Aloe arborescens* within the Upper Rock can be seen on the map in Fig. 31.

Figure 31. Map showing the distribution of *Aloe arborescens* within the Upper Rock Nature Reserve.

Threat

In Gibraltar, *Aloe arborescens* does not set seed and does not spread to new sites by natural means (Cortes & Abrines 1994). Furthermore, most stands of this plant that are found within the Upper Rock Nature Reserve are small. This species does not, therefore pose a significant threat to local flora. However, in the areas where it does occur in large numbers, *Aloe arborescens* forms very dense stands that exclude native flora.

Action

Since this species does not cause problems within the Upper Rock Nature Reserve, no real action needs to be taken against it. However, vigilance is necessary to ensure that stands of this plant do not increase in size dramatically. *Aloe arborescens* incurs no costs, as control of this species within the Nature Reserve is not necessary at this stage.

8.10 *Agave americana* L.

Figure 32. *Agave americana* in flower.

Description

Succulent with a large, trunkless rosette of 2-3m in diameter with 20-60 leaves. Produces suckers. Leaves of about 1-2m x 150-300mm, narrowed towards base, rigidly spreading or reflexed towards the apex. Leaves are smooth and leathery, with toothed margins. Marginal spines are about 8mm in length, curved and blackish brown, later turning to grey. Terminal spine of leaf 30-50mm. Floral spike or panicle of 5-8m, slender with 25-30 branches. Pale yellow flowers of 70-100mm (Walters *et al.* 1986).

Range

Agave americana is native to Mexico, but is widely naturalised elsewhere, including the Mediterranean.

This species has become naturalised in Gibraltar, and is a feature of open areas such as the east side and Europa Foreshore (Cortes & Abrines 1994). Within the Nature Reserve, *Agave americana* grows mainly below the Queen's lookout, with some scattered individuals

elsewhere, and so a map of its distribution has not been produced. The stand that grows at this site seems to be spreading slowly.

Figure 33. *Agave americana* growing within the Upper Rock Nature Reserve, below the Queen's lookout.

Threat

In Gibraltar, *Agave americana* reproduces by means of plantlets developing on flower spikes (Cortes & Abrines 1994) and also seems to produce suckers. Although the possibility that this species might exclude indigenous flora where it grows is a very real one, only very small numbers occur within the Nature Reserve, and the impact on local flora is therefore minimal.

Action

Since *Agave americana* does not cause significant problems at present, little action is necessary against this species within the Nature Reserve. The small stands that currently exist should be eliminated.

Cost

At present, *Agave americana* incurs no costs.

In addition to the plants described above, other introduced species also occur. However, these are not as problematic as those listed above. Examples include *Dracaena draco, Pelargonium inquinans, Freesia refracta* and *Plumabago auriculata*. There are also several species of exotic invasive that cause problems in other parts of Gibraltar but are not found (or are very rare) within the Upper Rock Nature Reserve. Two of these in particular stand out, as they are both found immediately outside the boundary of the Nature Reserve. The first of the these the Australian tree *Acacia cyanophylla*, which, together with *Acacia retinoides* has caused considerable trouble on the east side sand slopes, where large stands of these *Acacia* occur. *Acacia cyanophylla* can also be found growing elsewhere in Gibraltar, including along the upper reaches of Windmill Hill, from where this species could easily spread into the Jews' Gate area of the Upper Rock Nature Reserve. Two individuals of this species are also found in the PSA nursery, from where it could also spread into neighbouring areas.

The second invasive species that could pose problems in the future is the East African grass *Pennisetum clandestinum*, also known as 'Kikuyu grass'. This is an aggressive species that forms dense mats, smothering and excluding indigenous flora. It also releases allelopathic chemicals that kill most plants. This can be seen for example on Windmill Hill Flats, where a huge mat has formed at the northern end of the flats, excluding practically all local flora. Another large stand of *Pennisetum clandestinum* occurs along the lower reaches

of Engineer Road, where again all indigenous flora is being smothered. This stand of *Pennisetum clandestinum* poses an immediate threat to the flora of the Upper Rock Nature Reserve, given that it presently grows at only about 100m from the southern entrance of the Nature Reserve, and is rapidly spreading.

Although not found within the Nature Reserve yet, individuals or populations of potentially invasive species such as *Pennisetum clandestinum* and *Acacia cyanophylla* that lie within close proximity of the Upper Rock Nature Reserve should be tackled and eradicated as part of an Upper Rock management plan. This would ensure that invasion of the Nature Reserve by these exotic species does not occur.

8.11 Problem Areas

Although some of the exotic, invasive plant species found on the Upper Rock have quite a widespread range within the Nature Reserve, it is evident from the distribution maps that most are concentrated in similar areas, and that some sites within the Nature Reserve can be identified as 'problem areas'. These can be seen on the map of the Upper Rock in Fig. 34.

Figure 34. Map showing the distribution of all invasives on the Upper Rock. Some of the more prominent non-invasive exotics have been included as well.

As can be seen on the map, there are four main 'problem areas' for exotic plants within the Upper Rock. These are the Bruce's farm area, the Ince's farm area, the Jews' Gate and Mount area, and the St. Michael's cave area. These sites are all discussed next.

8.11.2 Bruce's farm

Figure 35. Map showing the density of exotic invasives growing in the Bruce's Farm area, which is contained in the black box.

This area, which includes a number of houses with gardens as well as the PSA nursery, is the area that is most badly affected by exotic invasives in the Upper Rock. *Chasmanthe floribunda*, *Aloe arborescens, Lantana camara, Oxalis pes-caprae, Ailanthus altissima, Senecio angulatus, Tecoma capensis* and *Opuntia ficus-indica* all occur within the Bruce's Farm area. Additionally, *Freesia refracta, Pelargonium inquinans* and *Plumbago auriculata* also occur. It is clear that the problem that this area faces with regard to exotic invasive flora comes as a result of these species having been grown within gardens in the residential area and in the PSA nursery.

8.11.3 Ince's Farm

Figure 36. Map showing the density of exotic invasives in the Ince's Farm area, which is surrounded by the black box.

Ince's Farm has almost as high a density of exotic invasives as the Bruce's Farm area, with *Chasmanthe floribunda, Aloe arborescens, Lantana camara, Oxalis pes-caprae, Senecio angulatus, Tecoma capensis* and *Opuntia ficus-indica* all occurring. These occur around the fringes of the gardens, and many of these species have now established populations around these gardens. Particularly noticeable are the stands of *Senecio angulatus* and *Opuntia ficus-indica* that occur on the opposite side of the road to Ince's Farm and further down towards Devil's Gap. In fact, the largest population of *Opuntia ficus-indica* occurs in this area; the cliffs below harbour large stands of this species.

8.11.4 Jew's Gate & The Mount

Figure 37. Map showing the density of exotic invasives in the Jews' Gate and Mount area, which is surrounded by the black box.

The exotic invasives that occur in this area are *Chasmanthe floribunda, Aloe arborescens, Carpobrotus acinaciformis x edulis, Lantana camara* and *Oxalis pes-caprae*. *Aloe arboresecens* and *Carpobrotus acinaciformis x edulis* occur below the Governor's Cottage, having probably been planted there to stabilise the scree slope. *Chasmanthe floribunda* and *Lantana camara* have spread into the area from the gardens of the Mount and from the garden at the Jews' Gate Field Centre, where a stand has been established for more than twelve years. *Plumbago auriculata* and *Freesia refracta* also occur at this site.

8.11.5 St. Michael's Cave area

Figure 38. Map showing the density of exotic invasives growing in the St. Michael's Cave area, which is surrounded by the black box.

The St. Michael's Cave area, which includes the adjacent firebreak, harbours an array of exotic invasives. The largest stands of *Chasmanthe floribunda* found within the Nature Reserve (or in Gibraltar, for that matter) grow on this firebreak. These have spread to the extent that large parts of the firebreak are now dominated by this species, to the exclusion of local flora. *Senecio angulatus* and *Tecoma capensis* were planted in the small garden behind the cabin, and stands of this species have grown larger and are beginning to spread into adjacent areas. The exotic *Freesia refracta* also occurs.

8.12 Proposed list of exotic plant species that should not be grown in gardens within the Nature Reserve

As can be seen, the areas within the Upper Rock Nature Reserve that have the gravest problem with exotic invasives all include gardens within them, from which these plants spread. It therefore seems logical that the most effective way to control the further spread of exotic invasives within the Upper Rock would be to ban the growing of certain problematic species, particularly those with a high potential for seed dispersal (such as bird or wind dispersed seeds). The authors of this report advise that legislation be put in place to prohibit the growing or keeping of the following exotic plant species in gardens and homes within the Nature Reserve (and within a buffer zone surrounding the Nature Reserve), as these species pose a substantial threat to local flora when feral populations are established:

Pennisetum clandestinum Chiov. ex. Hochst.
Senecio angulatus de Candolle
Chasmanthe floribunda (Salisbury) Brown
Ailanthus altissima (Miller) Swingle
Carpobrotus acinaciformis (L.) Bolus
Carpobrotus acinaciformis x edulis
Carpobrotus edulis (L.) N.E. Br.
Opuntia ficus-indica (L.) Miller
Lantana camara L.

In addition, the management of the Nature Reserve, in conjunction with the Town Planner, should give serious consideration to the implementation of a policy of not allowing garden types or garden plants that are out of character with the rest of the Nature Reserve, particularly when these gardens are visible to those who visit the Upper Rock. It is the authors' opinion, for example, that a garden consisting solely of succulents, attractive as it may look in itself, does very little for the overall aesthetic appeal of the Nature Reserve. Those who enter the Upper Rock are after all visiting a Mediterranean nature reserve and not one in the Sonora or Somali deserts. However, it is recognised that defining a policy regarding the definition of a garden that is deemed to be 'in character' with the Nature Reserve may be problematic, but a discretionary policy (perhaps enforced by the Town Planner) may be a good idea, providing that it is carried out fairly, of course.

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9. Pine Trees

9. Pine Trees

An edited version of this chapter was submitted to the 'Almoraima', the Journal of the Instituto de Estudios Campo-gibraltareños where it appears as Bensusan & Perez (2004).

9.1 Introduction

Two species of pine tree occur on the Upper Rock, both introduced to Gibraltar but probably native to nearby Spain. These are *Pinus pinea* L. (stone pine) and *Pinus halepensis* Miller (Aleppo pine). *P. pinea* is a tall tree that reaches up to 30m in height. It usually has a straight trunk, with an umbrella-shaped canopy, and can most easily be told from P. halepensis by its reddish bark with large scales and its rounded cones. *P. halepensis* is generally a smaller tree, reaching about 20m in height, has elongated cones, lacks the large scales of *P. pinea* on it's bark and often has twisted branches and trunk (Linares *et al.* 1996). *P. pinea* is a native of light sandy soils in and around the Mediterranean, such as coastal areas, and is the most common pine in the Campo de Gibraltar, where several woods of this species occur. *P. halepensis* is also native to the Mediterranean and is particularly drought resistant (Humpries *et al.* 1981). Photographs showing key features in the identification of both species are shown in Fig. 1 & 2.

Figure 1. *Pinus halepensis.* The photograph on the left shows the structure of a typical individual of this species, whilst that on the right illustrates its elongated cones.

Figure 2. *Pinus pinea*. A tree belonging to this species can be seen on the left. Its umbrella-shaped canopy is a diagnostic feature. The photograph on the right shows this species' rounded cones, a feature that distinguishes it from *P. halepensis* (Photo by L. Linares/GONHS).

Pine trees were originally planted on the Upper Rock by the garrison, and as such, pines are found mainly on roadsides and pathways. We therefore attempted to investigate the age of the trees by searching through Gibraltar Directories, from the 1880s to the 1930s. Although the exact dates when these trees were planted could not be found, Wolley-Dod (1914) mentions that '…in recent years a considerable number of pines and other trees have been planted on the western slopes.' Growth rings were counted on a number of individuals that had been sawed down once dead, and this did indeed show that most pines on the Upper Rock are between 80 and 100 years old. Those whose rings were counted ranged between 84 and 98 years old. Therefore, most pines were probably planted on the Upper Rock some time between the 1900s and the 1920s.

A severe drought occurred in the 1990's, from 1993 to 1996. Table 1 shows total annual rainfall data for Gibraltar from 1988 to 2002.

Table 1. Total annual rainfall in mm for Gibraltar from 1988 to 2002. Total rainfall for each month is also given (data provided by the Gibraltar Met Office).

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
January	70	191	136	61	18	71	55	28	482	212	75	70	111	107	24
February	54	101	0	95	111	102	83	36	57	0	160	40	0	48	112
March	26	22	90	118	42	204	2	21	130	4	54	77	20	1	94
April	23	50	132	64	49	100	58	28	123	24	22	33	145	79	67
May	19	42	10	3	3	58	23	10	80	39	27	10	43	21	22
June	15	1	2	4	147	1	2	27	5	5	4	0	0	1	13
July	8	0	0	0	1	0	1	1	0	2	0	1	0	0	0
August	0	0	0	3	0	5	0	0	1	1	0	0	0	0	0
September	13	15	5	56	15	22	18	9	25	30	30	27	9	39	22
October	102	102	76	195	142	158	49	1	58	70	1	149	86	72	204
November	263	369	55	66	11	143	62	97	161	230	2	43	90	55	260
December	0	556	292	145	112	7	4	357	652	182	64	35	287	306	133
Total	594	1448	799	810	650	869	358	613	1774	799	440	485	791	730	952

As can be seen, rainfall from the end of 1993 to the end of 1995 was extremely low. This is illustrated on the graph in Fig. 2.

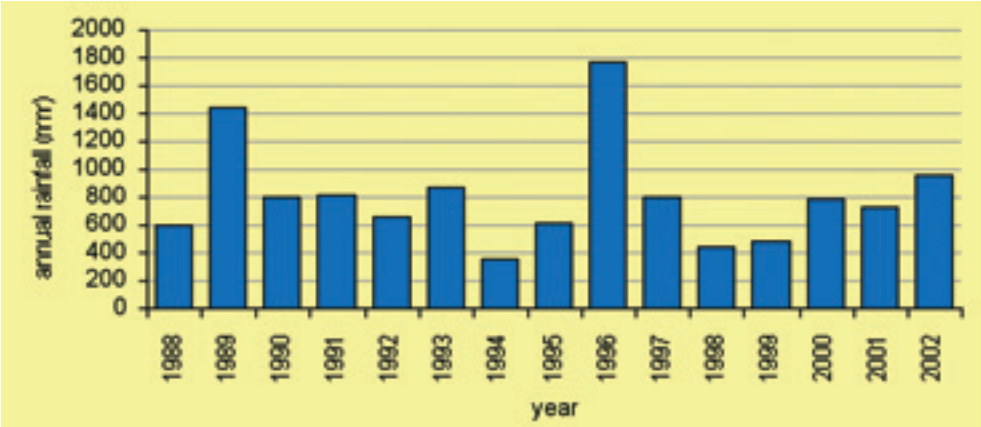


Figure 2. Annual rainfall in Gibraltar, from 1988 to 2002.

During the drought period, the pine tree population of the Upper Rock seems to have suffered dramatically from a lack of water, to the extent that a large number of trees died. As can be seen, 1994 was an exceptionally dry year. There was also a two year period of exceptionally low rainfall during 1998 and 1999, but this seems to have had less of an impact on the pine population of the Upper Rock, given that most of the trees that are found dead today were already dead or dying by then due to the earlier drought (*pers. obs.*). 1995 does not seem, from the bar chart, to have been as dry a year as would be expected during a drought. However, an inspection of the data in table 1 will show that most of the rain recorded during 1995 fell in December, and that month for month 1995 was an even dryer year than 1994. In fact, the data on table 1 shows that the drought began during December 1993 and ended at December 1995, lasting exactly two years. Therefore, in order to show the two-year drought more effectively in Fig. 3, we have changed December 1995's rainfall data for that of 1993, and vice-versa.

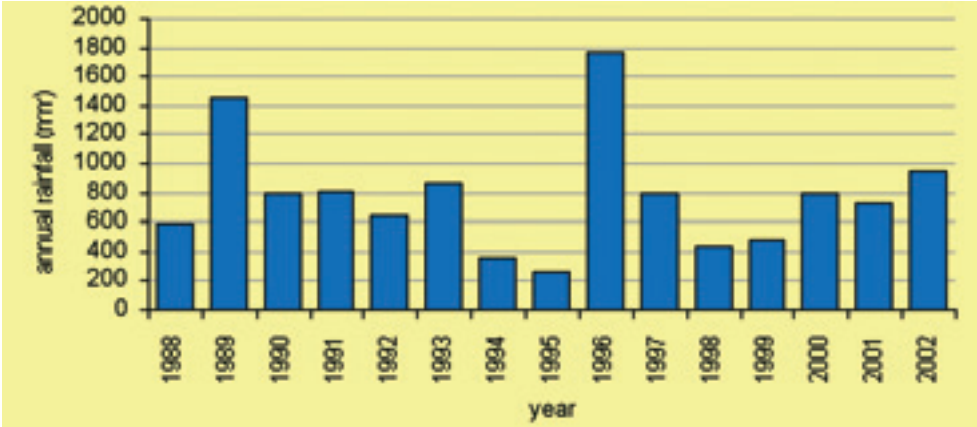


Figure 3. Annual rainfall in Gibraltar, from 1988 to 2002. The December rainfall data of 1993 and 1995 have been switched to show the two-year drought period more effectively.

It is evident, when the drought period is correlated to the period during which many trees died that these pines probably did not survive due to the 1993-1996 drought. In discussing this, we considered that the drought may have affected our two pine species differently, and that rates of mortality may differ spatially. With this in mind, we decided to investigate pine tree mortality and distribution on the Upper Rock.

9.2 Methods

Since pine trees are distributed mainly along roadsides and pathways and are clearly visible from a distance, trees were observed and counted by walking along the roads and paths of the Upper Rock, and individual pine trees were recorded on maps. Trees were given a score according to the state or 'health' of their canopy by recording an approximate percentage of foliage cover. The scores given are as follows; 0 = dead, 1 = <15% foliage cover of canopy, 2 = 16 – 30% foliage cover, 3 = 31 – 50% foliage cover, 4 = 51 – 69% foliage cover and 5 = 70%+ foliage cover. Once data were collected, several analyses were carried out. These are listed below:

• Maps were produced to show the distribution of both all of the pine trees counted, and live trees alone.

• Proportions of live and dead pine trees were investigated as percentages.

• Since two species of pine tree are found within the Upper Rock, a chi-square test for differences was used to investigate whether there is a significant statistical difference in the number of individuals that remain alive of each species. Due to our small sample size (with 1 *d.f.*), Yates's correction was applied to the chi-square test.

• The Upper Rock Nature Reserve was divided into eleven separate areas for the purposes of this study, and pine tree mortality was investigated within each individual site. Three types of analysis were carried out; between-species differences in survivorship, differences in the survivorship of pine trees in the area compared to the Upper Rock as a whole and differences in the survivorship of each species compared to the Upper Rock as a whole. Chi-square tests for differences were again used in these analyses. Many of our chi-square tests gave a probability *(p)* value of >0.05. It is customary in such a situation, where more than one test has been carried out, to alter *p* values according to the number of tests used, as the probability of arriving at a figure at random increases with every test. This would render some of our x^2 values insignificant. However, since sample sizes were very small in most cases, it was decided to consider any x^2 value with a p value of <0.05 significant for the purposes of our analysis.

• Using the 1-5 fitness scores given to live pine trees, the 'fitness' of those pine trees remaining alive was investigated by calculating the number of individuals that fall into each score as a percentage of the total number of live pine trees left within the Nature Reserve.

• Using the number of individuals recorded in each 'fitness' category, chi-square tests for differences were used to ascertain whether there is, a) a difference between fitness levels recorded for each species and, b) whether this difference remains once dead individuals are eliminated from the analysis.

• In order to illustrate the changing nature of the western slope of the Upper Rock from north to south, and relate this to spatial differences in tree mortality, six west-east intersections of the Rock of Gibraltar were produced and the angle of the slope measured at each one.

9.3 Results

The results obtained from the analyses described above are given next.

9.3.1 How many pine trees remain alive within the Upper Rock Nature Reserve?

A total of 307 trees of both species were counted within the Upper Rock Nature Reserve, 108 *P. halepensis* and 199 *P. pinea*. Of these, 113 individuals were alive whilst 194 were dead. This means that 63.2% of pine trees found within the Nature Reserve are dead, with only 36.8% alive. This is best illustrated in Fig. 4, which shows a map of all pine trees found on the Upper Rock (including dead individuals) and another map showing the distribution of live pine trees only on the Upper Rock.

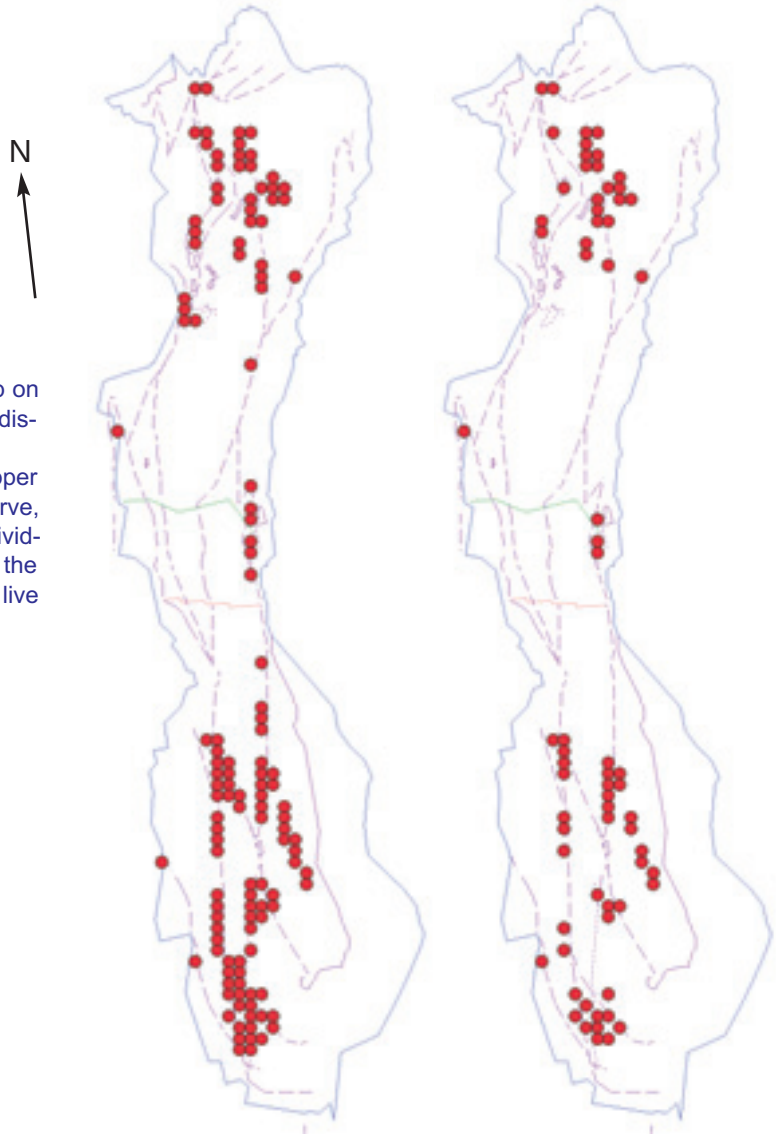


Figure 4. The map on the left shows the distribution of all pine trees within the Upper Rock Nature Reserve, including dead individuals. The map on the right includes only live pine trees.

Figure 5. Many of the pine trees found on the Upper Rock died during the drought of 1994-1996. Shown are some dead stone pines *Pinus pinea*, along Mediterranean Road.

9.3.2 Differences between the survivorship of *Pinus pinea* L. and *Pinus halepensis* Miller

The proportions of dead and live trees differ from species to species. Of the 108 *P. halepensis* counted, 59 were alive and 49 were dead, i.e., 54.6% are alive whilst 45.4% are dead. This contrasts sharply with *P. pinea*. Of the 199 individuals of this species counted, 54 were alive and 145 were dead, i.e., 27.1% are alive whilst 72.9% are dead. There is a marked difference in the probability of survival of both species, with *P. halepensis* having a significantly higher survivorship (x^2 = 21.58, *d.f.* = 1, p = <0.001).

9.3.3 Does pine tree mortality differ spatially?

Different areas of the Upper Rock showed differences in the proportion of pine trees dying, and indeed in the proportion of each species dying. The Upper Rock was divided into 11 separate areas for the purposes of this study. Table 2 shows all of our results.

Table 2. Number of *Pinus halepensis* and *Pinus pinea* found within the Upper Rock. Results have been divided up into 11 separate areas, and we have also recorded whether the trees are alive or dead.

Site	Pinus halepensis		Pinus pinea		Total		
	Live	Dead	Live	Dead	Live	Dead	Total
Martin's Path	6	7	0	15	6	22	28
Mediterranean Road	3	1	1	22	4	23	27
Queen's Road	9	2	8	41	17	43	60
Cave Branch Road	9	20	0	0	9	20	29
O' Hara's Road	5	4	7	12	12	16	28
St. Michael's Rd (Lower)	6	9	2	8	8	17	25
St. Michael's Rd (Upper)	0	3	0	10	0	13	13
Spur Battery Road	2	0	1	10	3	10	13
Signal Station Road	5	0	29	17	34	17	51
Cable Car Area	0	0	2	4	2	4	6
Governor's Lookout	14	3	4	6	18	9	27
Total	59	49	54	145	113	194	307

P. halepensis showed a higher survivorship than *P. pinea* in most cases, and at no site did *P. pinea* show a significantly higher rate of survival than *P. halepensis*. Our findings on each area are given below:

• Martin's Path – Pine trees in this area showed no significant difference to the overall proportion of trees found alive (x^2 = 2.02, *d.f.* = 1, p- = >0.05). Survivorship of *P. pinea* is significantly lower than average along Martin's Path (x^2 = 4.10, *d.f.* = 1, p- = <0.05).

• Mediterranean Road – With only 4.3% of *Pinus pinea* surviving, the survivorship of this species is significantly lower along this road than within the Upper Rock as a whole (x^2 = 4.59, *d.f.* = 1, p- = <0.05). At 14.8%, a significantly lower proportion of both species of pine tree have survived along Mediterranean road than in the whole of the Upper Rock (x^2 = 4.35, *d.f.* = 1, p- = <0.05).

• Queen's Road – Survivorship of both species combined along Queen's road does not differ significantly from that of the Upper Rock as a whole (x^2 = 1.23, *d.f.* = 1, p- = >0.05).

• Cave Branch Road – Only individuals of *Pinus halepensis* were found along this road, a lower proportion of which remain alive (at 31%) when compared to the whole of the Upper Rock (x^2 = 4.19, *d.f.* = 1, p- = <0.05).

• O'Hara's Road – Survivorship of both species does not differ from that of the Upper Rock (x^2 = 0.18, *d.f.* = 1, p- = >0.05).

• St. Michael's Road (Lower) – There is no significant difference between the proportion of trees found dead along this road and that of the Upper Rock as a whole (x^2 = 0.38, *d.f.* = 1, p- = >0.05).

• St. Michael's Road (Upper) – All of the pine trees found along this stretch of road were dead. It is therefore no surprise that the proportion of dead trees along this road (at 100%!) is significantly higher than that of the Upper Rock as a whole (x^2 = 5.87, *d.f.* = 1, p- = <0.05).

• Spur Battery Road – The proportion of trees of both species found dead along this road did not differ significantly from the proportion found within the Upper Rock (x^2 = 0.51, *d.f.* = 1, *p*- = >0.05).

• Signal Station Road – at 63%, a much higher proportion of *Pinus pinea* remain alive along this road than within the Upper Rock as a whole (x^2 = 19.93, *d.f.* = 1, *p*- = <0.001). The proportion of both species that remain alive is also much higher than within the whole of the Upper Rock, at 66.7% (x^2 = 14.9, *d.f.* = 1, *p*- = <0.001).

• Cable Car Area – only individuals of *Pinus pinea* were observed along this part of the Upper Rock, a similar proportion of which remained alive to the rest of the Upper Rock (x^2 = 0.02, *d.f.* = 1, *p*- = >0.05).

• Governor's Lookout – at 66.7%, a much higher proportion of pine trees survived around Governor's Lookout than within the whole of the Upper Rock (x^2 = 8.07, *d.f.* = 1, *p*- = <0.01).

We can arrive at some conclusions from these findings, and these are given later.

9.3.4 Pine tree 'fitness' within the Upper Rock Nature Reserve

Although 36.8% of pine trees within the Nature Reserve remain alive, not all of these are in a healthy condition. From the individuals that remain alive, the following fitness scores were recorded: 1 = 6 (5.3%), 2 = 40 (35.4%), 3 = 38 (33.6%), 4 = 24 (21.2%), 5 = 5 (4.4%). As can be seen, only 4.4% of pine trees achieved the highest score, and 74.3% were deemed to have a canopy foliage cover of less than 50%. This means, in fact, that many of the pine trees that remain alive within the Nature Reserve are not in a good condition, and extremely few are in prime condition. However, does 'fitness' (as measured by our 0-5 scale) differ between the two species found within the Nature Reserve? Table 3 gives scores recorded for both species at each of the eleven sites, together with the totals.

Table 3. Pine tree 'fitness' scores (as given in the methods section) within 11 separate areas of the Upper Rock Nature Reserve, together with overall scores for the whole of the Nature Reserve.

Site	P. halepensis						P. pinea					
	0	1	2	3	4	5	0	1	2	3	4	5
Martin's Path	7	0	2	2	2	0	15	0	0	0	0	0
Mediterranean Road	1	0	0	1	2	0	22	0	1	0	0	0
Queen's Road	2	0	1	6	2	0	41	1	4	3	0	0
Cave Branch Road	20	1	4	3	1	0	0	0	0	0	0	0
O' Hara's Road	4	0	1	3	1	0	12	2	3	2	0	0
St. Michael's Rd (Lower)	9	1	1	2	2	0	8	0	1	1	0	0
St. Michael's Rd (Upper)	3	0	0	0	0	0	10	0	0	0	0	0
Spur Battery Road	0	0	0	0	2	0	10	0	0	1	0	0
Signal Station Road	0	0	2	0	2	1	17	1	5	9	10	4
Cable Car Area	0	0	0	0	0	0	4	0	0	2	0	0
Governor's Lookout	3	0	14	0	0	0	6	0	1	3	0	0
Total	49	2	25	17	14	1	155	4	15	21	10	4

Using species totals, a chi-square test showed that there is a significant difference between the distributions of individuals of both species across our 'fitness' scores (x^2 = 18.00, *d.f.* = 5, *p* = <0.01). However, it is plain to see when looking at the number of individuals under each 'fitness' score that the largest discrepancy between both species occurs at the number of individuals that are dead (45.4% of *P. halepensis*, 72.9% of *P. pinea*). This first chi-square test was probably, therefore, skewed by this large discrepancy between the number of individuals in the '0' category, and may tell us little about differences in live tree 'fitness' between both species. With this in mind, a second chi-square test was carried discarding the '0' category. This showed that there is no significant difference between the fitness of live populations of *P. halepensis* and *P. pinea* (x^2 = 0.55, *d.f.* = 4, *p* = >0.05).

9.3.5 The western slope of the Upper Rock Nature Reserve

The angle of the western slope of the Upper Rock, that which constitutes the Upper Rock Nature Reserve, changes from south to north. The southern slopes are extremely steep, but these become progressively less steep as we move towards the northern end of the Nature Reserve. Six diagrams of cross-sections of the Upper Rock show the changing angle of the slope from north to south. These correspond roughly to our eleven sites, and are shown in Fig. 5 & 6.

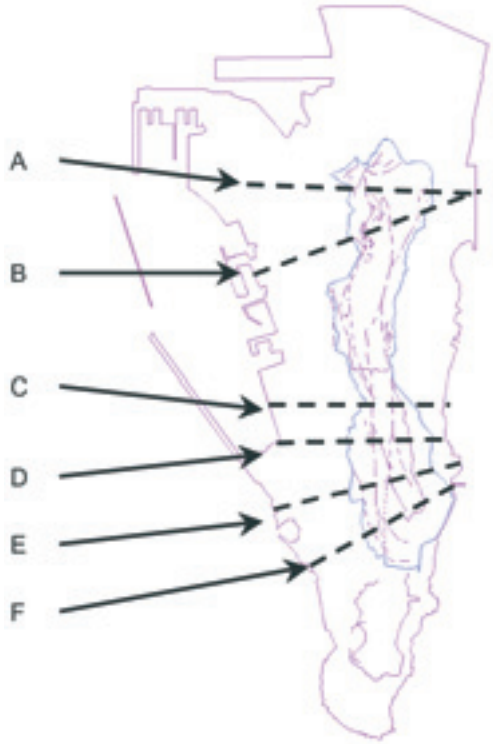
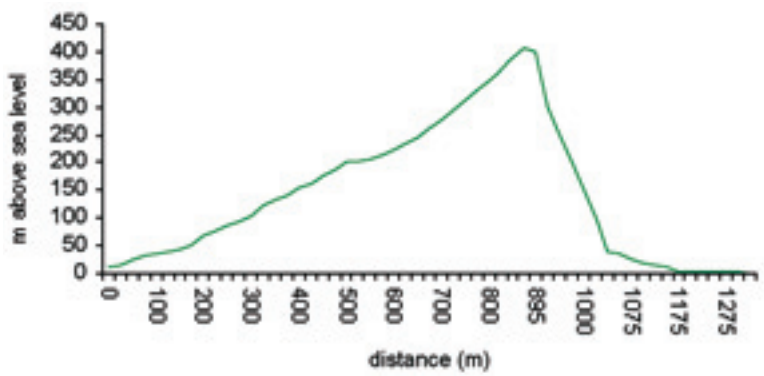


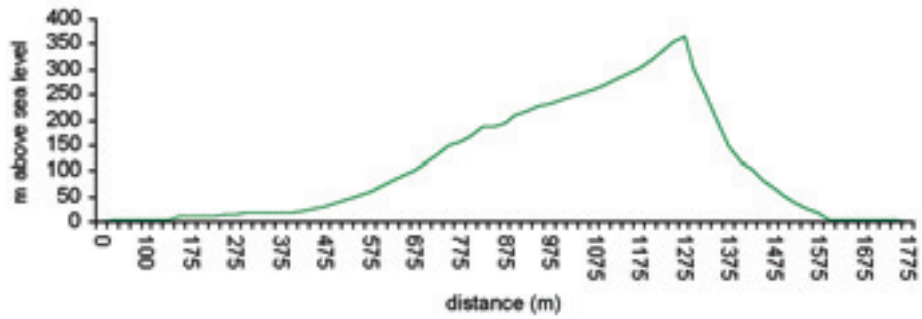
Figure 5. Map of Gibraltar, showing the lines of intersection at which west-east sections of the Rock have been produced. These are labelled A, B, C, D, E & F.

a)



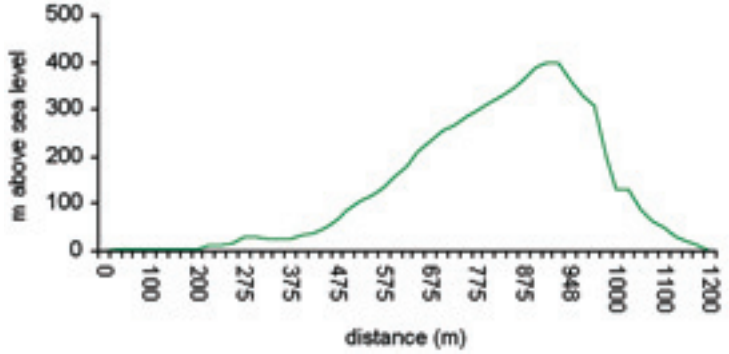
The angle of the slope at this intersection is, on average, about 18º. The angle at Governor's lookout, where most of the pines at this intersection grow, is about 5º.

b)



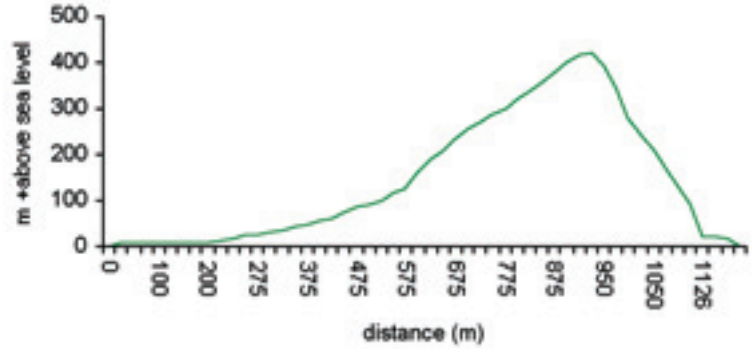
The angle of the slope at this intersection is steeper than the previous, at about 25º.

c)



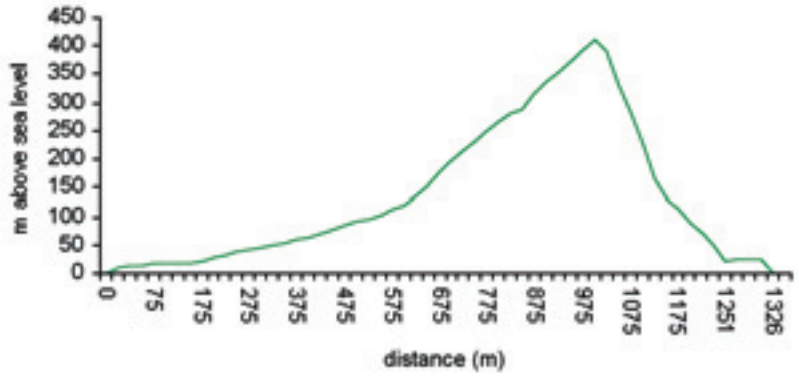
The angle of the slope at this intersection is far greater than the previous two, at about 35º.

d)



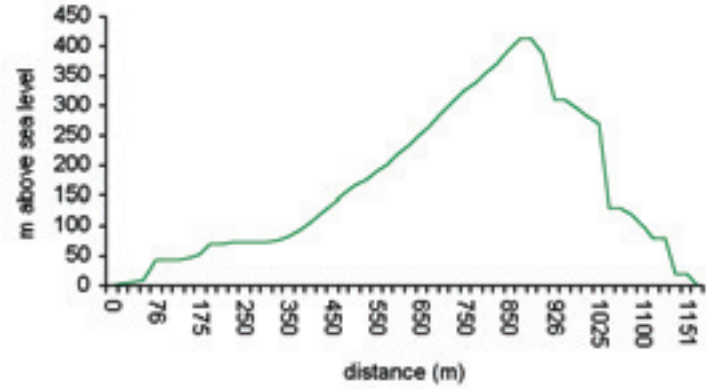
The angle of the slope at this intersection is about 36º.

e)



The angle of the slope at this intersection is about 39º.

f)



The angle of the slope at this intersection is about 38º.

Figure 6. West-east sections of the Rock, showing the angle of the western slope of the Rock at different positions from north to south.

Many of our eleven sites cut through more than one of our six intersections of the Rock, and so a correlation between angle of slope and pine tree survivorship cannot be carried out. However, it is plain to see that the angle of the slope at the southern end of the Upper Rock Nature Reserve is markedly steeper than that at the northern end, with slope angles ranging between averages of 18º and 25º at our northern sites, and between 35º and 39º at our southern sites. It is also evident from our results that the two sites at which pine trees have done best, Governor's Lookout and Signal Station Road, occur towards the northern end of the Upper Rock. There may therefore be a relationship between slope steepness and pine tree survivorship, with pine trees doing better on slopes that are less steep. This may be due to the possibility of two factors; that run-off of water is less drastic on these slopes, and that soil depth is greater. These two factors may aid the continued growth and health of pine trees within the Nature Reserve.

9.4 Discussion

It can be seen from our results that pine tree mortality does not occur at random within the Upper Rock Nature Reserve; rates of mortality differ between our two species, and patterns of mortality differ spatially. Furthermore, it is evident, given that a very large number of trees on the Upper Rock died during or immediately after the drought period of the mid 1990s, that rainfall is a factor that determines pine mortality. Other factors that may affect the health of pines are not

deemed to have contributed significantly to tree mortality during this period. For example, the pine processionary moth *Thaumetopoea pityocampa*, although common in Gibraltar, has never occurred in high enough densities to cause serious damage to pines, as frequently happens in pinewoods in the neighbouring area. Also, it can be argued that the basic nature of the soil on the Upper Rock Nature Reserve favours *P. halepensis* and not *P. pinea*, yet if this were the primary factor, then it would be difficult to explain how many of these trees survived in an apparently healthy state for more than 80 or 90 years.

Another factor to consider is why these trees were affected at this point in time. If they have been around for more than 80 or 90 years, then it seems highly likely that one or more droughts comparable to that of the mid 1990s will have occurred during these trees' lifetime. Why then did the trees perish during this period? A factor that may have affected pine trees on the Upper Rock is the large increase in traffic along all roads over the 1990s. It is not unreasonable to assume that pollution emanating from car exhaust may have affected and weakened trees (particularly since most pines are found along or close to the road), further exposing them to the effect of the drought. What is certain is that pine trees, and more specifically *P. pinea*, are very sensitive to pollution (Quezel 1977; Cortes 1979). Furthermore, the situation may be aggravated during years of low rainfall, when an increased volume of solids originating from car exhaust may accumulate on trees.

Our findings on pine fitness and mortality within the Upper Rock Nature Reserve are discussed next, in relation to their significance to pine tree management on the Upper Rock Nature Reserve.

9.4.1 Are Pine Trees Important to the Upper Rock Nature Reserve?

Before deciding whether or not to recommend the replanting of pine trees in the Nature Reserve, we must examine the role that pine trees have played within the Upper Rock and whether their presence is important.

Pine trees undoubtedly give character to the Nature Reserve; they have over the years lent an aesthetic appeal to the Upper Rock, and in particular it's roadsides. Their large canopies, when the majority of pine trees were healthy, provided ample shade for drivers and walkers, and this was particularly important during the summer months when temperatures regularly exceed 30ºC. Likewise, pine trees provide shade to picnickers in the Governor's Lookout area. Pines have also provided stability to the sides of roads, and this seems particularly important nowadays given the amount of traffic that passes through the Nature Reserve.

These trees are also beneficial to some of the wildlife of the Nature Reserve. Within the Upper Rock, the pine processionary moth *Thaumetopoea pityocampa*, is obviously only found on pine trees, and the buprestid beetle *Buprestis (Buprestis) magica* is found on *P. halepensis*. Some of the birds that use the Upper Rock also show an association to pine trees. For example, wintering firecrests *Regulus ignicapillus*, are almost always found on pine trees, whilst booted eagles *Hieraaetus pennatus*, (a species which is afforded the SPEC category of 3 and is deemed 'Rare' by BirdLife International (Tucker & Heath 1994)) regularly roost in pine trees during the post-nuptial migration, when prolonged easterlies produce large concentrations of this species on the northern shore of the Strait. Similarly, pine trees are frequently used by passerine migrants such as *Phylloscopus* warblers, and in particular the western Bonelli's warbler *Phylloscopus bonelli*, and also the spotted flycatcher *Muscicapa striata*, and the pied flycatcher *Ficedula hypoleuca*, amongst others.

It seems, therefore, that pine trees have had an important role to play in the Nature Reserve, and that some form of pine tree replanting would be beneficial to the Upper Rock. However, this should be restricted to sites at which these trees were originally planted, and their present range within the Nature Reserve should not be extended. Rather, broad-leaved trees that are known to have occurred on the Upper Rock prior to its deforestation or that occur on nearby limestone mountains should be used in any afforestation programme, as these are known to harbour a higher biodiversity. Such species could include carob *Ceratonia siliqua*, narrow-leaved ash *Fraxinus angustifolia*, round-leaved oak *Quercus rotundifolia*, Algerian oak *Quercus canariensis*, sweet bay *Laurus nobilis*, and possibly nettle tree *Celtis australis* (although the use of this last species must be considered carefully, as it may not in fact be native to this region). For more information on replanting programmes see Chapter 10 and Bensusan & Perez (2003).

9.4.2 Recommendations

Given the proportion of pine trees found within the Upper Rock Nature Reserve that are dead, it is obvious that an intensive replanting programme is necessary if a pine tree population, which has been characteristic of the Upper Rock over the years, is to continue existing. Some lessons can be learnt from the analysis above, and the following points should be taken into account when replanting pine trees on the Upper Rock:

1) Any dead tree should be replaced with a live tree. This should apply equally to any tree that dies after the implementation of this report.

2) In areas where a good number of pines still remain alive, an additional number of trees should be planted. Pine trees do especially well along Signal Station road and around Governor's Lookout, probably because the slope is less steep at these sites than along most of the Upper Rock. In the event of a tree-replanting programme, a special effort should be made to repopulate these two sites with a good number of trees, as these are most likely to survive here.

3) Many pine trees that are currently found in a live state within the Upper Rock Nature Reserve are not in a good condition. A replanting programme should therefore be quite intensive, as many of the trees that remain alive can perhaps be expected to die in the near future. This should include areas where a good number of pine trees still remain alive.

4) Given that there is no significant difference between the 'fitness' of live trees of both species, the only important factor to consider in a replanting programme is the difference in survivorship between both species. *Pinus halepensis* is better adapted to environments such as that found on the Upper Rock than *P. pinea*. This is shown by the much higher proportion of *P. halepensis* that survived the severe drought of 1994 – 1996, as is evident from our analysis. Therefore, in any replanting programme, *P. halepensis* and not *P. pinea* should be used. If any *P. pinea* are to be used, then these should be planted along and around Signal Station Road (on the northern end of the Rock), where survivorship for this species was highest.

Firecrest, a species associated with pine trees.

5) Pine trees seem to do particularly badly along the road that leads upwards from St. Michael's Cave, Mediterranean Road and Cave Branch Road. It is not surprising that these three sites are located towards the southern end of the Nature Reserve, as the slope is steeper in this area and therefore one would expect a lower depth of soil and greater runoff of water here. In fact, it can be seen clearly from the maps in Fig. 4 that the southern end of the Upper Rock has lost many more pine trees than the northern end. These areas should therefore be avoided in a pine tree-replanting programme. Rather, the planting of drought-resistant, broad-leaved species that provide shade should be looked into for these sites.

6) It is interesting to note that pine trees are very susceptible to pollution (Quezel 1977). This may be one of the reasons why these trees perished; the combination of a severe drought and increased traffic may have provided the deathblow. Restricted use of the roads along the upper reaches of the Nature Reserve would therefore benefit any pine-replanting programme.

7) A total of 194 dead pine trees can be found on the Upper Rock. It is the authors' opinion that these should be felled and left where they are, as they provide a habitat for a large diversity of invertebrates, as well as hibernating reptiles. If any dead tree poses a danger (e.g., if it overhangs a road precariously), then this should be felled and left lying in the same spot where it grew. This will not only provide a habitat for wildlife but also enrich the soil in the decaying process. Dead pine trees within the Nature Reserve are quickly attacked by wood-boring invertebrates, such as the termite *Reticulitermes lucifugus*, and beetles of the families Buprestidae and Cerambycidae. This accelerates the decomposition of dead trees. Although dead pine trees could be seen by some as a fire hazard, they are not any more of a hazard than any dead or live tree within the Nature Reserve. In fact, live pine trees burn for a longer period of time due to their resinous nature. Dead pine tree removal should not, therefore, be justified through these means.

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10. Habitats

10. Habitats

10.1 Introduction

The Upper Rock boasts a rich flora, with 363 species having been recorded within the boundary of the Nature Reserve (Linares 2003). The vegetation of the Upper Rock Nature Reserve is dominated by closed Mediterranean shrubland known as maquis (a tall, thick type of Mediterranean matorral), which consists of a dense community of evergreen, sclerophyllous shrubs that typically replaces evergreen woodland after fire or deforestation (Rocamora 1997), as was the case with the Upper Rock following the initial removal of its Mediterranean woodland. Maquis habitats are not determined by any species of trees or bushes in particular (Tomaselli 1977), but the typical shrub genera that dominate in this habitat, depending on location, soil and other conditions, are *Arbutus, Cistus, Erica, Olea, Phyllirea, Genista, Calycotome, Sarothamnus, Quercus, Ulex, Rhamnus, Pistacia* and *Myrtus* (Rocamora 1997).

All indications are that the vegetation of the Upper Rock once consisted of Mediterranean woodland. It is certain that *Ceratonia siliqua* and *Olea europea* were once dominant trees on the Upper Rock (Portillo *ca.* 1620). If the woodland that is found on nearby limestone mountains is taken as an indication of what tree species may have occurred on Gibraltar, then it is likely that *Quercus rotundifolia, Fraxinus angustifolia* and *Pinus halepensis* (which is now found on the Upper Rock again, having been introduced during the early 1900s (Wolley-Dod 1914; Bensusan & Perez 2004)) were possibly found on the Rock as well (Bensusan & Perez 2003, 2004). In addition, *Quercus canariensis* and/or *Quercus faginea* may have grown in areas that retain more moisture.

In fact, we know that *Quercus rotundifolia* probably occurred on the Rock until at least 150 years ago. Kelaart (1846) mentions *Quercus ilex* as growing in inaccessible areas of the western slope of the Rock (*Q. rotundifolia* was formally considered a subspecies of *Q. ilex*, i.e., *Q. ilex rotundifolia*, and so Kelaart (1846) presumably refers to this species). These were probably the last vestiges of the woodland once found on the Upper Rock. In addition, the wooded area above the Mount, which still retains a woodland character, harbours a number of apparently indigenous *Fraxinus angustifolia*.

Most of the woodland of the Upper Rock was eventually cleared by the British Garrison during the great siege, when firewood was in demand. Vegetation was subsequently kept very low by the goats that grazed on the Upper Rock (Cortes 1994). It is for this reason that photographs of the Rock taken in the late 1800s reveal a very stony landscape with little vegetation. It was in fact the removal of goats from the Upper Rock that caused the vegetation to develop into the maquis that can be seen today (Cortes 1979).

The maquis species composition that is found in Gibraltar today is unique in the region (Cortes, in Heath & Evans 2000; Galán de Mera *et al.* 2000) due largely to the Rock's basic soils, and includes such species as *Olea europea, Osyris quadripartita, Pistacia lentiscus, Pistacia terebinthus, Rhamnus alaternus, Jasminum fruticans, Lonicera implexa, Rubia peregrina, Ruscus hypophyllum, Calicotome villosa, Coronilla valentina* and *Genista linifolia* (Linares 1994). This already dense maquis is made impenetrable in places by the climbing plants *Smilax aspera, Aristolochia baetica, Tamus communis and Clematis cirrhosa* (Linares *et al.* 1996). In addition, scattered individuals of *Laurus nobilis, Rhamnus lycioides, Clematis flammula, Quercus coccifera, Celtis australis, Anagyris foetida, Ceratonia siliqua, Crataegus monogyna* and *Phillyrea latifolia* also occur (Linares 1994).

The Upper Rock also holds several smaller areas that hold habitats other than maquis. Some areas are dominated by garigue; a discontinuous, low matorral which on the Upper Rock occurs where soil is thin or covered by scree, or where mismanaged pseudosteppe (which will be described next) is slowly reverting back to maquis (Cortes 1979). Its heterogeneity means that areas that are dominated by garigue-type vegetation are often rich in flora. This is evident, for example, in the southernmost slopes of the Upper Rock; those that lead downward from Governor's Cottage to beyond the initial stretch of the path leading to the Mediterranean Steps. Garigue is in fact fairly rare and localised on the Upper Rock, and decreasing, as we shall see later.

In addition to those vegetation types that can be classified under the broad term 'matorral', open areas such as firebreaks and disused water catchments exist on the Upper Rock, and these support a very wide diversity of flora (about 37% of plant species found on the Upper Rock can be found growing on firebreaks (Linares 1997)). These areas can be classified as pseudosteppe, a mainly herbaceous vegetation with low plant cover that has been caused by man through regular clearing (Cortes 1979). Since roadsides are cleared, these

can be considered as pseudosteppe (albeit extremely small areas of this habitat), and in fact the flora of roadsides on the Upper Rock shares many similarities with those of the fire-breaks.

Although we have a very good knowledge of the species that are found on the Upper Rock (and where on the Upper Rock these are found), the vegetation of the Upper Rock has not been seriously analysed since 1979. Cortes (1979) recorded five different vegetation types on the Upper Rock: High Maquis, Low Maquis, Maquio-garigue, Garigue, and Pseudosteppe and Steppe. However, given that this vegetation is gradually becoming thicker and taller, some features may have changed since then. We therefore set about analysing the vegetation types found on the Upper Rock with a view to comparing our results to those of Cortes (1979) and then taking considerations on the future of the Upper Rock's vegetation, including possible recommendations on the future management of habitats.

10.2 Methods

A comprehensive survey of the Upper Rock's vegetation is a very laborious and time-consuming task. Cortes (1979) carried his study out selecting a number of random quadrats within the Upper Rock. He then analysed their vegetation using the 'Domin Scale', with 'Domin' values ascribed to each of the most characteristic species of the sample area. The Domin scale is shown in table 1.

Table 1. Domin scale, with the definition of each value.

Amount of cover/species	Domin value
cover about 100%	10
cover >75%	9
cover 50-75%	8
cover 33-50%	7
cover 25-33%	6
abundant, cover about 20%	5
abundant, cover about 5%	4
scattered, cover small	3
very scattered, cover small	2
scarce, cover small	1
isolated, cover small	X

Choosing and marking out quadrats is a task in itself. Since our time was limited, we chose to use boundaries defined by the roads of the Upper Rock, as well as by the vegetation itself. Otherwise, our methods were similar to those employed by Cortes in his 1979 study.

The Upper Rock was divided into 57 different sample areas, and the vegetation within each of these was assessed using the Domin Scale. Once this was done, areas were classified according to their vegetation. Cortes identified five different vegetation-types on the Upper Rock using the Domin method. These are given in table 2.

Table 2. Cortes' (1979) classification of vegetation types on the Upper Rock. Domin values are given as approximations, and both these and species compositions may obviously differ slightly from one area to another.

Vegetation Type	Species	(Approximate) Domin Value
High Maquis	*Olea europea*	8
	Pistacia lentiscus	5
	Rhamnus alaternus	5
	Osyris quadripartita	4
	Chamaerops humilis	3
	Calicotome villosa	2
	Genista linifolia	2
	Acanthus mollis	5
	Pinus pinea	(in some areas) 8-9
Low Maquis	*Genista linifolia*	9
	Calicotome villosa	5
	Olea europea	5
	Pistacia lentiscus	4
	Osyris quadripartita	3
	Coronilla valentina	3
Maquio-garigue	*Olea europea*	6
	Oxalis pes-capre	6
	Hyparrhenia hirta	6
	Rhamnus alaternus	5
	Osyris quadripartita	3
	Calicotome villosa	3
	Genista linifolia	3
	Pistacia lentiscus	3
	Coronilla valentina	2
Garigue	*bare ground*	5
	Oxalis pes-capre	5
	Narcissus papyraceus	5
	Acanthus mollis	4
	Pistacia lentiscus	3
	Asphodelus aestivus	3
	Chamaerops humilis	3
Pseudosteppe & Steppe	*bare ground*	5
	Dactylis glomerata	5
	Ferula tingitana	3
	Smyrnium olusatrum	3
	Asteriscus maritimus	3
	Asphodelus aestivus	3
	Narcissus papyraceus	3
	Gladiolus communis	2

The vegetation classifications used in this study are based broadly on those recorded by Cortes (1979) and shown in table 2. However, it must be stressed when looking at different habitats on the Upper Rock that vegetation types are very hard to define (Cortes 1979), and that since these tend to develop from one form to another (with pseudosteppe at the bottom of the scale and high maquis on the top, as shall be seen later), it is inevitable that some forms or structures of vegetation will fall in-between the broad categorisations that describe our different vegetation types. This is evident from our study, as some of the vegetation types recorded within the Nature Reserve do indeed constitute intermediate forms of vegetation.

In addition to those recorded by Cortes (1979), four new types of vegetation were recorded, with nine different vegetation-types identified in total. These were High Maquis, Low

Maquis, Maquio-garigue, Garigue, Pseudosteppe, Low Maquis/High Maquis, Pseudosteppe/Garigue, Open, Semi-exotic woodland and Mediterranean Woodland with some Exotics.

Once all sample areas were classified according to their vegetation, Average Domin values were calculated for each species within each habitat. In addition, the number of sample areas in which each species was recorded was also calculated. Average Domin values were calculated only from the number of samples in which the species was recorded. Thus, giving a value for the number of samples in which a species was found gives an idea of distribution (although it is recognised that some samples differ greatly in size), whilst the average Domin value shows the species' dominance within the samples in which it was found. It must be stressed that species may well have been found in more samples than recorded, only not in a high enough density to score a Domin value.

10.3 Results

Our results on each habitat type are given below. The average Domin value (given to 1 d.p.), taken from those samples in which the species was recorded only, is given alongside each species. The number of sample areas in which each species was recorded is given in brackets, and species are listed in order of the number of samples that they were recorded in.

10.3.1 High Maquis; 2.00-5.00m (27 samples)

Olea europea	8.5 (27)	*Pinus halepensis*	1.8 (4)
Osyris quadripartita	4.6 (27)	*Coronilla valentina*	2.7 (3)
Rhamnus alaternus	3.2 (26)	*Ficus carica*	1 (3)
Pistacia lentiscus	2.8 (24)	*Crataegus monogyna*	1 (3)
Clematis cirrhosa	4 (17)	*Senecio angulatus*	4 (2)
Smilax aspera	3.4 (15)	*Asparagus albus*	3 (2)
Pistacia terebinthus	1.9 (15)	*Opuntia ficus-indica*	2.5 (2)
Aristolochia baetica	3.5 (14)	*Ferula tingitana*	2.5 (2)
Acanthus mollis	3.1 (13)	*Ephedra fragilis*	1.5 (2)
Lonicera implexa	2.8 (12)	*Laurus nobilis*	1.5 (2)
Genista linifolia	2.1 (12)	*Ceratonia siliqua*	1 (2)
Tamus communis	2.8 (10)	*Prunus spp.*	1 (2)
Calicotome villosa	2 (10)	*Prasium majus*	3 (1)
Teucrium fruticans	2.8 (8)	*Hyparrhenia hirta*	3 (1)
Carthamus arborescens	2 (8)	*Asphodelus aestivus*	2 (1)
Celtis australis	1.8 (6)	*Stipa tenacissima*	2 (1)
Bupleurum fruticosum	2.6 (5)	*Eucalyptus camaldulensis*	2 (1)
Chamaerops humilis	1.6 (5)	*Thapsia villosa*	2 (1)
Phylliera latifolia	3 (4)	*Psoralea bituminosa*	2 (1)
Pinus pinea	2.5 (4)	*Anagyris foetida*	1 (1)
bare rock/open areas	2.5 (4)	*Clematis flammula*	1 (1)

10.3.2 Low Maquis; 1.00-1.80m (5 samples)

Olea europea	5.4 (5)	*Cistus albidus*	3 (1)
Osyris quadripartita	4 (5)	*Clematis cirrhosa*	2.5 (2)
Rhamnus alaternus	2.8 (5)	*Hyparrhenia hirta*	2.5 (2)
Pistacia lentiscus	4 (4)	*Coronilla valentina*	2 (2)
Chamaerops humilis	3.8 (4)	*Lonicera implexa*	1.5 (2)
Calicotome villosa	2.3 (4)	open rock	2 (1)
Pistacia terebinthus	2 (4)	*Malva sylvestris*	2 (1)
Stipa tenacissima	2.5 (4)	*Diplotaxis siifolia*	2 (1)
Acanthus mollis	3.3 (3)	*Psoralea bituminosa*	2 (1)
Genista linifolia	2.7 (3)	*Teucrium fruticans*	2 (1)
Rhamnus lycioides	2 (2)	*Carthamus arborescens*	2 (1)
Asparagus albus	4 (1)	*Bupleurum fruticosum*	2 (1)
Jasminum fruticans	4 (1)	*Opuntia ficus-indica*	2 (1)
grasses	4 (1)	*Rosmarinus officinalis*	2 (1)
Quercus coccifera	1 (1)	*Clematis flammula*	1 (1)

10.3.3 Maquio-garigue; 0.50-4.00m (7 samples)

Olea europea	5.7 (7)	*Avena spp.*	2 (2)
Osyris quadripartita	3.1 (7)	*Thapsia villosa*	1.5 (2)
Asphodelus aestivus	2.8 (5)	*Celtis australis*	1 (2)
Stipa tenacissima	5.3 (4)	*Galactites tomentosa*	3 (1)
Carthamus arborescens	3 (4)	*Compositae spp.*	3 (1)
open rock	5.3 (3)	*Lavandula dentata*	3 (1)
Pistacia lentiscus	4.3 (3)	*Genista linifolia*	3 (1)
Asteriscus maritimus	3 (3)	*Acanthus mollis*	3 (1)
Calicotome villosa	2.7 (3)	*Ephedra fragilis*	3 (1)
Hyparrhenia hirta	3.5 (2)	*Smyrnium olusatrum*	3 (1)
Asparagus albus	3 (2)	grasses	3 (1)
Chamaerops humilis	3 (2)	*Euphorbia squamigera*	2 (1)
Teucrium fruticans	3 (2)	*Rhamnus lycioides*	1 (1)
Rhamnus alaternus	2.5 (2)	*Aristolochia baetica*	1 (1)
Pistacia terebinthus	2.5 (2)	*Rosmarinus officinalis*	1 (1)
Ferula tingitana	2.5 (2)	*Lonicera implexa*	1 (1)
Teucrium lusitanicum	2 (2)	*Prasium majus*	1 (1)
Opuntia ficus-indica	2 (2)		

10.3.4 Garigue; 0.25-0.50m (3 samples)

bare rock/scree	8 (2)	*Asphodelus aestivus*	3 (1)
Osyris quadripartita	1 (2)	*Olea europea*	3 (1)
Acanthus mollis	8 (1)	*Chamaerops humilis*	3 (1)
Grasses/herbs	7 (1)	*Genista linifolia*	2 (1)
Hyparrhenia hirta	6 (1)	*Coronilla valentina*	2 (1)
Stipa tenacissima	6 (1)	*Prasium majus*	2 (1)
Pistacia lentiscus	5 (1)	*Carpobrotus acinaciformis*	1 (1)
Aloe arborescens	4 (1)	*Opuntia ficus-indica*	1 (1)

10.3.5 Pseudosteppe; 0.20-0.75m (5 samples)

Acanthus mollis	4.4 (5)	*Antirrhinum majus*	3 (1)
Carthamus arborescens	3.4 (5)	*Reseda alba*	3 (1)
Ferula tingitana	2.6 (5)	*Euphorbia squamigera*	3 (1)
Smyrnium olusatrum	6 (3)	*Diplotaxis siifolia*	3 (1)
bare rock-ground	5.7 (3)	*Shinus molle*	3 (1)
Galactites tomentosa	5 (3)	*Chamaerops humilis*	3 (1)
Teucrium fruticans	5 (3)	*Pistacia lentiscus*	3 (1)
Asphodelus aestivus	2.7 (3)	*Echium creticum*	2 (1)
Thapsia villosa	3 (2)	*Iberis gibraltarica*	2 (1)
Convolvulus althaeoides	3 (2)	*Verbascum sinuatum*	2 (1)
Asteriscus maritimus	2.5 (2)	*Foeniculum vulgare*	2 (1)
grasses	8 (1)	*Celtis australis*	1 (1)
Chasmanthe floribunda	7 (1)	*Chrysanthemum coronarium*	1 (1)
Hyparrhenia hirta	4 (1)	*Olea europea*	1 (1)
Malva sylvestris	4 (1)	*Rhamnus alaternus*	1 (1)
Oxalis pes-capre	4 (1)	*Nicotiana glauca*	1 (1)
Genista linifolia	3 (1)	*Eucalyptus camaldulensis*	1 (1)
Ecbalium elaterium	3 (1)		

In addition to the above vegetation types, some others were also identified. Two of these were intermediates between two vegetation types; low maquis/high maquis and pseudosteppe/garigue. These are given next, together with their species composition.

10.3.6 Low Maquis/High Maquis; 2.00m (1 sample)

Olea europea	8	*Genista linifolia*	2
Osyris quadripartita	5	*Acanthus mollis*	2
Teucrium fruticans	3	*Stipa tenacissima*	2
Carthamus arborescens	3	*Ferula tingitana*	2
Pistacia lentiscus	2	*Laurus nobilis*	1
Aristolochia baetica	2	*Smilax aspera*	1
Clematis cirrhosa	2	*Tamus communis*	1
Chamaerops humilis	2	*Pistacia terebinthus*	1
Rhamnus alaternus	2		

10.3.7 Pseudosteppe/Garigue; 0.40-1.00m (3 samples)

open/bare rock	7 (3)	*Avena spp.*	2.5 (2)
Psoralea bituminosa	4 (3)	*Osyris quadripartita*	1.5 (2)
Dittrichia viscosa	4(3)	*Pistacia lentiscus*	1 (2)
Genista linifolia	2.7 (3)	*Rhamnus alaternus*	3 (1)
Calicotome villosa	2.3 (3)	*Acanthus mollis*	2 (1)
Phagnalon saxatile	2.3 (3)	*Clematis flammula*	2 (1)
Asteriscus maritimus	2 (3)	*Coronilla valentina*	1 (1)
Foeniculum vulgare	5.5 (2)	*Olea europea*	1 (1)
Hyparrhenia hirta	3 (2)	*Lonicera implexa*	1 (1)

Finally, two woodland habitats were identified within our samples. These were 'open, semi-exotic woodland' (PSA Nursery) and 'Mediterranean woodland with some exotics' (Upper Mount Garden)'. Their species compositions are given next.

10.3.8 Open, Semi-exotic Woodland; 10.00m (1 sample)

Olea europea	5	*Plumbago auriculata*	3
Senecio angulatus	5	*Rosmarinus officinalis*	3
Acanthus mollis	5	*Eucalyptus camaldulensis*	3
Ailanthus altissima	4	Eucalyptus globulus	3
Opuntia ficus-indica	4	*Celtis australis*	2
Rhamnus alaternus	3	*Pittosporum japonica*	2
Ficus carica	3	*Jasminum fruticans*	2
Tecoma capensis	3	*Pinus halepensis*	1
Osyris quadripartita	3	*Cupressus sempervirens*	1
Genista linifolia	3	*Prunus communis*	1

10.3.9 Mediterranean Woodland with some Exotics; 10.00m (1 sample)

Olea europea	7	*Cupressus sempervirens*	4
Celtis australis	5	*Aristolochia baetica*	4
Ulmus minor	5	*Lantana camara*	4
Laurus nobilis	5	*Rubus ulmifolius*	3
Acanthus mollis	5	*Ficus carica*	2
Ailanthus altissima	4	*Ceratonia siliqua*	1

Using the data collected, the habitats of the Upper Rock can be mapped, as shown in Fig. 1. In addition, Figs. 2-8 show examples of vegetation-types on the Upper Rock.

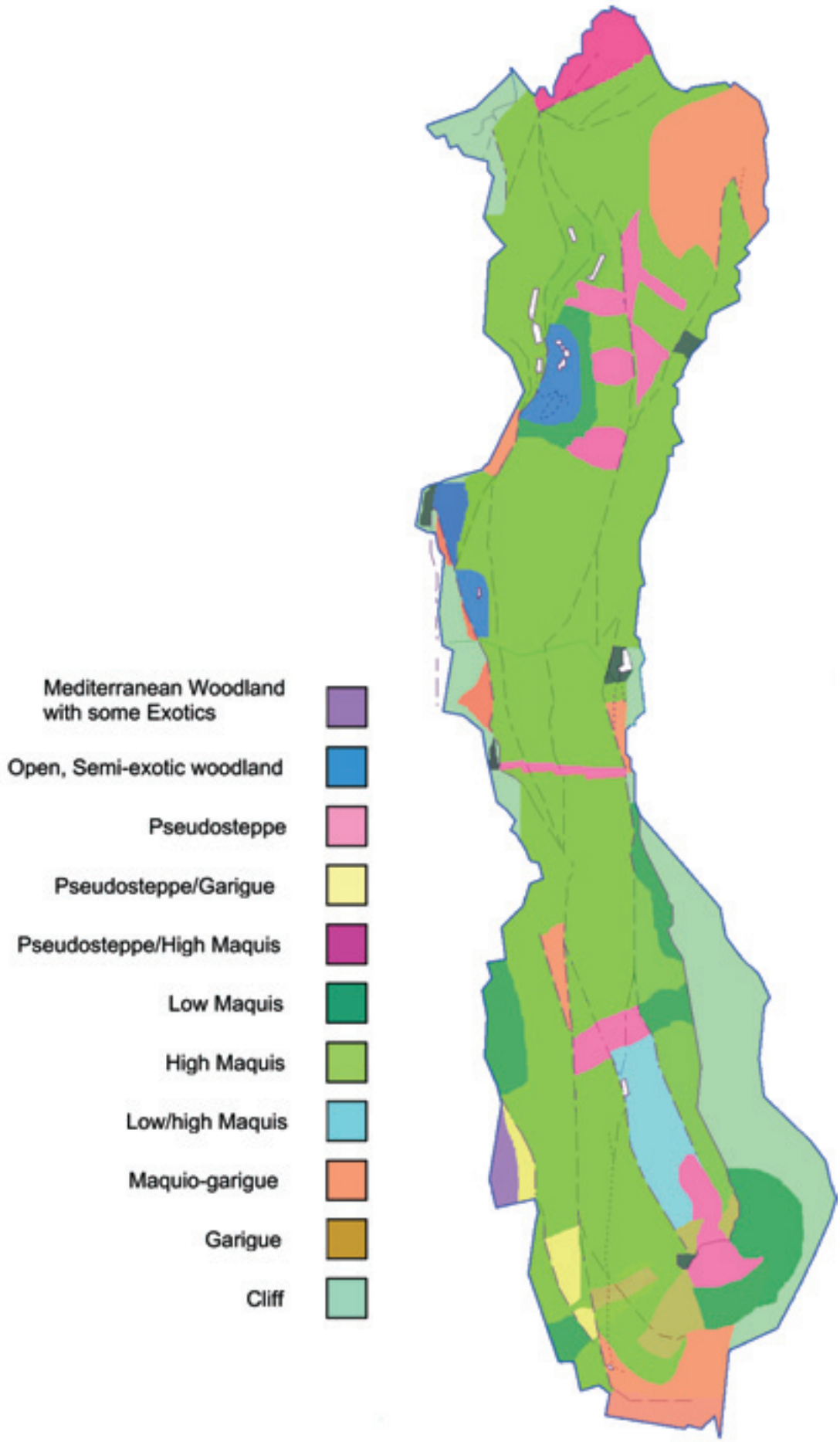


Figure 1. Map of the Upper Rock Nature Reserve showing the extent of each habitat recorded.

Figure 2. High Maquis.

Figure 5. Garigue

Figure 3. Low Maquis, contrasting with High Maquis in the background.

Figure 6. Pseudosteppe.

Figure 4. Maquio-garigue.

Figure 7. Open, semi-exotic woodland at Bruce's Farm.

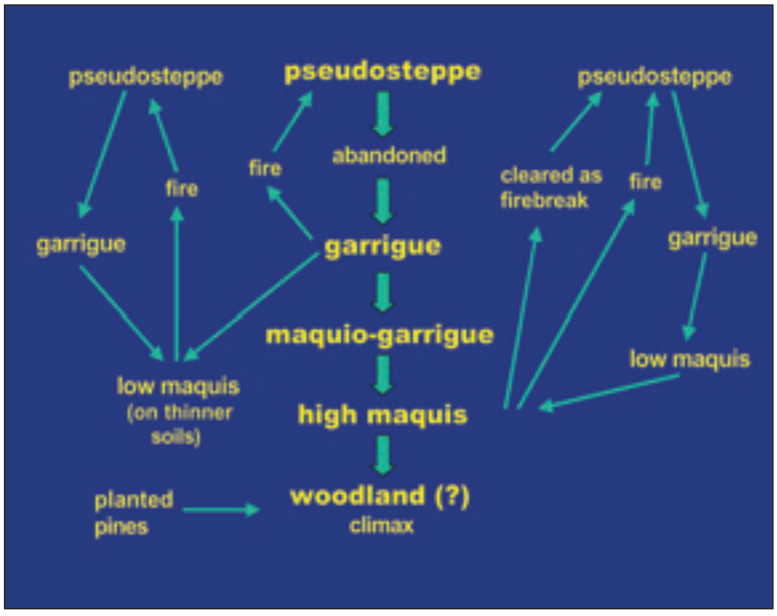
Figure 8. Mediterranean woodland with *Celtis australis* in the Mount.

10.4 Discussion

10.4.1 Development and Succession of Vegetation on the Upper Rock

It is evident that the maquis on the Upper Rock has developed considerably since Cortes (1979) carried out his study. A look at Cortes' (1979) results and our own shows that the vegetation of the Upper Rock has progressed to the extent that the composition of the maquis is now different to what it was 24 years ago. Although discrepancies between values recorded for herbaceous plants can be explained through seasonality (i.e., the effect of carrying out two similar studies at different times of the year), it is the dominating, woody shrubs, which are present all year round that provide the most noticeable differences. The taller *Olea europea* has remained the dominant shrub of the Upper Rock's maquis, but its continued growth has resulted in the gradual exclusion of smaller shrubs such as *Calicotome villosa* and *Genista linifolia*, which, although still not rare, are certainly far less common now than when Cortes (1979) carried out his study. Although an in depth study using an identical methodology to that employed by Cortes (1979) would be welcomed in order to accurately ascertain the development of the maquis on the Upper Rock, the very large differences between our results and his mean that a fairly accurate indication is given on the new status of most species.

Although this next point is not shown in our data, it is evident on visual examination of the Upper Rock's maquis that most of the *Calicotome villosa, Genista linifolia* and *Coronilla valentina* that now grows on the Upper Rock does so in two main areas. The first are the neglected firebreaks where the matorral has still not developed to a height that excludes these species. In addition, these species are also common on roadsides and firebreak edges. In this last case, it is the continued clearing of these habitats that allows these species to maintain a presence in these areas.



Cortes (1979) attempted to schematise the development of vegetation on the Upper Rock. The diagram produced can be seen in Fig. 9.

Figure 9. Vegetation succession as it occurs on the Upper Rock (taken from Cortes (1979)).

It is interesting to note that, whereas the scheme continues to be correct in its progression, there seems to be some disagreement between Cortes (1979) and us over what constitutes each habitat. For example, Domin figures given by Cortes for some of the species in his high maquis correspond to those recorded in our low maquis. This can be easily explained though. Cortes (1979) obviously classified his maquis according, in part, to the highest and lowest maquis found on the Rock, as have we. Thus, for example, shrubs belonging to the Papilionaceae (= Fabaceae or Leguminosae) and Labiatae are far less prevalent in our low maquis than in that of Cortes (1979). In fact, these discrepancies between our results and his illustrate the very dynamic nature of vegetation progression, and how quickly vegetation-types can disappear, being replaced by new ones. If the vegetation on the Upper Rock continues to develop at the rate that it has done since 1979, then it can only be supposed that the already ubiquitous *Olea europea*, being the tallest shrub, will eventually become even more dominant. This may result in the eventual exclusion of species that are still very common components of the Upper Rock's matorral, such as *Osyris quadripartita* and *Pistacia lentiscus*. *Rhamnus alaternus*, which also grows well in shady woodland understories, would possibly remain a common shrub in most areas. At the same time the continued presence on the Upper Rock of some of the species of the more open habitats, such as *Lavandula multifida, Lavandula dentata* and *Daphne gnidium* may under threat.

10.4.2 Acanthus mollis

It seems that the problematic species *Acanthus mollis* subsp. *platyphyllos* was under-recorded by us within the maquis, but our methodology explains this. Habitats were assessed visually from the sides of roads, and so understorey plants were under-recorded. Cortes (1979) obviously penetrated the vegetation in his efforts to record its composition. We did not have the time to do this. Thus, Cortes gives *A. mollis* a Domin score of 5, whereas this species scored 3.1 on average in our study. It is unlikely that this species has decreased within the maquis, given that *A. mollis* is more common on the Upper Rock now than it was 25 years ago (Linares *et al.* 1996; Linares 1997). In this sense, an analysis of the understorey of maquis habitats on the Rock would be desirable for a full comparison with Cortes' (1979) findings.

A larger discrepancy is noticeable between our Domin values for *A. mollis* and those recorded by Cortes (1979) in areas of pseudosteppe. Neither methodology would have missed its presence and thus this must be a true reflection of the relative position in the two studies. In table 2, we can see that *A. mollis* did not form an important component of the pseudosteppe of the Upper Rock in 1979, to the extent that no value is given for this species at all. This contrasts sharply with our findings. In 2003, *A. mollis* was found to be the most common and most dominant species of the pseudosteppe; it was found growing in all five samples of this habitat, and scored a higher Domin value than any other species. These findings illustrate that the spread of *A. mollis* into open habitats on the Upper Rock has been a recent phenomenon. This is interesting, given that *A. mollis* has always been associated with shaded areas. The reasons behind this recent spread are unclear. However, it is possibly related to the less intense clearing regime to which the pseudosteppe (largely within the firebreaks) is currently subjected.

A. mollis poses a serious threat to the flora of these open, pseudosteppe habitats. The leaves of this species are large, and thus allow little sunlight to reach the ground. This means that few if any other plants can grow where this species has spread. If left unchecked, this will no doubt cause a reduction in the biodiversity of the Upper Rock Nature Reserve (Linares 1997). *A. mollis* currently threatens all open habitats on the Upper Rock. This includes roadsides, which are also extremely important to the maintenance of floral diversity on the Upper Rock.

Every effort should be made to control the spread of *A. mollis* on the Upper Rock. This could be done as part of the firebreaks and roadsides clearing operation (*see* section 10.43, and Chapters 5 & 11). Personnel entrusted with the clearing of these areas could be instructed to target this species in particular. However, any programme to control the spread of this species and remove it from open areas should ideally be timed a few months earlier that the actual clearing operation (during the early spring) when these plants are in leaf but have not yet produced seed. Plants could be cleared either manually or with the use of herbicide. If herbicide is used, then the utmost care should be taken to ensure that *Acanthus* leaves alone are sprayed, and that this affects no other species. A herbicide containing glyphosphate would be suitable for this.

It is interesting to note that populations of *Acanthus mollis* in nearby Spain do not show the same tendencies as those on the Rock. This species is not found growing in open areas in southern Spain, and even in shaded areas *A. mollis* does not seem to be as abundant as in Gibraltar. This may suggest that natural enemies (such as large herbivores, *see* 10.47)

that this species may have in the hinterland are absent from Gibraltar. Certainly, sweep-netting of *A. mollis* in Gibraltar has revealed that this plant does not seem to support an entomofauna on the Rock. A study into the reasons for these differences would be greatly welcomed, as the results and findings of such research would provide some important aid in the control of this species (*see* Chapter 17, section 9).

10.4.3 Firebreaks and Roadsides

The management of firebreaks on the Upper Rock, including considerations on their vegetation, is dealt with in Chapter 11. The regular clearing of roadsides is also thoroughly important to the maintenance of floral diversity within the Nature Reserve, given the features that these areas share with firebreaks and their importance to herbaceous plants. This is dealt with in Chapter 5, section 9.

10.4.4 Rock Gun

The disused water catchment within the MOD site at Rock Gun and Middle Hill forms the largest open area in the whole of the Upper Rock Nature Reserve. As such, it is of considerable importance to the flora of the Upper Rock Nature Reserve, and the many species that grow at this site include some endemic and near-endemic taxa. Indeed, *Silene tomentosa*, one of the rarest plants in the world, was last recorded growing wild at this site. Rock Gun's importance to local wildlife and its proposed management are discussed in Chapters 18 & 17, and also in Bensusan & Perez (2003).

10.4.5 The Mount and PSA Gardens

The Mount and PSA Gardens form the only stands of woodland within the Upper Rock Nature Reserve. The Mount in particular boasts an array of Mediterranean woodland tree species that, within Gibraltar, either find their stronghold here or are found nowhere else. This is the case, for example, with *Celtis australis, Ulmus minor* and *Laurus nobilis*. In addition, the understorey at the Mount, which is composed mainly of *Vinca difformis, Acanthus mollis, Rubus ulmifolius* and *Hedera helix* has a unique character that gives the site a true woodland feel. This is accentuated by the presence of woodland plant species such as *Arum italicum*, which also grows well in shady areas within some of the taller vegetation of the Upper Rock, such as the Ince's Farm area.

Since both of our woodland sites were once gardens, exotic flora is unfortunately a prevalent feature of these habitats. This is particularly the case with the PSA nursery, which, as can be seen from the results, is composed mainly of exotic species. Some exotic species, such as *Eucalyptus* spp. or *Cupressus sempervirens* pose little or no threat to native flora, given that they rarely or never produce fertile seeds and do not form suckers, and cannot therefore spread. However, other exotics such as *Senecio angulatus* pose a very serious threat given the rate at which they spread and their effect on other flora (this is described in Chapter 8). These exotics should be removed from these habitats. Methods with which to deal with such species as *Senecio angulatus, Opuntia ficus-indica, Tecoma capensis* and *Ailanthus altissima* are given in Chapter 8. In addition, some of the more common exotic shrubs in the PSA nursery, such as *Pittosporum japonica* and *Plumbago auriculata* should be removed.

The planting of species that are either native to Gibraltar or are thought to have been native prior to the Rock's deforestation should follow the removal of exotic shrubs within these two habitats. Species to be used in such replanting programmes should include *Ceratonia siliqua, Fraxinus angustifolia, Quercus rotundifolia* and *Quercus canariensis*. In addition, exotic trees or shrubs that have died should be felled and replaced with the species listed above. Felled trees should not be removed, but rather left on the ground, as these provide a habitat for a large diversity of invertebrates, as well as reptiles in winter. In this sense, it would probably be best to cut any felled trunks into lengths of one or two metres.

10.4.6 Cliffs

The vegetation of the cliffs of the Upper Rock was not surveyed in this study. However, cliffs are known to be extremely important to plants in Gibraltar. Of Gibraltar's seven endemic plant taxa, six are cliff-loving species. In addition, other plants that are 'special' to Gibraltar due to restricted ranges grow especially well on cliffs. This includes species such as *Petroselinum crispum, Succowia balearica* and *Ephedra fragilis*, which have extremely restricted ranges within the area of western Andalucia and Gibraltar (within this area, the first two species are found in Gibraltar alone) (Valdés *et al.* 1987). As such, the cliffs of the Rock constitute an extremely important habitat for the plants of Gibraltar, making a huge contribution to the Rock's biodiversity. In fact, all of the cliffs of Gibraltar fall under one of two EC Habitats Directive priority categories that require the designation of Special Areas of Conservation. These are Vegetated Sea Cliffs of the Mediterranean Coast (with endemic *Limonium* spp.) and Chasmophytic Vegetation of Rocky Slopes (*see* Chapter 4, section 5).

Any cliffs adjacent to the Upper Rock Nature Reserve that do not fall within the Nature Reserve boundary should be included within a revised boundary. In addition, all cliffs in Gibraltar should be protected as part of a NATURA 2000 site under the EC Habitats Directive.

10.4.7 Management of Garigue Habitats

Most areas of the Upper Rock should be left to develop naturally, so that apart from those sites mentioned above, habitats on the Upper Rock should remain largely untouched. However, some small areas of garigue (including some which at present consist of maquio-garigue) should be managed, so that these do not gradually develop a maquis vegetation. This is because garigue on the Upper Rock, although not extensive, supports a very large proportion of the Nature Reserve's plant diversity (L. Linares, *pers. comm.*). The continued importance of these sites to floral diversity could be undermined if maquis is allowed to develop here, as the taller shrubs would gradually exclude the smaller plants, including the herbaceous species. It is important to realise that many of the plants found on the Upper Rock are found mainly or solely in garigue habitats, and so these should be conserved on this basis.

In particular, garigue areas to be cleared of taller vegetation should include the slope from Governor's Cottage to Levant Battery, which is one of the most floristically diverse areas of the Upper Rock Nature Reserve. In such areas, shrubs removed should include the more common components of the Upper Rock's maquis, such as *Olea europea, Rhamnus alaternus, Osyris quadripartita* and *Pistacia lentiscus*. Other, smaller shrubs such as *Chamaerops humilis* and *Ephedra fragilis* should not be removed, as these have always formed part of these areas' vegetation, and lend them a very unique aesthetic appeal. In the case of *Ephedra fragilis*, this species also supports a very distinct entomofauna, and the bushes found from Governor's Cottage to Levant Battery in particular hold an important population of the rare buprestid beetle *Buprestis (Yamina) sanguinea*.

The clearing of tall shrubs in garigue habitats should only be carried out by GONHS-supervised personnel.

10.4.8 Ungulates

As mentioned in Chapter 13, one method of habitat maintenance and management would be the introduction of ungulates. It is particularly interesting to note in this respect that the feral goats that currently roam parts of the Upper Rock seem to enjoy feasting on the problematic *Acanthus mollis*. The introduction of wild goats would probably, therefore, cause an impact on the spread and success of this plant. In addition, wild ungulates with browsing habits would help to control and maintain shrubs and bushes in areas that need clearing, such as the firebreaks and the disused water catchment at Rock Gun.

Three possibilities exist for introduction. These are the Spanish ibex *Capra pyrenaica*, the Barbary sheep *Ammotragus lervia* and the roe deer *Capreolus capreolus*. The roe deer is a browser, whilst the Barbary sheep and Spanish ibex would both browse and graze. The acquisition of these and their possible contributions to the Upper Rock Nature Reserve are discussed fully in Chapter 13.

Apart from helping to manage and maintain habitats, the presence of ungulates in the Nature Reserve would enhance the aesthetic appeal of the Upper Rock for tourists and locals who are keen on observing wildlife.

10.4.9 Habitat Management

The task of managing the vegetation of the Upper Rock as described above is one that is not extremely intensive (given that most of the Nature Reserve's vegetation requires little or no management), but which needs constant, year-round attention. In this sense, it would be desirable to employ a team of 10-12 persons in order to address all aspects of management of the Upper Rock's vegetation. This would include the clearing of the firebreaks and roadsides, management of garigue habitats, clearing and management of the disused water catchments at Rock Gun, control and eradication of exotic flora within the Upper Rock, removal of exotic species from the PSA and Mount Gardens and the replanting, maintenance and care of native species at these two sites. This team should be trained and supervised by GONHS personnel, and should carry out their works in accordance with the guidelines set out in this report. The responsibilities of this team of workers could easily be combined with matters that do not relate to habitat management, as described in the Action Plan (Chapter 24).

10.5 Recommendations

1) Most areas of high maquis, the habitat that dominates on the Upper Rock, should be left to develop naturally.

2) Every effort should be made to control the aggressive species *Acanthus mollis*. This should particularly be the case in open areas, where this species has only recently established itself, and where its impact to other species is greatest. This could be carried out using a herbicide that contains glyphosphate. If this is done, then care must be taken not to eliminate surrounding plants in the process. Alternatively, open areas can be cleared of *A. mollis* manually during the early spring. The introduction of large herbivores, as described in Chapter 13 and section 10.47, would almost certainly cause an immediate negative impact on the success of this plant.

3) Research on the reasons behind the recent success of *Acanthus mollis* in Gibraltar would be greatly welcomed, as the findings would go a long way towards determining suitable methods of control.

4) Firebreaks should be cleared annually using the methods highlighted in Chapter 11.

5) Roadsides should be cleared annually, but only using the guidelines stated in Linares (1997), which are explained in Chapter 5. This will help to maintain the Upper Rock's floral diversity. Given that open areas are being lost, and that even some matorral species now find their strongholds on roadsides, it would also be useful to widen the area of vegetation cleared on roadsides so that three or four metres remain clear on each side of the road. This is also stated in Chapter 5.

6) The disused water catchment at Rock Gun requires immediate habitat management if it is to remain an area of importance to plants and animals of open, rocky areas. All trees and woody shrubs should be removed from this area. The introduction of ungulates to this area would help to maintain the vegetation permanently low. This is discussed in more detail in Chapter 18 and in Bensusan & Perez (2003).

7) The removal of exotic species from both woodland sites (PSA gardens & the Mount) would be an important step in the restoration of the last vestiges of Gibraltar's original woodland habitat. Particularly important is the removal of *Ailanthus altissima* from both sites, as this species spreads extremely quickly through seeds and suckers and excludes native species. The control of *A. altissima* is discussed fully in Chapter 8, section 7.

8) Planting programmes should take place at both woodland sites. Ideally, each exotic tree removed should be replaced with a native tree. Species suitable for replanting are *Quercus rotundifolia, Q. canariensis, Fraxinus angustifolia, Laurus nobilis* and *Ceratonia siliqua*. In addition, there is much scope for replanting at the PSA nursery (in addition to the replacement of exotic species with native ones) where an example of Mediterranean woodland could be planted and managed.

9) The PSA nursery should continue being utilised as a site at which to propagate native species. This is already being carried out by a group of GONHS volunteers, who have grown hundreds of saplings that are suitable for replanting on the Upper Rock. Significantly, this includes many pines, which could be used to replace those that have died (*see* Chapter 9).

10) All cliffs surrounding the Upper Rock Nature Reserve should be included within the Nature Reserve boundary. Many of these cliffs are already included, but the boundary around cliffs is not clearly defined. In addition, all cliffs in Gibraltar should be designated as Special Areas of Conservation under the EC Habitats Directive.

11) Garigue habitats are amongst the most important areas for flora on the Upper Rock. Therefore, these should be managed to prevent them from developing into maquis. Woody shrubs such as *Olea europea, Rhamnus alaternus, Pistacia lentiscus* and *Osyris quadripartita* should be removed from these areas, as well as from areas that are currently composed of Maquio-garigue. As ever, GONHS should be consulted before any removal takes place.

12) The introduction of ungulates to the Upper Rock Nature Reserve could prove an effective measure in controlling and maintaining the vegetation of the Upper Rock. This is discussed fully in Chapter 13.

13) A team of 10-12 persons should be employed to tackle every aspect of habitat management within the Nature Reserve. This would include the clearing of firebreaks, roadsides and disused water catchments, the control and eradication of exotic flora and replanting programmes. This team could also tackle other aspects of Nature Reserve management, such as the clearing of pathways, etc. The team should be trained and supervised by GONHS personnel.

Southern polypody, a fern of shady areas of the Upper Rock.

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11. Fire and Firebreaks

11. Fire and Firebreaks

The Upper Rock can become extremely dry during the summer months, and the abundance of dry vegetation during this period makes fires a very definite possibility. Indeed, several large fires have occurred on the Upper Rock, the most recent of which took place during the summer of 1988. Therefore, precautions against fires are extremely important both to the residents of the Upper Rock and to the many thousands of tourists who visit the Nature Reserve every year, as well as to the wildlife of the area.

In spite of the threat that fire causes, not enough precautionary measures are taken to ensure that the risk of fire on the Upper Rock is minimal. A series of firebreaks exists on the Upper Rock Nature Reserve in order to contain any fire to specific areas and limit the spread of the same. However, firebreaks are not cleared as regularly as they should be and some are not cleared at all, as shall be seen later. In addition to this, the visitor is not made adequately aware of the dangers that some of their actions may pose to the Upper Rock during the summer months. Very few signs warning of the danger of fires remain, and the abundance of litter, which includes glass and tin aggravate what is already a serious threat.

11.1 Location of Firebreaks

The location of the firebreaks found on the Upper Rock Nature Reserve can be seen in Fig. 1.

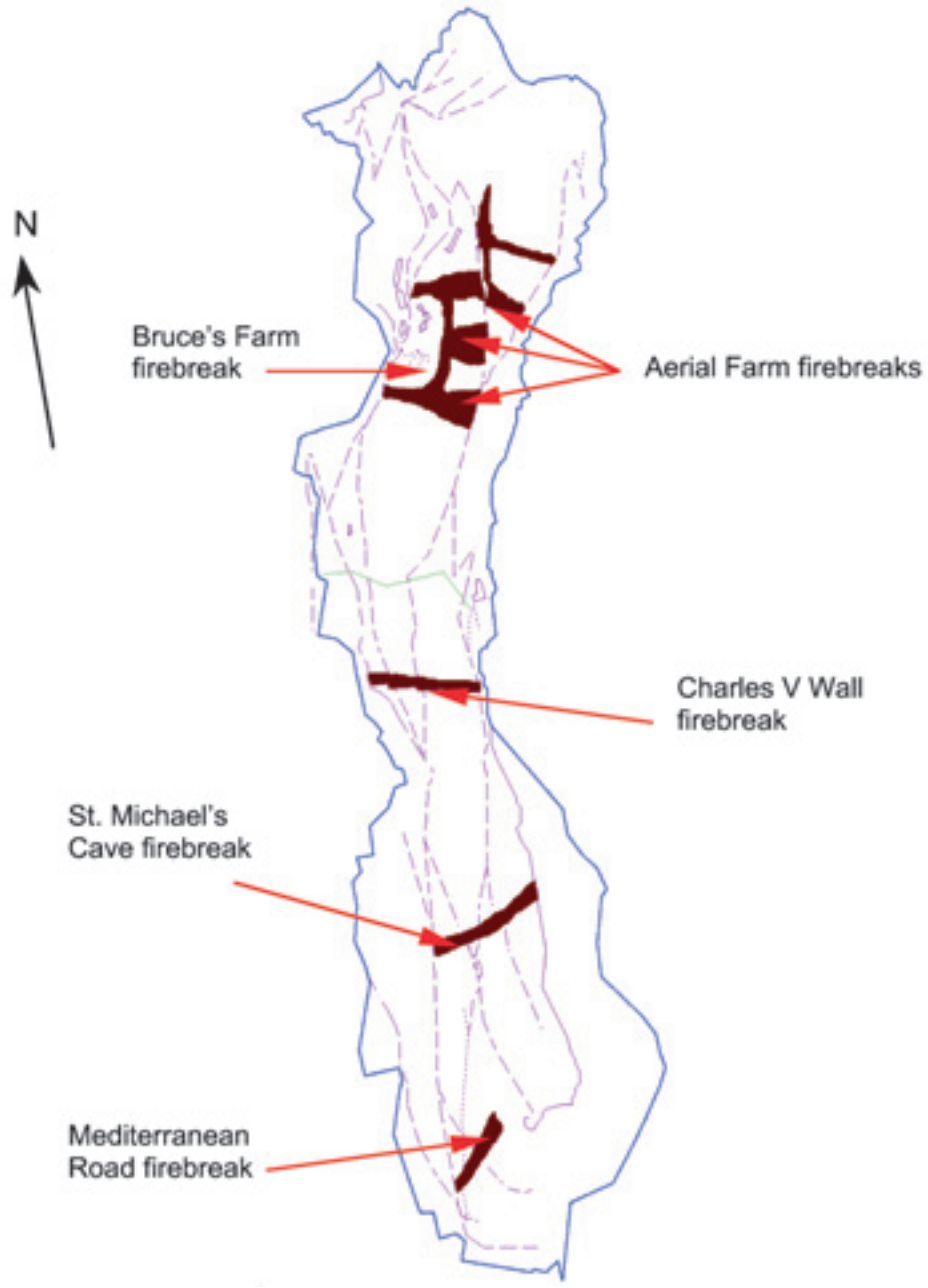

Figure 1. Map of Upper Rock Nature Reserve showing location of firebreaks.

Fig. 1 shows that firebreaks are spread out along the length of the Nature Reserve, with the highest concentration at the MOD aerial farm towards the northern end of the Reserve. These are in fact the best-maintained firebreaks on the Upper Rock. The three southernmost firebreaks are cleared from time to time, but not as regularly as they used to be, or indeed should be if they are to prove effective in the event of fire (A. Almeida, *pers. comm.*). The firebreak behind the Bruce's Farm residential area (labelled 'Bruce's Farm firebreak' on our map) has not been cleared for a number of years.

Firebreaks on the Upper Rock have different histories. Whilst those at Mediterranean Road, St. Michael's Cave, Charles V Wall and Bruce's Farm were created to control the spread of fire generally, those that are found within the MOD's aerial farm are there to protect the military installations and property. It is therefore likely that as these installations are dismantled or vacated, these firebreaks will cease to exist unless responsibility for their maintenance is assumed by the Government.

11.2 Flora and Fauna of the Firebreaks

The firebreaks on the Upper Rock are also extremely important for indigenous flora. They provide large clearings among the dense maquis that covers most of the Nature Reserve, a habitat that limits light penetration to the ground cover resulting in a limited growth of annuals (Linares 1997). Firebreaks therefore help to maintain the impressive diversity of plants found on Gibraltar, and 37% of the Rock's flora (213 species) can be found in these areas (Linares 1994). Some of the plants that grow on the firebreaks grow nowhere else in Gibraltar. Others, although not found exclusively on the firebreaks, find their main populations in these areas. Table 1 illustrates this.

Table 1. Plants that grow mainly or exclusively on the firebreaks. These are categorised as either only or mainly on the third column (taken from Linares 2003).

Species	Common Name	Only or Mainly
Ajuga iva	lesser ground pine	Mainly
Bellardia trixago	bellardia	Mainly
Campanula rampunculus	rampion	Only
Centaurium pulchellum	lesser centaury	Only
Cuscuta planiflora	dodder	Mainly
Daphne gnidium	Mediterranean mezereon	Mainly
Euphorbia exigua	dwarf spurge	Mainly
Euphorbia pterococca		Only
Hypericum perforatum	common St. John's wort	Only
Logfia gallica	narrow-leaved cudweed	Only
Medicago tornata		Mainly
Nepeta tuberosa	greater catmint	Only
Ononis pubescens	hairy restharrow	Mainly
Ononis viscosa ssp. subcordata	sticky restharrow	Mainly
Ophrys fusca ssp. fusca	brown-bee orchid	Mainly
Ophrys lutea ssp. lutea	yellow-bee orchid	Mainly
Orobanche sanguinea		Mainly
Parentucellia viscosa	yellow bartsia	Mainly
Pulicaria odora	fleabane	Only
Sideritis arborescens ssp. arborescens	shrubby sideritis	Only
Trifolium glomeratum	clustered clover	Only
Dulia geniculata		Mainly

Firebreaks are also important for the fauna of the Upper Rock Nature Reserve. Barbary Partridges *Alectoris barbara*, (which are endangered in Europe (Tucker & Heath 1994) and are a Schedule 3 species under the 'Nature Protection Ordinance, 1991' (L/N 11 of 1991)) require open areas in order to survive, and this habitat is becoming less common on the Upper Rock. Similarly, rabbits *Oryctolagus cuniculus*, favour open ground, and the clearing of firebreaks is important to their survival within the Upper Rock Nature Reserve. This is also the case for bats, most reptile species (*see* Cortes 1982) and invertebrates, being particularly important for phytophagous insects due to the floristic diversity that such areas harbour. Rabbits, bats, reptiles and many species of butterfly that use these sites are protected under Schedule 1 of the 'Nature Protection Ordinance, 1991'.

Despite being of such importance to the fauna and flora of the Nature Reserve, nowadays most of the firebreaks on the Upper Rock are not managed properly, and shrubs and small trees now grow on the majority of the firebreaks that are no longer cleared. Nowhere is this more evident than on the firebreak above the Bruce's Farm area (which is actually the firebreak that is richest in flora) where woody vegetation now reaches shoulder height, as seen in Fig. 2.

Figure 2. The vegetation on the Bruce's Farm firebreak has grown to such an extent that woody plants, some of which reach shoulder height, now dominate it.

If the vegetation on this firebreak continues to grow, the area will eventually lose its importance to indigenous flora. Furthermore, the development of a canopy over this until now open area may facilitate the spread of the exotic invasive *Senecio angulatus*, which already grows profusely in the Bruce's Farm area and the PSA nursery (*see* Chapter 8, section 8.1), into areas within and beyond the firebreak.

11.3 Fire and Firebreaks

In an interview, Divisional Officer of Operations and Training, Gibraltar City Fire Brigade Mr Tony Almeida expressed serious concerns regarding the threat of fire on the Upper Rock. In particular, Officer Almeida expressed the view that firebreaks are not cleared nearly as often as they should be, and added that the City Fire Brigade had expressed concern about this in the past to the management of the Upper Rock Nature Reserve, the Gibraltar Tourist Board. Officer Almeida also made reference to residential areas, highlighting that these are all surrounded by thick vegetation, and that none of these are protected by firebreaks. This is of particular concern given that some of the older buildings are constructed partly from timber. Particular reference was made to the Bruce's Farm residential area, and the fact that the firebreak surrounding these buildings has become extremely dense and now poses a threat. Surrounding vegetation should therefore be cut back around these buildings to provide firebreaks.

11.4 The Gibraltar City Fire Brigade and the Upper Rock Nature Reserve

The following is based on information received during an interview with Officer Tony Almeida of the Gibraltar City Fire Brigade.

The City Fire Brigade considers that there are two main seasons throughout the year, in terms of the threat of fire on the Upper Rock. These are the low-risk season (from the end of October to the end of May) and the high-risk season (from late May to late October). No checks are carried out on the Upper Rock during the low-risk season. During the high-risk season, the Upper Rock is divided into three main routes, and each one is checked every three weeks. Checks are always carried out on Fridays, and hydrants, tanks, general equipment and hazards are checked on every inspection. A report is produced that is sent to the Gibraltar Tourist Board, which manages the Nature Reserve. This report highlights all fire hazards identified, and suggests improvements to lessen the chances of fire.

The Fire Brigade has a contingency plan in case of fire on the Upper Rock. As soon as there is any indication of a fire within the Nature Reserve, all traffic is stopped at the Casino, and within the Nature Reserve, traffic is moved either on along the road or back towards the entrance, always away from the fire. Help from the cable car is also available to transport

equipment, etc. However, accessibility to the Upper Rock Nature Reserve during peak traffic hours is of grave concern to the Fire Brigade. Whereas before 10am it will only take a few minutes for a fire engine to reach the Upper Rock, this will take substantially longer during later hours of the day given that traffic can be heavy at times, and that roads within the Nature Reserve are narrow and unsuitable to clear such heavy traffic in the event of a fire. The fact that tour operators visit the Upper Rock more often during the high-risk season makes the situation particularly worrying. There are some traffic bottlenecks within the Nature Reserve that are of particular concern to the Fire Brigade, namely St. Michael's Cave, Jews' Gate, Prince Phillip's Arch and to a lesser extent Princess Caroline's Battery.

The Fire Brigade considers that vandalism is a problem within the Nature Reserve, particularly at night. City Fire Brigade equipment on the Upper Rock, such as water tanks, is frequently vandalised. When water tanks were filled with fresh water, people often used this water to wash their cars, with little regard to the dangers that this might pose. Due partly to vandalism, the supply of water hydrants within the Reserve is less than adequate. Many of these are not in a fit state, and it is unclear whom they belong to in any case (i.e., whether they belong to the MOD or the Government of Gibraltar). These should be replaced with fibreglass tanks, which would prove cheaper to maintain. The largest water tank within the Nature Reserve is found at Mount Misery, but the water level was down to about 50%, although the problem is being addressed (at 28/4/03). The supply of water to the Nature Reserve is the responsibility of the Government of Gibraltar.

There should be more signs on the Upper Rock making people aware of possible fire hazards. Cigarette ends and items of discarded litter such as shards of glass and tins can all cause fire. The litter problem on the Upper Rock aggravates the situation, and as a result the number of fire hazards on the Upper Rock is currently higher than it should be. Likewise, derelict cars, some of which can be found within the Nature Reserve, are of some concern. Whilst a smoking ban within the Reserve would be impossible to police, people should be advised or encouraged not to smoke by being made aware of the dangers that this may pose. The density of some of the vegetation on the Upper Rock, and in particular dry vegetation during the summer months is of concern to the Fire Brigade, which would favour a policy of vegetation clearing in some areas.

In addition to fires, the City Fire Brigade also carries out rescues, including cliff rescues, and has a small team that is trained for these purposes. In the event of a fire on the Upper Rock, the whole Fire Brigade Staff is called in, as is the Services Fire Brigade. As long as there are sufficient fire-fighting capabilities, half the battle is won, so availability and protection of equipment within the Nature Reserve is particularly important.

11.5 Management of the Firebreaks

Originally, all firebreaks within the Upper Rock Nature Reserve were managed by the MOD. This is no longer the case, and the MOD now clear only those firebreaks that form part of the aerial farm at Rock Gun and Middle Hill. This will presumably cease after 2004 as these areas are being handed over to the Gibraltar Government. The firebreak at Bruce's Farm, which at present falls within MOD land (see Bensusan & Perez 2003, and Chapter 10, section 10.33), is no longer cleared, and as such has developed dense, woody vegetation such as has already been described. The rest of the firebreaks on the Upper Rock fall under the responsibility of the management of the Upper Rock Nature Reserve, the Gibraltar Tourist Board.

11.6 Clearing of the Firebreaks

It is the authors' view and that of the City Fire Brigade, that firebreaks on the Upper Rock are mismanaged. This is especially the case with regard to those that are the responsibility of the Government of Gibraltar, but the state of the Bruce's Farm firebreak, which currently belongs to the MOD, is particularly worrying. The responsibility for maintaining these firebreaks will soon pass to the Gibraltar Government. All firebreaks should be cleared every year. Furthermore, the timing for clearing the firebreaks is crucial to the maintenance of floral diversity at these sites. The majority of the important plant species found on firebreaks will have gone to seed by the middle of July (this may vary somewhat depending on the length of the rainy season), and so clearing should not take place before this time (Linares 1997). This in fact ties in with the beginning of the high-risk season as defined by the City Fire Brigade.

Most of the important plants grow in fairly well defined areas within the firebreaks, and so with the right instruction and direction, clearing can begin sooner than mid-July, providing that these areas are avoided and left until the end. Linares (1997) highlights that if a certain order is adhered to, the clearing of the firebreaks can begin as early as the beginning of June without endangering any species. The order of clearing recommended by Linares (1997) is given next.

1st St. Michael's Cave firebreak and sections A, B, C and D of Bruce's Farm firebreak, in that order (Bruce's Farm firebreak sections are shown in Fig. 3).
2nd Charles V Wall firebreak.
3rd Mediterranean Road firebreak
4th Sections E to G of Bruce's Farm firebreak (as shown in Fig. 3). These are the most important areas for plants on any of the firebreaks, and should be cleared in alphabetical order (E, F, G).

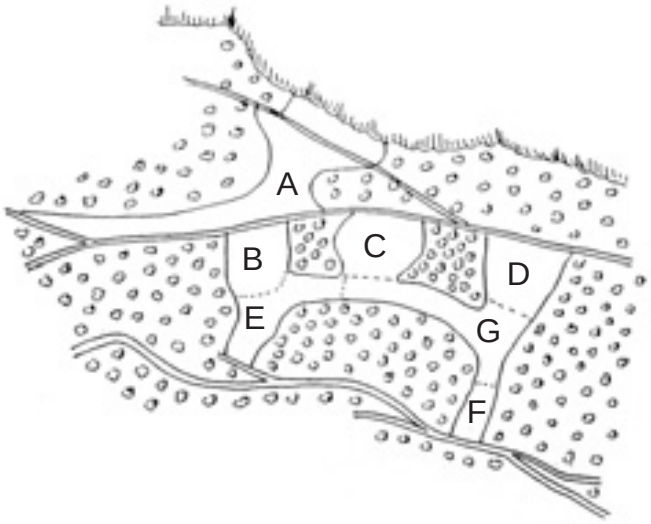

Figure 3. Diagram of the firebreak and aerial farm above Bruce's Farm. This is divided into seven sections, A-G, which should be cleared in succession to ensure the maintenance of the site's floral diversity (taken from Linares 1997).

When this clearing takes place, it is important that all woody vegetation be removed. The amount of woody vegetation varies from one firebreak to another. Some have little, whilst others, in particular the Bruce's Farm firebreak, are covered in bushes and small trees, namely *Calicotome villosa, Coronilla valentina, Olea europea, Osyris quadripartita, Pistacia lentiscus, Pistacia terebinthus, Rhamnus alaternus, Rhamnus lycioides* and *Genista linifolia*. These should be cut down, with stumps treated with a wood killer such as SBK to prevent these from sprouting again. The rest of the vegetation can be cleared with the use of rakes or shears, but care should be taken not to remove the topsoil, as this contains both the nutrients and the seeds that are necessary for the continued survival of interesting plant communities (Linares 1997). It is also important that the shrubs and bushes on the fringes of the firebreaks be cut back when firebreaks are being cleared, as these are encroaching on the open areas with the result that firebreaks, even when cleared, are gradually becoming smaller and smaller.

Further to the clearing of firebreaks, an effort should be made to open up the vegetation in some areas. This would lessen the threat of fire in these areas, and would assist the development of the vegetation and promote floral diversity within the Nature Reserve. It would also be useful to introduce ungulates such as Spanish ibex *Capra pyrenaeica*, or Barbary sheep *Ammotragus lervia*, to keep vegetation down on the firebreaks once these have been adequately cleared, as is also discussed in Chapter 13. This should in no way detract the importance of the maquis, which is a unique habitat not only in Gibraltar but also in southern Iberia, where the existence of this type of vegetation is relatively unique to the Rock.

11.7 Recommendations

1) The visitor to the Upper Rock Nature Reserve should be made more aware of the dangers of fire within the reserve. Signs should be erected highlighting that the deposition of matches, cigarette ends, glass bottles, tin cans, etc., all pose a serious fire hazard. Visitors to the Nature Reserve should be encouraged not to smoke, particularly during the summer months.

2) Collection and clearing of litter should be more effective to ensure that glass, tin and other objects that could pose a fire risk do not accumulate and are removed promptly.

3) Those firebreaks that currently exist within the MOD's aerial farm should not cease to exist once the military installations at these sites have fallen out of use. Rather, these should continue to be cleared by the managers of the land, be they the MOD or the Government of Gibraltar. This would be beneficial to both fire safety and the maintenance of biodiversity within the Nature Reserve.

4) Traffic on the Upper Rock is of some concern to fire safety. If a fire occurs during peak

hours, the heavy congestion of traffic at certain bottlenecks within the Nature Reserve will cause problems; it will make access difficult for the fire Brigade and will also make a quick evacuation of the Upper Rock problematic. This is just one of the reasons why the traffic problem within the reserve, including the use of the upper roads, needs to be tackled.

5) There is an insufficient number of water hydrants in some areas of the Upper Rock, and this should be increased in order to tackle large fires effectively.

6) Water tanks within the Nature Reserve are sometimes vandalised, rendering these useless. What is more, they are rarely replaced. Any damaged tanks should be replaced with fibreglass tanks, which would prove cheaper to maintain.

7) All firebreaks on the Upper Rock should be cleared on an annual basis. This is particularly important in the case of the Bruce's Farm firebreak, which has not been cleared for many years now and which was originally intended to protect a still active residential area from the threat of fire. As land owners within the Nature Reserve, the MOD should not be any less responsible for the safety of residents and visitors than the Government of Gibraltar, and as such should ensure that all of the firebreaks within their land, including the Bruce's Farm firebreak are cleared effectively on an annual basis.

8) Shrubs and bushes growing along the edges of the firebreaks should be cut back annually to ensure that these do not encroach on the firebreaks, reducing their size as they currently do.

9) Firebreaks should be cleared during the time of the year highlighted above, and in the sequence described in detail above.

10) In relation to the risk of fire on the Upper Rock the authors propose an 'Upper Rock Disaster Exercise' whereby the pertinent authorities would put into practice their Upper Rock Disaster Plan and enable the necessary planned infrastructure and strategy to tackle a major fire, serious traffic accident or any other serious incident that may occur on the Upper Rock. This exercise would highlight the problems and deficiencies, and enable the authorities to provide solutions in the event of a real disaster.

yellow-bee orchid Leslie Linares / GONHS

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12. Birds

12. Birds

The Upper Rock Nature Reserve boasts an impressive diversity of birds. This is largely due to its geographical position; the Strait of Gibraltar provides the most important bottleneck for migrating birds in Western Europe. An estimated 250,000 raptors cross the Strait in a season, and many passerines and near-passerines use the Rock as a stop-over site (Heath & Evans 2000). The number of these that cross the Strait undoubtedly exceeds that of soaring birds by many thousands (Moreau 1961). As well as this, a number of species that BirdLife International deem to be of European conservation concern (SPECs) breed regularly within the Upper Rock. These include the lesser kestrel *Falco naumanni*, which is of global conservation concern (Tucker & Heath 1994; Heath & Evans 2000). This chapter highlights the Importance of the Upper Rock Nature Reserve to both migrant and resident birds and discusses the challenges that these species face within the Nature Reserve.

12.1 Directives and Conventions

In addition to local legislation, several international conventions relevant to birds have been ratified by the United Kingdom Government on behalf of Gibraltar, and European Union Directives and Regulations also apply here (Heath & Evans 2000). The following all apply to Gibraltar (as given by Heath & Evans 2000):

• 'Biodiversity Convention: Convention on Biological Diversity (CBD)'. This convention has three objectives, namely the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the use of genetic resources. This convention applies not only to birds, but also to all other forms of life.

• 'Bonn Convention: Convention on the conservation of migratory species of wild animals (CMS)' aims to protect migratory species in recognition of the fact that these species need adequate protection throughout all parts of their migratory range if they are to be conserved, and that this requires international cooperation and action. Again, all migratory species, not just birds, are included under this convention. In Gibraltar, this would include birds, butterflies and moths, dragonflies, fish, marine turtles and cetaceans.

• 'EC Birds Directive': Council Directive on the conservation of wild birds (79/409/EEC). This Directive concerns the conservation and protection of all wild bird species in the European territory of the Member States of the European Union. All member states are committed to providing a variety of habitats and to preserve, maintain or restore an adequate proportion of these for all wild bird species in their territory. The number and the area of habitats to be designated as Special Protection Areas should be determined on the basis of the protection requirements and the conservation status of the species involved. One of the requirements of this Directive is the classification of Special Protected Areas that are considered the most suitable for the conservation of species or subspecies listed under Annex 1 of the Directive. These species include the lesser kestrel *Falco naumanni*, peregrine *Falco peregrinus* and Barbary partridge *Alectoris barbara*, all of which breed within the Nature Reserve. In addition to this, many of the migrant birds that occur within the Upper Rock are listed under Annex 1 of the Directive, and as such the Nature Reserve merits classification on this basis.

• 'EC Habitats Directive': Council Directive on the conservation of natural habitats of wild fauna and flora (92/43/EEC). The main aim of this Directive is to create a coherent ecological network (Natura 2000) of Special Areas for Conservation (SACs), setting a minimum standard for biodiversity conservation within the EU. The network should be designed to maintain the distribution and abundance of threatened species and habitats, and member states are required to take necessary and appropriate conservation measures for SACs. Member states are required to avoid significant disturbance and habitat deterioration within SACs. Any plans within or around SACs are also to be considered in accordance to the aims of the Natura 2000 Network, and works that affect the integrity of these networks should not be considered.

• 'World Heritage Convention: Convention concerning the Protection of the World Cultural and Natural Heritage'. The aim of the World Heritage Convention is the protection of natural and cultural areas of outstanding universal value. The Convention imposes a legal duty on each party to do its utmost to protect designated sites.

12.2 How are these applied in the Gibraltar?

Although the Government of Gibraltar is committed to those directives and conventions listed above, most of these have so far not been fully implemented. Most of the provisions of the Birds Directive were incorporated into the Nature Protection Ordinance (1991), but no "special protection areas" (SPAs) have yet been declared; and for example, although the Habitats Directive was transposed into Gibraltar law in 1995 (L/N118/95), nevertheless 'special areas of conservation' (SAC's) have not yet been designated. In fact, the European Union has considered initiating infraction proceedings against the United Kingdom due to the lack of implementation of the EC Habitats Directives, 'Natura 2000' Network in the UK, including specifically Gibraltar (given that Gibraltar is a member of the EU under the UK). This has prompted the Government of Gibraltar to initiate once again the implementation of this aspect of the Directive, although progress on this and on similar requirements relating to its sister Directive, the EC Birds Directive, had so far been slow. Similarly, no significant measures have been taken to conserve Gibraltar's biodiversity in accordance with the Biodiversity Convention. However, an effective implementation of the Habitats Directive that designates a wide cross-section of the habitats found in Gibraltar under the 'Natura 2000' Network, which also covers the requests of the Birds Directive, would also be seen as a measure taken in the spirit of the Biodiversity Convention, thus killing two (proverbial) birds with one stone.

The World Heritage Convention is similarly not adhered to. Both cultural and natural heritage, both within the Upper Rock and outside, are largely neglected. Historic buildings and sites within the Nature Reserve are largely in a state of neglect (except in a few cases where they provide direct money-earners for the management of the reserve), and a management plan for the natural aspects of the Upper Rock simply does not yet exist. This last point in particular is rather striking, given that the Upper Rock is after all a *Nature Reserve*, and was designated without any appropriate plan.

The only convention that can be said to have been implemented is the Bonn Convention, which aims to protect migratory species (be they birds or others) throughout the whole of their ranges. This convention has been implemented in that all migratory birds and cetaceans are protected in Gibraltar (in fact, all birds are protected in Gibraltar) under the 'Nature Protection Ordinance, 1991' (L/N 11 of 1991)), and should any illegal action be taken against such birds, this would no doubt result in prosecution.

12.3 International Importance of Gibraltar for Birds

The whole 600 ha. that comprise the Rock of Gibraltar is considered an Important Bird Area by BirdLife International, being classed as Gibraltar IBA 001 (the Strait is Gibraltar's second IBA, 002). It is important to stress that sites selected as IBAs have true significance for the international conservation of bird populations (Heath & Evans 2000). The criteria for international importance of IBAs is as follows:

A = site of global importance
B = site of European importance
C = site of importance within the EC

Gibraltar is afforded the IBA criteria A1, A4iv, B1iv, B2, C1 and C5* (Heath & Evans 2000).

12.4 Migrants

The Rock of Gibraltar, and in particular the Upper Rock Nature Reserve is dominated by a dense cover of mostly maquis, with some garrigue, and these habitats include many important fruit-bearing shrubs that support large passerine populations during passage periods and in winter (Heath *et al.* 2000). The slopes of the Rock also serve as a staging site for large numbers of passerine and near-passerine migrants. Most migratory western European species can occur at Gibraltar during the northward or southward migration periods (Cortes 1996). The passerine and near-passerine species that occur within the Nature Reserve on migration are listed in table 1, which shows that a number of these birds have an unfavourable conservation status within Europe.

In addition, many migratory birds of prey and storks congregate at the Strait of Gibraltar on their way towards their wintering grounds in Africa. When westerly winds blow across the Strait, Gibraltar itself sees the majority of raptor passage during both the pre-nuptial (northerly) and post-nuptial (southerly) migrations, and most of these birds fly directly over the Upper Rock Nature Reserve. The species that can be observed over the Rock on migration are listed in table 2. It is interesting to note, as can be observed from the table, that most of these birds have an unfavourable conservation status.

During the post-nuptial passage, when prolonged easterlies create windy, cloudy conditions, large congregations of raptors often form on the northern shore of the strait. The most

* A1= The site regularly holds significant numbers of a globally threatened species, or other species of global concern.
A4iv= The site is known or thought to be a 'bottleneck' site where at least 20,000 storks (Ciconiidae) raptors (Accipitriformes and Falconiformes) or cranes (Gruidae) regularly pass during spring or autumn migration.
B1iv= The site is a 'bottleneck' where over 5,000 storks, or over 3,000 raptors or cranes regularly pass on spring or autumn migration.
B2= The site is one of the 'n' most important in the country for a species with an unfavourable conservation status in Europe (SPEC 2, 3) and for which the site protection approach is thought to be appropriate.
C1= This site regularly holds significant numbers of a globally threatened species, or other species of global conservation concern.
C5= The site is a 'bottleneck' site where at least 5,000 storks and/or at least 3,000 raptors and/or 3,000 cranes regularly pass on migration.
(Taken from Heath *et al.* (2002).)

noticeable species during these periods is the booted eagle *Hieraaetus pennatus* (a bird with an unfavourable conservation status (Tucker & Heath 1994)), of which flocks of several hundred birds can occur, but many other species are also common. During these days, a varying number of birds, particularly booted eagles and Eurasian sparrowhawks *Accipiter nisus* roost on the Rock, particularly on taller trees such as those that line many of the roads. It is useful to point out that the number of birds roosting on the Rock has decreased substantially since the Upper Roads have been used by ordinary traffic, contrary to the requirements of what are rare and declining birds.

Eurasian sparrowhawk

Barbary partridge John Cortes / GONHS

Table 1. Migrant passerines and near-passerines of the Upper Rock Nature Reserve, together with their frequency of occurrence and conservation status and category attributed to them by BirdLife International.

Common Name	Scientific Name	Frequency of Occurrence	SPEC Category	European Threat Status
stone curlew	*Burhinus oedicnemus*	O	3	V
woodpigeon	*Columba palumbus*	O	4	S
turtle dove	*Streptopelia turtur*	R	3	D
great spotted cuckoo	*Clamator galandrius*	R		S
common cuckoo	*Cuculus canorus*	O		S
European scops owl	*Otus scops*	R	2	D
common nightjar	*Caprimulgus europaeus*	R	2	D
red-necked nightjar	*Caprimulgus ruficollis*	R		S
common swift	*Apus apus*	R		S
pallid swift	*Apus pallidus*	R		S
alpine swift	*Apus melba*	R		S
European bee-eater	*Merops apiaster*	R	3	D

CONTINUE >>

Common Name	Scientific Name	Frequency of Occurrence	SPEC Category	European Threat Status
European roller	*Coracias garrulus*	O	2	D
Eurasian hoopoe	*Upupa epops*	R		S
Eurasian wryneck	*Jynx torquilla*	R	3	D
short-toed lark	*Calandrella brachydactyla*	R	3	V
woodlark	*Lullula arborea*	O	2	V
common skylark	*Alauda arvensis*	R	3	V
sand martin	*Riparia riparia*	R	3	D
crag martin	*Ptyonoprogne rupestris*	R		S
barn swallow	*Hirundo rustica*	R	3	D
red-rumped swallow	*Hirundo daurica*	R		S
house martin	*Delichon urbica*	R		S
tawny pipit	*Anthus campestris*	R	3	V
tree pipit	*Anthus trivialis*	R		S
meadow pipit	*Anthus pratensis*	R	4	S
yellow wagtail	*Motacilla flava*	R		S
grey wagtail	*Motacilla cinerea*	R		S
white wagtail	*Motacilla alba*	R		S
rufous bush robin	*Cercotrichas galactotes*	O		S
European robin	*Erithacus rubecula*	R	4	S
common nightingale	*Luscinia megarynchos*	R	4	S
black redstart	*Phoenicurus ochruros*	R		S
common redstart	*Phoenicurus phoenicurus*	R	2	V
whinchat	*Saxicola rubetra*	R	4	S
stonechat	*Saxicola torquata*	R	3	D
northern wheatear	*Oenanthe oenanthe*	R		S
black-eared wheatear	*Oenanthe hispanica*	R	2	V
rock thrush	*Monticola saxatilis*	O	3	D
ring ouzel	*Turdus torquatus*	R	4	S
Song thrush	*Turdus philomenos*	R	4	S
redwing	*Turdus iliacus*	R	4	S
zitting cisticola	*Cisticola juncidis*	R		S
grasshopper warbler	*Locustella naevia*	R	4	S
sedge warbler	*Acrocephalus schoenobaenus*	O	4	S
European reed warbler	*Acrocephalus scirpaceus*	R	4	S
olivaceous warbler	*Hippolais pallida*	O	3	V
melodius warbler	*Hippolais polyglotta*	R	4	S
Dartford warbler	*Sylvia undata*	R	2	V
spectacled warbler	*Sylvia conspicillata*	R		S
subalpine warbler	*Sylvia cantillans*	R	4	S
Orphean warbler	*Sylvia hortensis*	R	3	V
common whitethroat	*Sylvia communis*	R	4	S
garden warbler	*Sylvia borin*	R	4	S
blackcap	*Sylvia atricapilla*	R	4	S
western Bonelli's warbler	*Phylloscopus bonelli*	R	4	S
wood warbler	*Phylloscopus sibilatrix*	O	4	S
common chiffchaff	*Phylloscopus collybita*	R		S
willow warbler	*Phylloscopus trochilus*	R		S
firecrest	*Regulus ignicapillus*	R	4	S
spotted flycatcher	*Muscicapa striata*	R	3	D
pied flycatcher	*Ficedula hypoleuca*	R	4	S
Short-toed treecreeper	*Certhia brachydactyla*	O	4	S
golden oriole	*Oriolus oriolus*	R		S
woodchat shrike	*Lanius senator*	R	2	V
Spanish sparrow	*Passer hispaniolensis*	O		S

CONTINUE >>

Common Name	Scientific Name	Frequency of Occurrence	SPEC Category	European Threat Status
chaffinch	*Fringilla coelebs*	R	4	S
brambling	*Fringilla montifringilla*	O		S
European serin	*Serinus*	R	4	S
greenfinch	*Carduelis chloris*	R	4	S
goldfinch	*Carduelis carduelis*	R		S
siskin	*Carduelis spinus*	R	4	S
linnet	*Carduelis cannabina*	R		S
common crossbill	*Loxia curvirostra*	O		S
Ortolan bunting	*Emberiza hortulana*	R	2	V

Frequency of Occurrence:

R = regular (every year)

O = occasional

SPEC category (Taken from Tucker & Heath (1994)):

1 = species of global conservation concern

2 = concentrated in Europe and with an unfavourable conservation status

3 = not concentrated in Europe but with an unfavourable conservation status

4 = concentrated in Europe and with a favourable conservation status

European Threat Status (Taken from Tucker & Heath (1994)):

E = Endangered

V = Vulnerable

D = Declining

R = Rare

S = Stable

Table 2. Raptor, stork and crane species that can be seen from the Upper Rock Nature Reserve on migration, together with their frequency of occurrence and conservation status and the category attributed to them by BirdLife International (which follow those of table 1).

Common Name	Scientific Name	Frequency of Occurrence	SPEC Category	European Threat Status
black stork	*Ciconia nigra*	R	3	R
white stork	*Ciconia ciconia*	R	2	V
honey buzzard	*Pernis apivorus*	R	4	S
black-winged kite	*Elanus caeruleus*	O	3	V
black kite	*Milvus migrans*	R	3	V
red kite	*Milvus milvus*	R	4	S
griffon vulture	*Gyps fulvus*	R	3	R
cinereous vulture	*Aegypius monachus*	O	3	V
short-toed eagle	*Circaetus gallicus*	R	3	R
marsh harrier	*Circus aeruginosus*	R		S
hen harrier	*Circus cyaneus*	R	3	V
Montagu's harrier	*Circus pygargus*	R	4	S
goshawk	*Accipiter gentilis*	O		S
sparrowhawk	*Accipiter nisus*	R		S
common buzzard	*Buteo buteo*	R		S
Spanish imperial eagle	*Aquila adalberti*	O	1	E
booted eagle	*Hieraaetus pennatus*	R	3	R
Bonelli's eagle	*Hieraaetus fasciatus*	R	3	E
osprey	*Pandion haliaetus*	R	3	R
lesser kestrel	*Falco naumanni*	R	1	V
common kestrel	*Falco tinnunculus*	R	3	D
merlin	*Falco columbarius*	O		S
hobby	*Falco subbuteo*	R		S
Eleonora's falcon	*Falco eleonorae*	R	2	R
lanner	*Falco biarmicus*	O	3	E
peregrine	*Falco peregrinus*	R	3	R
European crane	*Grus grus*	O	3	V

In addition to passage migrants, many migrants arrive from northern Europe every year to spend their winter in Gibraltar, augmenting the passerine density on the Upper Rock considerably. Species that winter on the Rock are listed in table 3.

common kestrel Juan Tébar/GONHS

Table 3. Birds that occur on the Upper Rock Nature Reserve during the winter, together with their frequency of occurrence and conservation status and the category attributed to them by BirdLife International with which they can be seen and conservation status criteria attributed to them by BirdLife International (which follow those of table 1).

Common Name	Scientific Name	Frequency of Occurrence	SPEC Category	European Threat Status
short-toed eagle	*Circaetus gallicus*	O	3	R
common buzzard	*Buteo buteo*	O		S
booted eagle	*Hieraaetus pennatus*	R	3	R
Eurasian woodcock	*Scolopax rusticola*	O	3w	Vw
tawny owl	*Strix aluco*	O	4	S
crag martin	*Ptyonoprogne rupestris*	R		S
grey wagtail	*Motacilla cinerea*	R		S
white wagtail	*Motacilla alba*	R		S
Dunnock	*Prunella modularis*	R	4	S
alpine accentor	*Prunella collaris*	R		S
European robin	*Erithacus rubecula*	R	4	S
black redstart	*Phoenicurus ochruros*	R		S
Stonechat	*Saxicola torquata*	R	3	D
song thrush	*Turdus philomelos*	R		S
Redwing	*Turdus iliacus*	O		S
Blackcap	*Sylvia atricapilla*	R	4	S
common chiffchaff	*Phylloscopus collybita*	R		S
Firecrest	*Regulus ignicapillus*	R	4	S
coal tit	*Parus ater*	O		S
common starling	*Sturnus vulgaris*	R		S
common chaffinch	*Fringilla coelebs*	O	4	S
European serin	*Serinus serinus*	R	4	S
European greenfinch	*Carduelis chloris*	R	4	S
European goldfinch	*Carduelis carduelis*	R		S
Siskin	*Carduelis spinus*	O		S

European bee-eater

Although most of the birds that winter within the Nature Reserve have a secure conservation status, some habitat management measures could ensure that parts of the Upper Rock provide an optimal habitat for these species. Opening up some of the vegetation and regular clearing of the firebreaks (as discussed in Chapters 10 & 11) would benefit most of these species, including the stonechat *Saxicola torquata* which is declining in Europe, and which can no longer be seen on the Upper Rock as often as it used to due to the increasingly dense vegetation.

12.5 Breeding Birds

Table 4. Breeding birds of the Upper Rock Nature Reserve, together with frequency with which they breed at the site and conservation status and criteria attributed to them by BirdLife International (which follows that of table 1).

Common Name	Scientific Name	Frequency of Occurrence	SPEC Category	European Threat Status
lesser kestrel	*Falco naumanni*	R	1	V
common kestrel	*Falco tinnunculus*	R	3	D
Peregrine	*Falco peregrinus*	R	3	R
Barbary partridge	*Alectoris barbara*	R	3	E
yellow-legged gull	*Larus cachinnans*	R		S
barn owl	*Tyto alba*	O	3	D
European scops owl	*Otus scops*	O	2	D
little owl	*Athene noctua*	R	3	D
Pallid swift	*Apus pallidus*	R		S
alpine swift	*Apus melba*	R		S
crag martin	*Ptyonoprogne rupestris*	O		S
winter wren	*Troglodytes troglodytes*	R		S
European robin	*Erithacus rubecula*	R	4	S
Nightingale	*Luscinia megarhynchos*	O	4	S
blue rock thrush	*Monticola solitarius*	R	3	V
Blackbird	*Turdus merula*	R	4	S
Sardinian warbler	*Sylvia melanocephala*	R	4	S
Blackcap	*Sylvia atricapilla*	R	4	S
western Bonelli's warbler	*Phylloscopus bonelli*	O	4	S
blue tit	*Parus caeruleus*	R	4	S
Great tit	*Parus major*	R		S
common raven	*Corvus corax*	O		S
spotless starling	*Sturnus unicolor*	R	4	S
house sparrow	*Passer domesticus*	R		S
common chaffinch	*Fringilla coelebs*	O	4	S
European serin	*Serinus serinus*	R	4	S
European greenfinch	*Carduelis chloris*	R	4	S
European goldfinch	*Carduelis carduelis*	O		S
rock bunting	*Emberiza cia*	O	3	V

As can be seen from the table 3, twenty species of birds breed regularly (i.e., every year) within the Upper Rock Nature Reserve. This number is augmented by some 9 species that, although not breeding every year, breed occasionally. Of these 29 species, 9 have an unfavourable conservation status, with the lesser kestrel *Falco naumanni*, being a species of global conservation concern, and the Barbary partridge *Alectoris barbara*, being endangered within Europe (as well as being a Schedule 3 species).

One of the species that breeds regularly within the Nature Reserve, the peregrine *Falco peregrinus* is given a European Threat Status of 'Rare' by BirdLife International, as well as hav-

ing a globally unfavourable conservation status. It is significant to point out that this species occurs in Gibraltar at a far higher density than in most parts of the world, due to the amount of food that occurs in the Strait area in the form of migrant birds. Within our two and a half square miles, 4-6 pairs of this species nest, with 4-5 of these nesting on the cliffs of the Upper Rock Nature Reserve. In the spring of 2002, six pairs nested on the Rock, five of these within the Nature Reserve (V. Robba & S. Olivero, *pers. comm.*).

Three of these 29 species are attributed a European Threat Status of 'Vulnerable'. These are the lesser kestrel *Falco naumanni*, the blue rock thrush *Monticola solitarius*, and the rock bunting *Emberiza cia.* Of these three species, the first two breed within the Nature Reserve every year. The blue rock thrush is found breeding on the cliffs in some numbers, and the population size has remained fairly stable over the years. This is not the case with the lesser kestrel however. This species breeds on the Cliff at North Front, directly below Princess Caroline's battery, where a colony of this bird finds itself in steady decline. Irby (1895) recorded vast numbers breeding here in 1895, and these had dropped to about 15 pairs by 1980 (Cortes et al. 1980). The count in 2002 recorded seven pairs (P. Rocca, *pers. comm.*) whilst five pairs were recorded in 2003 (V. Robba, *pers. comm.*), but the number of pairs has gone down to four in some years. The cause of decline seems to be a combination of habitat loss (given that its hunting grounds in the Spanish hinterland have been reduced due to increased urbanisation in the La Linea area) and competition for nesting sites with the larger and more robust feral pigeon, an introduced species. This is significant in that habitat loss and loss of nest sites is a problem that this species faces throughout the whole of its range (Heredia *et al.* 1996). The second factor seems to be a problem at many lesser kestrel breeding colonies in the vicinity, such as that at the castle at Vieja Castellar, where an increasing number of nest holes are being taken by pigeons, resulting in a decrease in lesser kestrel numbers (*pers. obs.*).

The Barbary partridge *Alectoris barbara*, is seen by many as Gibraltar's 'National bird', the reason for which it is depicted in various local artefacts, most notably on Government of Gibraltar one-penny coins and twenty pound notes. Gibraltar is the only place in mainland Europe where this species is to be found, and the only place in Europe where the hunting of this species is banned (this bird is also found in Sardinia and the Canary Islands, where it is hunted extensively (Tucker *et al.* 1994)). Our partridge is given a European Threat Status of 'Endangered', and has an unfavourable global conservation status. Although the population of partridges on the Rock is small when compared to those of Sardinia and the Canaries, it is a population of European importance, not only because it is located on the mainland, but also because it is unique in that it is free of human persecution.

There are however some problems which face the local population of the Barbary partridge, a large proportion of which is found within the Upper Rock Nature Reserve. The first of these is that there has been a notable reduction in suitable habitat for this species due to the pronounced neglect that some of the firebreaks have suffered from. Secondly, and equally serious problem is that there has been a marked increase in the feral population of the domestic cat *Felis catus*, with up to sixteen counted at one time at St Michael's cave, for example. Cats have a strong predatory instinct, and partridges, and in particular their chicks are easy prey for these animals. A female Barbary partridge lost seven chicks within the space of 24 hours, having its brood reduced from nine to two (J.P. Acolina, *pers. comm.*). Although the cause of death of these chicks is unknown, it is likely that domestic cats were responsible for at least some of them. An added problem is the rise in illegal chicken coops on the Upper Rock with one at St. Michael's cave, another beside the Cable Car Top Station and chickens around Bruce's Farm and Princess Caroline's Battery. These wildfowl can transmit diseases to the Barbary partridge and may compete for food. Predation by yellow-legged gulls *Larus michahellis*, is also a possibility and they may take some chicks from time to time (GONHS 1994).

The last confirmed nesting record of common raven *Corvus corax* in Gibraltar was back in 1972. However, a pair of ravens recolonised the Rock in 2000 and nesting was attempted at Anglian Way in 2001 and the cliffs above Catalan Bay in 2002 and 2003, although the raising of fledglings was unlikely on both occasions. Apart from further enhancing Gibraltar's biodiversity, there is one very clear benefit to the presence of ravens on the Rock; they are undoubtedly a nuisance to the gulls. These birds will readily feed on unattended eggs and chicks, and they have in fact been observed feeding on feral pigeon chicks and eggs as well (V. Robba, *pers. comm.*). The role of the raven in controlling both gull and, perhaps more effectively, feral pigeon reproductive success could in fact be an important one, since they have been seen to raid feral pigeons nests on the cliffs above Catalan Bay, (V. Robba, *pers. comm.*).

A number of bird species were lost as residents of the Upper Rock at the beginning of the Twentieth Century, either due to habitat loss or disturbance in WWII, during the quarrying of rock for the creation of the runway. Species that were lost include Bonelli's eagle *Hieraaetus fasciatus*, Egyptian vulture *Neophron percnopterus*, western jackdaw *Corvus monedula*, Dartford war-

bler *Sylvia undata*, and black wheatear *Oenanthe leucura*. Of these, two species disappeared due to habitat loss; the Dartford warbler due to the changing nature of the vegetation on the Upper Rock and the black wheatear due to both this and the development of the water-catchments on the sand slopes of the east side of the Rock. The other species, all of which bred on cliffs, were lost during the disturbance that the development of the runway caused.

It is significant to note that on the 19th June 2003, a female, hand-reared Bonelli's eagle was released in Gibraltar, after having been expertly trained by Vincent Robba and Stanley Olivero of the GONHS Raptor Rehabilitation Unit. The bird had been fed on yellow-legged gull carcasses and had been trained to hunt and attack gulls. For at least eight weeks the bird remained in Gibraltar, relying on the large yellow-legged gull population for food. However, as gulls began to undertake their post-breeding dispersal, the eagle moved away from the Rock. It was hoped that this bird would return to Gibraltar once the gulls did so, but it has not been seen since and the possibility that it found a mate in the territory in nearby Spain seems feasible. It was successful in disrupting the gull colony during its short stay and it might be an idea to acquire a pair of captive-bred Bonelli's eagles in order to try to establish a breeding pair. This would probably go a long way towards controlling the gull population, as these birds would predate on both adult and young gulls, and provide a source of constant disturbance to the gulls.

12.6 Recommendations

1) It is strongly advised that all Directives and conventions that Gibraltar is committed to, be fully implemented as soon as possible. Apart from avoiding infraction proceedings against the UK, these would be of unquestionable benefit to Gibraltar's wildlife. It would also ensure that Gibraltar is seen within these Directives and conventions as a responsible, respectable partner who is equally committed to conservation issues as other partners in these international efforts. The 'Natura 2000' Network in particular is important in that it covers many of the aspects of other conventions and Directives, as well as the Habitats Directive. A diverse cross-section of habitats in Gibraltar should therefore be protected on this basis. In addition, action plans should also be considered for species with unfavourable status (both locally and internationally), in order to ensure that important elements of our biodiversity are conserved.

2) There should be a co-ordinated programme for the control of the feral pigeon within and around the Upper Rock Nature Reserve. This would allow the globally threatened lesser kestrel to make maximum use of breeding sites available at the North Face of the Rock.

3) Heredia *et al.* (1996) recommend that all lesser kestrel colonies should be designated as protected areas. The cliffs of the North Face of the Rock and most of the cliffs along the Nature Reserve boundary are not included within the Upper Rock Nature Reserve. These cliffs should certainly be included within the Nature Reserve especially the North Face, given that it hosts an extremely vulnerable colony of lesser kestrels, as well as a range of Gibraltar's rare plants. In addition, other cliff sites that hold breeding lesser kestrels, peregrines, or other birds with an unfavourable status should be protected.

4) Heredia *et. al.* (1996) also recommend that colonies of lesser kestrels should be protected from accidental and deliberate disturbance. This applies to work carried out at Princess Caroline's Battery, which, when close to the colony, should take place outside the lesser kestrel's breeding season. This should also apply to any occurrences in Devil's Tower Road and its vicinity. It is also noted that a scrap-yard is located directly below the colony, and an effort should be made to create awareness of these birds amongst those who run and work at the scrap-yard, and to keep disturbance to a minimum. Rock climbing on any of the cliffs of Gibraltar should also be restricted during the breeding season. It is interesting to note that under the 'Nature Protection Ordinance, 1991' (L/N 11 of 1991) it is illegal to 'deliberately disturb any wild bird'[1]. In keeping with amendments of the UK Wildlife and Countryside Act (2000), this should be amended to include the word recklessly as well as deliberately, as for example, an excess of disturbance in the vicinity of a lesser kestrel colony, whilst not deliberate, could result in the loss of this bird as a breeding species on the Rock. It is worth noting that lesser kestrels frequently breed within town centres, in old buildings such as churches, and are therefore tolerant of some disturbance. People within the vicinity of a lesser kestrel colony can therefore go about their business normally, providing an excess of disturbance is not produced.

5) An effort should be made to increase the number of lesser kestrels breeding at the North Front colony or within the Nature Reserve through a reintroduction programme.

6) As has been said, one of the factors that has led to the sharp decline in lesser kestrels has been habitat loss. These birds once fed on the isthmus, and the habitat in this area has all but disappeared. It is interesting to note that one of the last vestiges of isthmus habitat is the MOD Aerial Farm on Devil's Tower Road. Aerials at this site are being dismantled, and the site will eventually be, in MOD parlance, 'alienated', i.e., released to the Government of Gibraltar. Given

[1] Pp.919,2A.(d).

the site's potential importance to the maintenance of our lesser kestrel colony, it would be wise to include this area within the 'Natura 2000' network, under the EC Birds Directive (of which the lesser kestrel is an 'Annex 1' species) and EC Habitats Directive, a system that is designed to conserve globally threatened species such as the lesser kestrel, and to which Gibraltar, under the UK, is committed. Not only this, but the site can be actively enhanced and restored back to its original state, with invertebrate, reptile and amphibian reintroductions (the spiny-footed lizard *Acanthodactylus erythrurus*, and western spadefoot toad *Pelobates cultripes*, were once found in this area), This would undoubtedly improve the site immensely for the lesser kestrels. Being an 'Annex 1' species, the Government of Gibraltar is required to participate actively in lesser kestrel conservation efforts.

7) An action plan should be drawn up for the conservation of lesser kestrels on the Rock, taking all of the above points into consideration. This is currently being prepared.

8) Regular clearing of the firebreaks should be carried out outside of the Barbary partridge's breeding season. This would ensure that partridges are not disturbed whilst they are breeding. It would also ensure that enough habitat is available to maintain a healthy population of Barbary partridges.

9) Stray cats provide a serious threat to much of the Upper Rock's fauna, not just birds. A serious attempt should be made to eradicate this pest species from within the Nature Reserve.

10) Deliberate release of this and any other animal and the feeding of the same should be made illegal, and the law enforced.

11) The establishment of chicken coops within the Upper Rock should be prohibited and the introduction and/or rearing of any wild animal or plant even in residential areas should be allowed only through the express permission of the Board of Management after consultation with the Scientific Authority.

12) The regeneration of the east side sand slopes means that a reintroduction programme for the black wheatear could prove successful, and is recommended, as the highly sedentary nature of this species makes natural recolonisation unlikely. This should extend to the cliffs of the Upper Rock and other suitable areas within the Nature Reserve, such as the area immediately below Rock Gun.

13) A possible reintroduction of the western jackdaw could be looked into, as these could possibly control the gull population in some areas with some success, given that gull eggs would provide a major food-source. However, these birds formally bred at the site where the lesser kestrels are to be found, and so any plans for reintroduction should be treated with caution, as this species could compete with the lesser kestrels for nest sites, and the lesser kestrels could also suffer from egg-theft as a result of the introduction. Should a reintroduction take place therefore (albeit after careful consideration), it is recommended that this be carried out at a different site to their former nesting site. A possibility for this could be the Moorish Castle, where, as well as being away from the lesser kestrels, the jackdaws would have easy access to the nests of those gulls that breed in the town area.

14) As well as tackling those species that are endangered at a European or global level, it is important to point out that BirdLife International recommends that 'absence of species from the SPEC list or its allocation to a low European Threat Status does not automatically justify its exclusion from national conservation action' (Tucker, *et al.*, 1994). It is therefore justifiably recommended that measures be maintained to protect the whole of the Upper Rock's breeding avifauna.

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13. Mammals

13. Mammals

Mammals are not well represented within the Upper Rock Nature Reserve. The list of species that are found within the Nature Reserve is therefore small, and is given in table 1, together with IUCN classifications. This is followed by a brief account of the status of each species within the Nature Reserve.

Table 1. Mammals currently occurring within the Upper Rock Nature Reserve, together with their IUCN classifications, which are as follows: DD = data deficient, LC = lower concern, VU = vulnerable. Classifications taken from Rowe (1996) and Palomo & Gisbert (2002).

Common Name	Scientific Name	IUCN Classification
Greater white-toothed shrew	*Crocidura russula russula*	LC
Greater mouse-eared bat	*Myotis myotis myotis*	
Mediterranean pipistrelle	*Pipistellus mediterraneus*	
Schreiber's bat	*Miniopterus schreibersii*	
European free-tailed bat	*Tadarida teniotis teniotis*	
Barbary macaque	*Macaca sylvanus*	VU
black rat	*Rattus rattus alexandrinus*	DD
house mouse	*Mus domesticus*	LC
Rabbit	*Oryctolagus cuniculus*	LC

As can be seen in table 1, none of the European bats are given a category by the IUCN. However, both the Schreiber's bat *Miniopterus schreibersii*, and the large mouse-eared bat *Myotis myotis*, are protected by European law, under 'The Convention on the Conservation of Migratory Species of Wild Animals' also known as the Bonn Convention, and more specifically in the 'The Agreement on the Conservation of Bats in Europe (1994)' (*see* Chapter 4, European Directives).

The status of each species within the Upper Rock Nature Reserve is given below.

• Greater white-toothed shrew *Crocidura russula russula* – small numbers can be found within the Nature Reserve, where it seems to be relatively common. Feral domestic cats *Felis catus*, are a threat to this species, as are discarded empty bottles and cans which these animals frequently enter in search of prey, only to find themselves trapped subsequently.

• Greater mouse-eared bat *Myotis myotis myotis* – large numbers formally occurred in the caves of the Upper Rock, where roosts of up to about 1000 were recorded in the 1960s (Palao *Unpubl.*) (a breakdown of the number recorded within each cave can be seen in table 2). The status of this species within the Nature Reserve (and in Gibraltar) is now uncertain, but numbers have certainly declined dramatically, and this bat has not been recorded for a number of years (although this may also be due to a lack of observers). Disturbance at roosting sites such as Martin's Cave is undoubtedly one of the reasons why this species has declined, as may be the loss of feeding habitat, although population patterns observed at Gibraltar may also mirror regional trends.

• Mediterranean pipistrelle *Pipistrellus mediterraneus* – this species is fairly common within the Nature Reserve, and throughout Gibraltar as a whole.

• Schreiber's bat *Miniopterus schreibersii* – caves in Gibraltar formally held large populations of this endangered species; about 6800 were recorded in caves within the Upper Rock in the 1960s (Palao *Unpubl.*) (a breakdown of the number recorded within each cave can be seen in table 2). However, like the greater mouse-eared bat, numbers have dropped substantially, and the largest number recorded recently has been 210 in 2002. These included two individuals that had been ringed at a roost about 200km northeast in Málaga province, Spain. Reasons for this sharp decline in numbers are likely to be similar to those for the greater mouse-eared bat, with disturbance to roosting sites and possibly loss of feeding habitat, being important factors, although another reason is disease, which has been noted in this species in Iberia in 2003 (A. Hutton. *pers. comm.*).

• European free-tailed bat *Tadarida teniotis teniotis* – this large bat is common within the Nature Reserve, and can frequently be heard at night. It roosts on cliffs, ledges and buildings in the Town, and is present throughout the year. Since it does not rely on caves and tunnels as roosting sites, it does not seem to suffer the same threats as the greater mouse-eared and Schreiber's bats.

• Barbary macaque *Macaca sylvanus* – the Barbary macaques found within the Upper Rock Nature Reserve are the only free-ranging non-human primates in the whole of Europe, and a population of 209 can currently be found within the Nature Reserve. Chapter 11 deals with the macaques at length.

• House mouse *Mus domesticus* – small populations of this species are located around human habitation, and some can be found at the Ape's Den.

• Black rat *Rattus rattus alexandrinus* – the black rat, originally introduced, is abundant within the Nature Reserve. Although these will feed on practically anything, within the Nature Reserve they seem to be mainly frugivorous in nature, with a particular taste for pine seeds (pine cones that have been attacked by rats are a common sight on the Upper Rock). The black rat is preyed upon by some of the predators of the Nature Reserve, particularly the larger snakes such as the horseshoe whip-snake *Coluber hippocrepis*, Montpellier snake *Malpolon monspessulanus*, and ladder snake *Elaphe scalaris*. It was also no doubt an important source of prey for the red fox before this species disappeared from Gibraltar.

• Rabbit *Oryctolagus cuniculus algirus* – a small population of rabbits can be found on the Upper Rock. Although found mainly in clearings, rabbits can also be seen within the scrub. Numbers fluctuate according to the prevalence of the *Myxomatosis virus*, but are never high. Another problem is that of pet rabbits which are often released on the Upper Rock. These have the potential to interbreed with the indigenous population, and can have a negative effect on the local genetic stock. Since numbers have in the past been hit hard by *Myxomatosis*, and given that the population on the Upper Rock is completely isolated, a reintroduction and captive breeding programme would help to maintain a healthy population.

Table 2. Breakdown of bat totals at different caves within the Upper Rock during the 1960s (taken from Palao *Unpubl.*).

Site	Species	Number
Goat's hair Twin Caves	*Miniopterus schreibersii*	300
Martins Cave	*Miniopterus schreibersii*	5000
	Myotis myotis	1000
Spider Cave	*Miniopterus schreibersii*	100
Old Hut, top of Med. Steps	*Miniopterus schreibersii*	50
Tunnel below O'Hara's Battery	*Miniopterus schreibersii*	200
Lower series, St Michael's Cave	*Miniopterus schreibersii*	500
Leonora's Cave	*Miniopterus schreibersii*	300
Breakneck Battery	*Myotis myotis*	30
Haynes Cave	*Pipistrellus spp.*	100
Ancient Moorish lookout	*Miniopterus schreibersii*	5
Ancient Visigothic guardhouse	*Miniopterus schreibersii*	200
Devil's Gap Battery, south magazine	*Miniopterus schreibersii*	20
Poca Roca cave	*Miniopterus schreibersii*	100
Willis's Magazine	Unknown sp.	200

In addition to these, several species occurred until relatively recently (*i.e.*, the last few hundred years). These are listed in table 3 together with their IUCN classifications, and an account of each species follows.

Table 3. Mammals that have become extinct within recent history, together with their IUCN categories.

Common Name	Scientific Name	IUCN Classification
Algerian hedgehog	*Atelerix algirus algirus*	DD
red fox	*Vulpes vulpes silacea*	LC
small-spotted genet	*Genetta genetta*	LC
wild boar	*Sus scrofa boeticus*	LC
Spanish ibex	*Capra pyrenaeica*	VU

Of these five species, the red fox, small-spotted genet and probably the Algerian hedgehog survived on the Rock into the twentieth century. The other two species disappeared long before this.

• Algerian hedgehog *Atelerix algirus algirus* – it is not certain whether this species ever actually formed a part of our fauna (at least in recent times). However, hedgehogs of this species were at one time seen or recovered from the Upper Rock with some frequency, although this is no longer the case. This species was in fact introduced to the Iberian Peninsula by man (Palomo & Gisbert 2002), and so is not native to the region, the native species being the western hedgehog *Erinaceus europeus*. However, this species does better in drier maquis and garrigue habitats than does its European counterpart, and is therefore more suited to the Rock's conditions.

• Red fox *Vulpes vulpes silacea* – the red fox was once found on the Upper Rock but became extinct in the 1980s. There are some who believe that foxes were originally introduced to Gibraltar by the British for the purposes of hunting. Jackson (1987) states of the early 1800s that 'it was at this time that the Reverend M.A. Mackereth, chaplain to the Duke of Kent, and a local lawyer, Mr. Ralph, imported the first two English foxhounds to hunt foxes on the Upper Rock'. This suggests that foxes already occurred on the Upper Rock naturally, and so the British decided to hunt them. However, the possibility of importations of foxes to bolster the local population cannot be ruled out.

• Small-spotted genet *Genetta genetta* – this animal, which was probably introduced to Iberia by the Moors, was certainly present in Gibraltar in recent history, possibly as late as the early 1900s, when genets were reportedly a nuisance to those who kept chickens (Miles 1920).

• Wild boar *Sus scrofa baeticus* – wild boars disappeared from the Upper Rock in the late 1700s.

• Spanish ibex *Capra pyrenaeica* – records of ibex in Gibraltar are prehistoric, and it is not known exactly when these animals disappeared from the Rock. Records of wildlife in Gibraltar before the 1700s are not good, and it may be that these animals were still present a few hundred years ago.

13.1 Mammal Reintroductions

Some scope exists for the reintroduction of certain species of mammals into the Upper Rock Nature Reserve. As mentioned previously, it would be a good idea to release rabbits on the Upper Rock in order to replenish the local population. Wild rabbits are bred in nearby Spain and can be easily obtained by GONHS.

A red fox breeding programme was attempted by GONHS based on the rationale that a fox population within the Nature Reserve would go a long way towards controlling the gull population of the Rock, and restricting these birds to cliffs (foxes would feed on adult gulls, young birds and even their eggs). This began in 1995, using animals from nearby Spain that had previously been kept in captivity. Unfortunately, due possibly to the fact that the male fox was profoundly imprinted these animals did not breed, and have not bred to this day. Although this was indeed a considerable setback, the option of a red fox reintroduction still remains open for the Upper Rock Nature Reserve. This would be beneficial, not only to the Nature Reserve, but to the whole of Gibraltar in the sense that a red fox reintroduction would go some way towards reducing the gull population of the Upper Rock effectively. GONHS have access to foxes from nearby Spain (which are frequently trapped and even culled in some areas) and so would have no problem in obtaining animals for the purposes of reintroduction. Furthermore, rather than embark on another attempt to breed foxes in captivity, it would be preferable to bring wild animals in from Spain, screen these for diseases, vaccinate them against any disease that might pose a danger to the public and then release them immediately.

Vegetation succession presents a serious problem to open areas in the Upper Rock, particularly given that areas such as firebreaks are not cleared as often as they used to be (some are not cleared at all). One solution to this problem would be to introduce large herbivores into these open areas. If this is carried out following the clearing of the area, then these animals will keep the vegetation permanently low. Perhaps this could be done using livestock such as cattle, sheep or goats. However, these animals would lend very little to the aesthetic appeal of the Nature Reserve. In this sense, it would seem far better to introduce wild ungulates such as Spanish ibex *Capra pyrenaeica*, or Barbary sheep *Ammotragus lervia*. Both of these species are considered vulnerable by the IUCN (Palomo & Gisbert 2002), and so maintaining a population of any of these two species on the Rock would also assist in the conservation of these animals. The Spanish ibex would perhaps be the favoured option, given that this animal once occurred on the Rock and is still found in the mountains to the north of Gibraltar. However, there is no reason why both species cannot be introduced. These animals would help to both clear the vegetation and provide a natural attraction with-

in the Nature Reserve. Both Spanish ibex and Barbary sheep are readily available to GONHS. However, the two herds of domestic goat that are currently found on the Upper Rock (one at Royal Anglian Way and the other at Rock Gun) should be eliminated before this occurs to ensure that these do not interbreed with the introduced animals, as they are certainly capable of doing with the ibex.

The possibility of introducing roe deer *Capreolus capreolus*, to Gibraltar has been considered in some detail. Discussions with Spanish roe deer expert Dr Cristina San Jose Huguenot, which included a visit to the Upper Rock, have reached the conclusion that the habitat is suitable for the species. Many of the components of the Gibraltar maquis are known food plants for these small deer. Dr San Jose however recommended that in order to maintain a population of these animals, a number of watering points would be needed on the Upper Rock, with running water. She supported the initiative as this would set up a new population of the relatively uncommon Andalusian form of the Roe Deer.

Initial consideration is being given to the area above Bruce's Farm and the proposed Middle Hill/Rock Gun Biological Reserve as the most suitable in which to locate a source of water for these animals, and the possibility of setting up a number of watering points with running water is being studied. A number, probably four, young Roe Deer, which would be made available by the Cádiz Conserjería Provincial de Medio Ambiente would then be released on the site, fitted with radio collars, and their movements monitored by GONHS.

Since the roe deer is a largely solitary browser that lives in low densities (compare a few smaller, solitary animals to a whole herd of the larger and more voracious ibex or sheep), then this herbivore would probably have a limited effect on vegetation control, but the main purpose of the introduction would be to enhance the diversity and interest of the fauna of the Upper Rock. There is no doubt that the chance of seeing a roe deer on an early morning or late evening walk would enhance the appeal of the Upper Rock Nature Reserve considerably to both tourist and local nature enthusiasts. However, given that the species is hard to see in its native habitats due to its secretive habits, the roe deer would not be an animal that most visitors to the Upper Rock would be able to observe. Furthermore, introducing roe deer would incur the cost of constructing and maintaining several watering points. The advantages and disadvantages of introducing this animal must be seriously weighed out before a firm decision is made on the possibility of its introduction to the Upper Rock Nature Reserve.

13.2 Recommendations

1) A more effective system of litter control and clearance (taking in the whole of the Nature Reserve and not only the roadsides) is needed on the Upper Rock, as cannot be stressed enough. Discarded cans and bottle pose a serious threat to shrews, and is just one of the many reasons why the litter problem on the Upper Rock should be addressed effectively.

2) Although grilles and fences have been erected close to the entrances of some of the caves and tunnels that bats use as roosts, the actual management of the Nature Reserve should take a more active part in the conservation of bats, and in particular bat roosts on the Upper Rock. This should include erection of and repairs to fences and grilles when these are needed, as well as monitoring of bat populations. Monitoring should always be carried out in a responsible manner, and should not take place without the advice and supervision of experts (such as GONHS members).

3) Some thought should be given to the introduction of wild rabbits in the Nature Reserve in order to replenish the depleting local population. These can be obtained by GONHS from nearby Spain, where wild rabbits are bred in large numbers. This would, for example, make the local population less vulnerable to extinction due to factors such as severe outbreaks of the *Myxomatosis virus*, which sometimes affects the local population dramatically (although it is now a number of years since large numbers of rabbits suffering from this disease were last observed). Steps should also be taken to remove released domestic rabbit and to prevent future releases of this type.

4) The reintroduction of red foxes to the Upper Rock Nature Reserve should be attempted once again. Young animals can be procured from Spain, screened for diseases and vaccinated against any possible disease such as rabies, canine distemper, etc. Those animals that are clear of disease should be released after a small period of familiarisation, within the current fox pen. This release could be carried out at a time during which gulls are common on the Upper Rock, such as the gulls' breeding season. An abundance of food would certainly make the animals adapt to the Upper Rock more quickly (although foxes are highly adaptable creatures, and food sources such as rats, berries etc. are always available).

5) Large grazers such as Spanish ibex or Barbary sheep should be introduced to areas

of the Nature Reserve where vegetation is low, such as the firebreaks and the Rock gun water catchment. If this is preceded by a clearance of the vegetation, then these ungulates will help to maintain the vegetation permanently low. Since the ibex was formally found on the Rock and is still native to southern Spain, then this would possibly be the preferred option. However, it must also be considered that the Barbary sheep is an animal that is seriously threatened with extinction within its native range. The maintenance of a herd on the Upper Rock would then justifiably serve as a case of *ex situ* conservation. The possibility of introducing a herd of each species, perhaps with ibex introduced to the disused water catchment at Rock Gun and sheep introduced to the lower firebreaks, could also be considered. Access to these animals would present little problem. Barbary sheep can be readily obtained from Jerez zoo, whilst, as in the case of the roe deer, the Cádiz Consejería Provincial de Medio Ambiente would make ibex available to us.

6) The introduction of the roe deer is a more complex issue, and one that requires serious consideration before making any decision. This animal would undoubtedly enhance the appeal of the Upper Rock Nature Reserve, and the chance of catching an elusive view of one of these animals during the early morning or late evening is something that would excite any person with a love or appreciation of nature. However, it must also be considered that roe deer need a constant supply of water, and any attempted introduction must take into account that a water supply must be properly maintained, and that this will undoubtedly incur some sort of cost.

7) The population of feral cats *Felis catus*, that currently exists on the Upper Rock should be eradicated, as these pose a serious threat to smaller mammals such as shrews and rabbits, as well as birds, reptiles and amphibians, and may compete with introduced red foxes.

red fox Eric Shaw / GONHS

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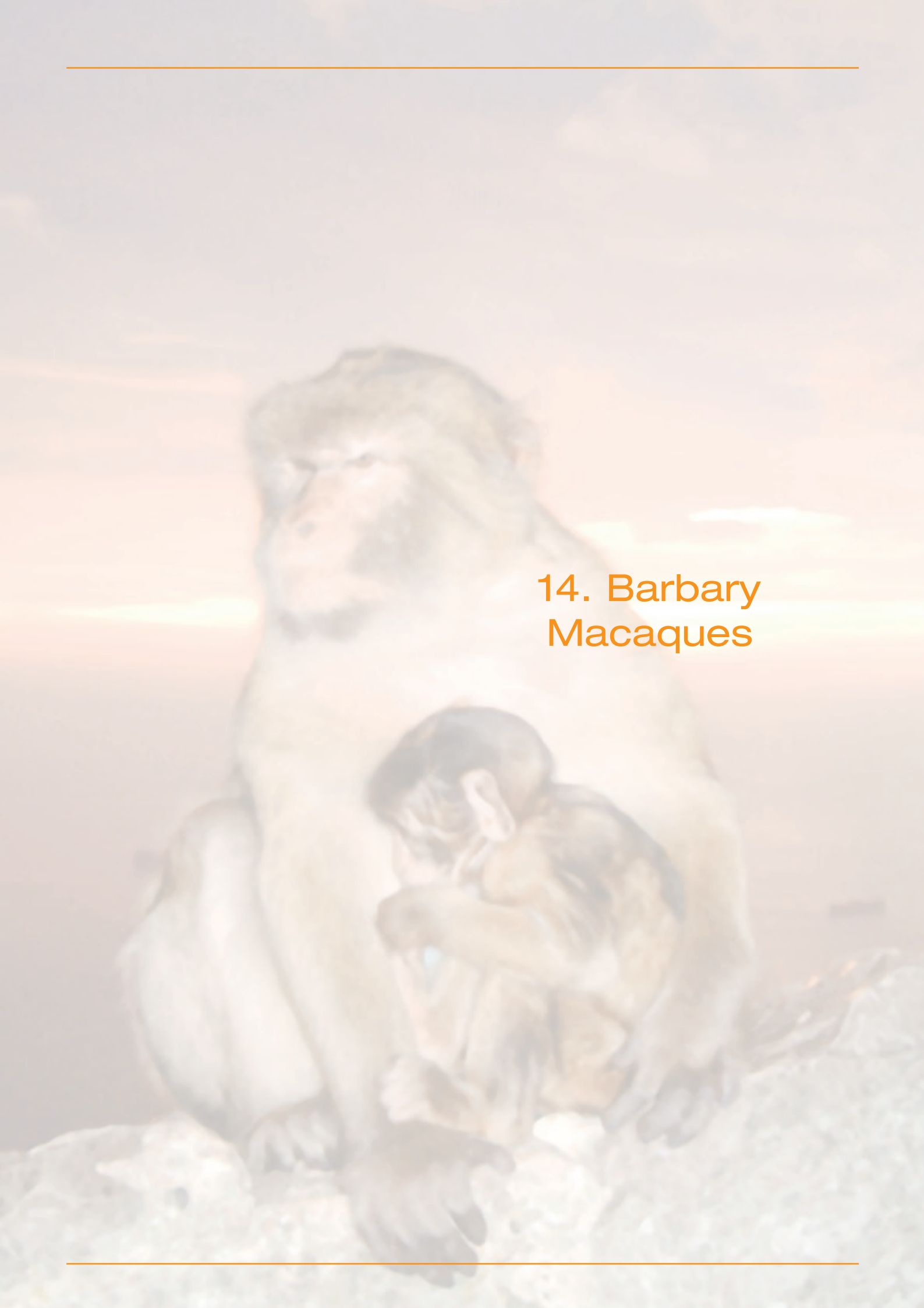

14. Barbary Macaques

14. Barbary Macaques

The Barbary macaque *Macaca sylvanus*, known locally as the Rock Ape, is the only free-ranging wild primate in Europe. Its European range is restricted to the Rock of Gibraltar, where they have possibly been present since the Moorish occupation of the Iberian Peninsula from 711ad. Records of their presence during the British occupation date back as far as 1740 (Burton 1972; Dawn Carroll 2001).

In 1915, the Armed Forces in Gibraltar took on responsibility for the Barbary macaques on the Rock, with the Gibraltar Volunteer Corps managing the population (MacRoberts & MacRoberts1966; Dawn Carroll 2001). This consisted of regular feeding, allegedly in order to prevent the macaques from wandering down to town in search of food, and maintaining the population at a fixed number through culling. Initially, the population was maintained at twenty-five animals, and then at a minimum of thirty-four as from 1955 (Burton & Sawchuk 1974; Dawn Carroll 2001). Between 1939 and 1945 the population was restocked repeatedly with animals from North Africa (MacRoberts 1970, Burton & Sawchuk 1974; 1984, Dawn Carroll 2001, Cortes & Shaw 2003 *in press*). At one time during this period the population was critically low and was restocked at the request of the Prime Minister of the United Kingdom at the time, Sir Winston Churchill, on the basis of the legend that Gibraltar would only remain under British rule as long as there were Barbary macaques on the Rock of Gibraltar (Cortes & Finlayson 1988).

Originally, the macaques were restricted to one group at Queen's Gate, also known as the 'Apes Den'. At a later date a second group became established at Middle Hill. These two packs remained under the responsibility of The Gibraltar Regiment until 1990, when the Gibraltar Tourism Agency, owned by the Gibraltar Government, took over the responsibility of the Queen's Gate group at the 'Apes' Den'. The management of this group was contracted out to 'MEDAMBIOS' from 1990 until 1992, after which the Gibraltar Tourism Agency took over the management of the site, together with responsibility over the entire population. In 1992 Sights Management Ltd. was contracted by the Gibraltar Tourism Agency to manage the Barbary macaques (Fa & Lind 1996; Isola & Isola 1993; Dawn Carroll 2001). This arrangement continued until 1997 when the Gibraltar Tourism Agency ended the contract and took over responsibility for the management for the next two years. In 1999, after lengthy discussions, the contract was awarded to the Gibraltar Ornithological & Natural History Society (GONHS). At present the responsibility for the feeding and management of the Barbary macaques still lies with this organisation.

14.1 Documentation & Research

In 1915 the Army took over responsibility for the Barbary macaques, but it was not until 1920 that a record of numbers was kept, although this was not consistent until the early 1940's (MacRoberts & MacRoberts 1966; Dawn Carroll 2001). All the observed births since World War II were recorded in the Regimental Records up to 1992, with the names of different personalities in Gibraltar bestowed on new macaques. Twice a year the Regiment would carry out a census of the Barbary macaques. Obviously identification of individuals was not always conclusive and inaccuracies in this and exact numbers were possible (Burton & Sawchuk 1974; Dawn Carroll 2001), but since only one person of the Regiment was charged with the task of looking after the macaque's interests, the possibility of error was greatly reduced. Only four persons, usually sergeants, were tasked with this appointment between 1935 and 1990. The last two were Sergeant Alfred Holmes and Private Kenneth Asquez.

In 1992 Sights Management took over the responsibility of the macaques on contract from the Gibraltar Tourism Agency. During this period, the Barbary macaque population increased from the two groups at Queen's Gate and Middle Hill, the former splitting into three to form a new group at Anglian Way and another at Prince Philip's Arch, and the latter forming the groups at Farringdon's Battery, Princess Caroline's Battery and Middle Hill. The feeding staff in charge of the macaques, now headed by Mr. Mark Zammitt, recorded newly born individuals. However, documentation for this period is sparse.

During the early 1980s Dr John Fa researched the Barbary macaque in Gibraltar for his doctoral thesis. His research and subsequent papers (e.g., Fa 1984; Fa and Lind 1986), on this subject made him a world authority on this particular animal. Based on his wide knowledge and experience on the subject he was awarded the contract for the management of the macaques, under the company name 'MEDAMBIOS', from 1990 to 1992. During this time he introduced a rudimentary interpretation centre at Queen's Gate with the introduction of wardens to control traffic and provide information to tourists at the site. He also improved the feeding of the animals and focused on the conservation of the species.

When the contract between both parties was rescinded in 1997, the Gibraltar Tourism Agency took over management for a period of two years, using the same feeding staff. In 1999 GONHS was awarded the contract for the management of the macaques. This organisation's background and knowledge, together with contacts with various institutions have provided a constant flow of students researching different aspects of the biology of the species, which will ensure that the future of the Barbary macaque in Gibraltar is secure.

Apart from Fa's work, research on the Barbary macaque population at Gibraltar has been ongoing since the 1960's. Before the 1960's only general descriptions and a brief population study was published (Anonymous 1834; Kenyon 1938; Hooton 1942). In the 1960's, MacRoberts and MacRoberts (1966) studied the Macaques' social behaviour and reproductive cycles (Dawn Carroll 2001). In addition, Burton and her colleagues conducted initial research in a variety of disciplines of the biology of the macaques between the 1970s and early 1980s (Burton 1972; Burton & Sawchuk 1974, 1984, 1982, 1984; Burton & de Pelham 1979; Burton & Underwood 1987; Zeller 1980, 1986; Dawn Carroll 2001).

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Links were established by GONHS with the Anthropological Institute of Zurich in the early 1990s. This led to the establishment of an ongoing research relationship between Professor Robert Martin of Zurich University and GONHS, based at the 'Bruce's Farm Research Centre', which has produced numerous studies of the biology of the Barbary macaque with particular emphasis on genetics. After numerous visits Professor Martin presented GONHS with a proposed management plan, known popularly as 'The Martin Plan' (Martin 1997) that helped GONHS secure the contract for the management of the macaques in 1999. As part of the research and monitoring of the macaques, GONHS, together with the Veterinary Clinic initiated a programme to tattoo and microchip all the macaques. This project, together with a population control scheme is continuing at present.

After Professor Martin's departure to the Chicago Field Museum, research contact was established with the German Primate Centre, under Professor Keith Hodges. Other institutions currently active in research in Gibraltar under the GONHS co-ordinated "Gibraltar Barbary Macaque Project" are Notre Dame University, Indiana, USA and the University of Vienna, Austria.

14.2 Feeding

One of the reasons that the Army was tasked with the management of the Barbary macaques in 1915 was that these animals would venture down to the town in search of food, and were becoming a nuisance, frequently raiding kitchens and taking fruit from gardens in close proximity to the Upper Rock. It was thought, erroneously as it turned out, that if they were fed up the Rock they would not venture into areas of human habitation. Initially, the Army was tasked with maintaining the population to within twenty-five animals and after 1955 to a minimum of thirty-four (Burton & Sawchuk 1974). Fa (1984) distinguishes four distinct periods of provisioning, distinguished by type and volume. From 1936 to 1946 only a proportion of the daily food requirement was provided, and some of this consisted of refuse from the cookhouse, resulting in widespread enteritis. The rest was obtained by the macaques through foraging. A similar volume of food was provided from 1946 to 1960, but in this case no cookhouse refuse was given. The absence of cooked and waste food during this period was responsible for the revival of the colony (Zeuner 1952; Fa 1984).

There was an increase in the size of the population between 1960 and 1967, resulting in the macaques being promoted as an important tourist attraction. This resulted in an increase in the volume of food provided. The provisioning of the second group took place at Princess Caroline's Battery, but this was later moved to Middle Hill. The quantity of food was increased a second time in 1970 with the aim of preventing animals wandering down to town. In 1980, culling of the population, which had been carried out by the Army without publicity, ceased (Fa & Lind 1996). This resulted in an increase in the population from 33 in two groups in 1970, to 105 in 1993 and 190 in 2001 (*see* Fig 1 & 2).

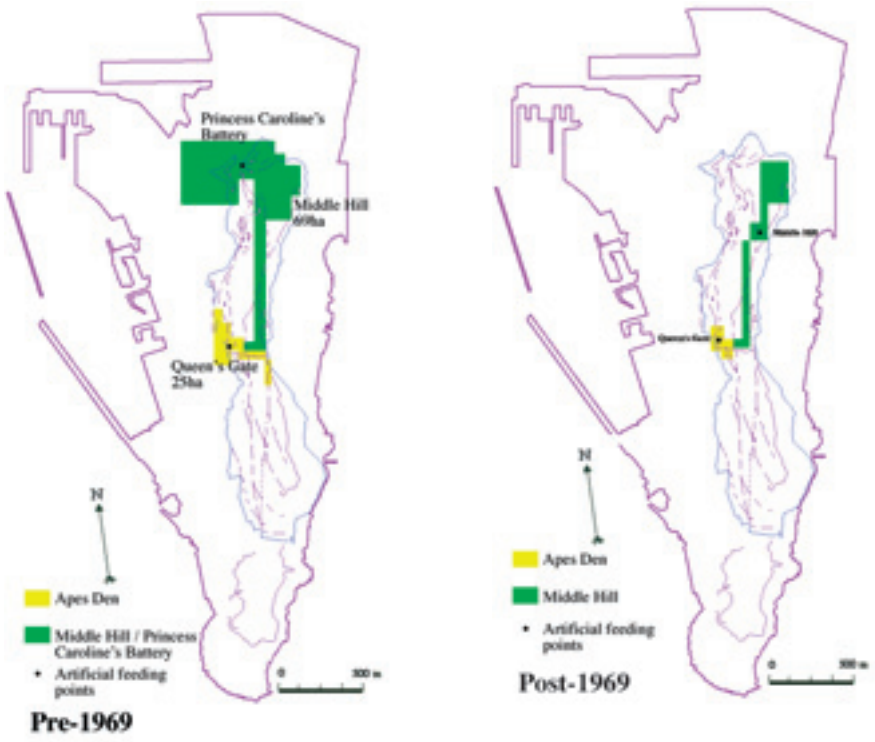

Figure 1. Home range sizes for both Barbary Macaque troops in Gibraltar before and after 1969. Data from MacRoberts and MacRoberts (1970) and Fa (Unpublished data).

The amount of food given throughout this period is difficult to quantify, but the actual expenditure on provisioned food found in the 'Gibraltar Government, Revenue and Expenditure Estimates' gives us an insight into the history of the management of the macaques. This started with £10 from 1940-50, and increased to £81 per animal per year in 1981 (Fa 1984). Roaming and foraging of the macaque groups was reduced (but not halted), possibly as a result of the increase in food supplied. Significantly, the Queen's Gate group greatly reduced its home range, presumably as a result of this and the considerable interaction and feeding by tourists. This is in stark contrast to the Middle Hill group, which although also experiencing a reduced home range, still foraged for extra sustenance.

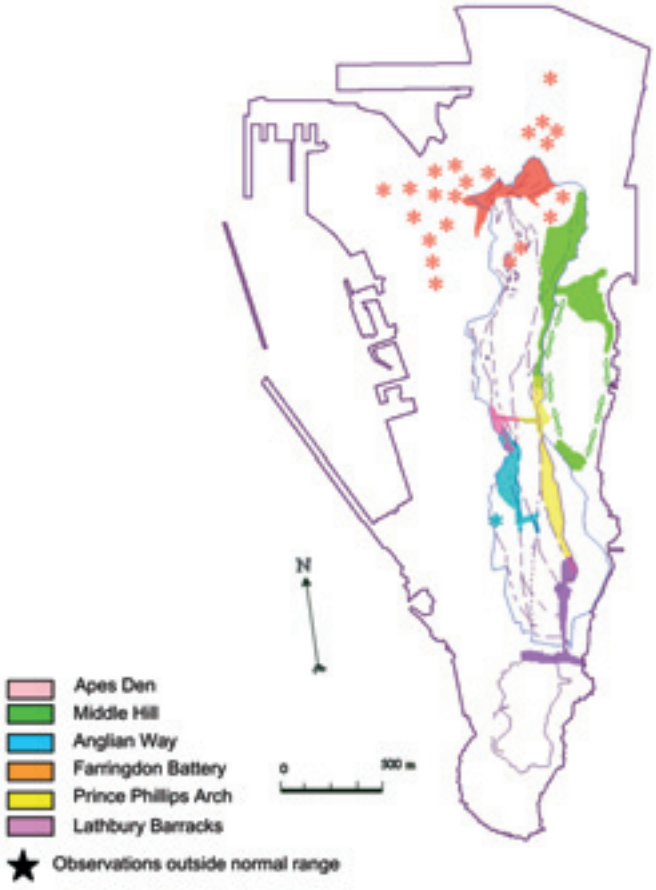

Figure 2. Current home ranges of the macaque groups (2004).

In his conclusions, Fa (1984) stated that there were current problems in overfeeding and overall disturbance from people visiting, and that the effect of this was proving detrimental to the breeding of the species and could present further problems in the future. Although this might be true, what in fact happened was an increase in the population coinciding with a huge increase in visitor numbers. Sights Management made considerable dietary improvements, on advice from GONHS, by providing a range of fruits and vegetables in the early morning and sunflower seeds and peanuts in the afternoon. Water was supplied daily but no vitamin or mineral supplements were provided, although the animals showed no deficiencies (Lewis 1997).

When GONHS took over the feeding, emphasis on "natural foods" and ensuring a nutritionally complete diet in accordance with the 'Martin Plan' (Martin 1997) was adopted. Additional nutritional advice was obtained from Dr. Jutta Küster, the biologist responsible for the captive population in Salem and later Daun in Germany. A minimum of 500g per animal per day was introduced on her recommendation. A breakdown of food provisioned during 2000 and 2001 is shown in Table 1 as an example. Recommendations on the feeding and routine management of the sites were undertaken where possible but not all sites have running water for adequate cleaning of the feeding area.

Table 1. Breakdown of food in kg /yr. for the years 2000 and 2001.

Total Amount In kg /year			
2000		**2001**	
Potato	9042.5	*Potato*	4512.5
Carrot	6305.0	*Carrot*	7280.0
Swede	1360.0	*Red Cabbage*	23.0
Orange	5639.0	*Orange*	2491.0
Cabbage	3901.5	*Cabbage*	5176.5
Onion	3627.0	*Onion*	3655.0
Sweet Potato	899.5	*Sweet Potato*	67.5
Pear	2607.0	*Pear*	2085.0
Celeriac	818.0	*Cauliflower*	486.0
Tomato	1552.0	*Tomato*	4829.0
Turnip	45.0	*Pumpkin*	6.0
Apple	5934.5	*Apple*	7467.0
Cucumber	1552.5	*Cucumber*	1322.0
Aubergine	10.0	*Melon*	3180.0
Banana	50.0	*Celery*	1300.0
Green Bean	20.0		
Total	43363.5	*Total*	43879.5

It must be stated that the amount of food given in Table 1 supplements the diet of the Barbary macaque. The macaques tend to forage frequently in search of their dietary preferences. This includes berries and wild fruit, roots and leaves and occasionally invertebrates.

14.3 Illegal Feeding

The problems caused by unauthorised feeding of the macaques dates back to the early 1900's when a law was passed prohibiting feeding. This was also incorporated in the 'Nature Protection Ordinance, 1991' (L/N 11 of 1991), but some taxi drivers and tour operators have continued this practice. They entice macaques to their vehicles using a variety of highly calorific and attractive foods such as chocolates and sweets, in the hope of receiving a substantial tip at the end of the tour. Many visitors and even locals do likewise and this has led to overweight and unhealthy individuals displaying lethargic behaviour and developing such diseases as diabetes. Nowhere is this more obvious than with the Ape's Den group, which until recently received the greatest number of visitors. The macaques also then associate humans, and their bags, with food, and tend to accost visitors and grab backpacks, etc., expecting the usual titbits.

Notices at all the sites warn of the dangers that these wild animals could pose, and signs bring to the attention that feeding is illegal and harmful to the animals. However, since there has been no enforcement of this law, many tour operators, taxi drivers and visitors have turned a blind eye. In 2002, the penalty for feeding macaques was substantially increased to £500, and larger signs were erected. There has been a subsequent improvement, but most people continue to feed the macaques. Many of those who chose to continue this prac-

tice have nevertheless realised the detrimental effects that chocolates and sweets were having on the animals due to concerns voiced by GONHS in the press. Now most people tend to feed them pasta, nuts and fruit, which although better food is still unacceptable (pasta and nuts in particular have very high carbohydrate contents and the problem of associating visitors with food continues). In addition, the problem posed by disease transmission through direct interaction is independent of the type of food presented. It must be highlighted that, since macaques are closely related to humans, both species potentially share many diseases.

One can understand the enjoyment of feeding a wild animal, and it also makes for better photographs. So what is the solution? Since there is no enforcement, despite the penalties being increased, the best solution would be to have food packets with appropriate nutritional items on sale to visitors at *only one site*, preferably the Ape's Den. This would supplement the daily requirements of the macaques and would provide an income to support the feeding costs and improve the nature of interactions between the animals and visitors. This of course excludes direct feeding, and food items must be placed on the ground to eliminate the possibility of disease transmission to and from the macaques.

Feeding outside the Upper Rock Nature Reserve, or at sites other than the Ape's Den should still be prohibited. This causes severe problems with groups wandering down to town, establishing themselves around areas where they can access rubbish bins and close to schools and restaurants, where they also receive handouts. They delight the public until such time when they enter dwellings with open windows and raid kitchens, damage and soil cars and washing and try to snatch bags from shoppers and schoolchildren, etc., which they associate with food. When this happens, the authorities have to call out the macaque management staff, which is faced with the unenviable task of luring the macaques back to the Reserve, in the knowledge that there will be a repetition of the problem the following day. Urbanised macaques will not readily become un-urbanised and will ultimately need to be culled. This has been done on several occasions since 1998, and has been the cause of considerable controversy.

This situation could be further aggravated in the future, as the Gibraltar population grows the demands for housing will put pressure on areas of the lower rock for development. This will inevitably mean more interactions with groups of macaques and the residents with an increase in the problems outlined above.

14.4 Population Control

The 'Martin Plan' recommended that the Rock of Gibraltar could accommodate a managed population of 400 macaques in 10-11 groups. With adequate feeding sites and a thinning of the vegetation to provide more foraging and ranging of the groups, it was envisaged that the macaques would be restricted to the Upper Rock Nature Reserve without ranging down to the town area. He estimated that without proper controls the population could reach 400 in 2001 and 800 in 2006. GONHS agreed that the potential population on the Rock could be 400 individuals but the clearing of vegetation would have an adverse effect on other wildlife and erosion would damage sensitive plant life. With this in mind, the suggested 'manageable' population would be in the region of 180 - 200 macaques in a maximum of six groups, and this is roughly the number of the population at the end of 2003 (*see* Table 2). So how can this number be maintained at a stable level?

Table 2. Status of the Barbary Macaque population on 1st Jan 2004.

Site	Males	Females	Total
Prince Phillip's Arch	31	31	62
Royal Anglian Way	15	24	39
Apes Den	19	18	37
Middle Hill	35	25	60
Farringdon Battery	14	12	26
Total	114	110	224

14.4.1 Culling

The number of Barbary macaques in Gibraltar was in the past maintained artificially by the British Army, including the Gibraltar Regiment. This was done by culling animals that allegedly presented a threat to people or property. Also, since numbers had to be kept low, any fragmentation of a group or aggression between young males resulted in the culling of these. Obviously, no publicity was given to this and for years the general public was unaware of this fact, assuming that the population was naturally stable. This clandestine methodolo-

gy only became clearer once culling ceased, with the transfer of management to the Gibraltar Tourism Agency, after which the population levels rose considerably. In recent years, approximately seventy-five animals have been culled as a result of a lack of demand for zoos or wildlife parks to take the surplus animals, and also because of aggressive behaviour on the part of some individuals.

In 1998 a group of macaques from the former Rock Gun/Princess Caroline's group took up residence in the Moorish Castle Estate area, remaining there as they were fed by residents. A decision to cull was taken and about 19 animals were put down.

In 1999 the increase in population levels resulted in a group establishing themselves at Catalan Bay outside the Caleta Hotel. They remained there because of the frequent illegal feeding on the part of tourists and the general public and because of lack of enforcement of the feeding laws. After all attempts to relocate/export the group had been exhausted, the decision to cull them was taken, and the twenty-four animals were regrettably put down.

In 2003 a section of the Middle Hill group again settled down at Catalan Bay outside the Caleta Hotel, as a result of enticement with food items and the presence of the Hotel's refuse bins, that provided the macaques with additional titbits. The macaque management officials where frequently called out to tackle the problem, but the group would descend on a daily basis. They would also frequently make their way across to the sand slopes above Sandy Bay, where workers were dismantling the MOD area of the water catchment's corrugated metal sheets. The problem came to a head in late July, a period when the beaches and the Hotel are full to the brim. This provided the macaques with the greatest interaction with people. There were frequent letters in the Gibraltar Chronicle complaining about this issue, especially by the residents of the area beside the hotel. This lead to the controversial decision on the part of the Ministry for Tourism, who instructed the Gibraltar Veterinary Clinic to cull the animals. The Ape Management officials and the GONHS were not fully informed. By the time GONHS had intervened, 27 macaques had been culled, including whole family lineages and mature animals, leaving many females with young on the basis that they were cute. This endeavour was illegal. It was not licensed under the Nature Protection Ordinance and was carried out at random, not respecting the family lineage and hierarchy. It also destroyed very valuable, ongoing data collection and the work of two postgraduate students from Zurich University.

This action led to cancellation, in protest, of the visit of the co-organiser and speaker Prof. Bob Martin to the Barbary Macaque conference in November 2003. In a press statement, Prof. Martin complained about the action taken by the Gibraltar authorities against the group of macaques that had been the focus of an ongoing study for more than two decades. This major setback resulted in a loss of confidence in academic students visiting Gibraltar, an embarrassment to GONHS, particularly on the eve of the conference, and the resulting financial implications, which include £2500 *per annum* in lab fees.

14.4.2 Re-location

The first option to be considered, and the most desirable is exportation. The 'Martin Plan' favoured this, with the possibility of exporting macaques to zoological parks in North America. Another possibility was to re-introduce some animals back into the wild in Morocco (Martin 1997). This is a costly affair, which involves a great deal of time and trouble, but the rewards would outweigh the problems. GONHS embarked in such a project in 1999 when the Farringdon group was captured and shipped in a specially chartered Antonov plane to the Wildpark, Daun, in Germany, (see Fig. 1). The cost was borne by the Gibraltar Government and received much publicity in the local press, but at £32,000 it was expensive, and the public purse could ill afford to spend such large sums regularly.

Figure 3. Barbary macaques from Gibraltar, foraging in their new home at Wildpark, Daun, Germany.

Other attempts at exportation have met with political impediments at the land frontier with Spain. Here, the Spanish authorities have blocked attempts to introduce the macaques into the country, even when in transit to other countries, although the animals had their veterinary certificates and CITIES papers in order. A recent export to Portugal was faced with such problems, and the animals eventually had to be transported by air via London. As a result of this, other avenues of population control were investigated, with the possibility of contraception favoured. This would certainly have more public acceptance than culling. In addition, the possibility of re-introduction to Morocco remains and is currently being investigated by GONHS as part of GIBMANATUR, an EU co-funded project under the INTERREG IIIA Gibraltar – Morocco programme.

14.4.3 Contraception

GONHS accepted the recommendations of the 'Martin Plan' to attempt to implant some female macaques with contraceptives every year. This would involve trapping from September to November, and would require about five people dedicated to this operation on a full time basis for the duration of this period. An estimate of the costs was prepared by GONHS for one of the groups and is reproduced in table 3.

Table 3. Implanting of females at Middle Hill 1998 (taken from Martin (1997)).

Staff & Equipment	Duration (weeks)	Cost (£)
Feeding cage		2,500.00
Veterinarian from Salem	1	1,000.00
Dr. Walter Angst (Salem).	1	1,000.00
Travel costs for Salem team.		1,000.00
Accommodation for Salem team	1	500.00
GONHS personnel (5 including one veterinarian)	3	5,000.00
Transport, etc	3	1,000.00
Tranquilliser darts, and related equipment etc.	3	5,000.00
Total		17,000.00

Dr Walter Angst, the Managing Director of the macaque park at Affenberg, Salem, would train GONHS personnel, who would be able to carry out the work in future years, and the veterinarian from Salem would do likewise with the local vet. These costs and the construction of the feeding cage would not be incurred in future years. Initially, only a representative from Zurich University would be needed for the collection of samples for the ongoing genetic work and to supervise the operation. The recurrent expenditure would be in the region of £13,000. This, multiplied by the number of groups, works out to between £50,000 and £65,000 *per annum* plus the cost of the contraceptives. It was felt that the cost should be borne from the entrance fees to the Upper Rock Nature Reserve. Bearing in mind that the Barbary macaques are the main attraction for tourists visiting the Rock, the Gibraltar Tourism Agency should re-invest whatever is necessary into maintaining a healthy and well-managed macaque population, which after all is its key product in the Nature Reserve. Unfortunately this project never got off the ground.

Recently, in early 2003 GONHS, together with the Veterinary Clinic, managed to acquire a new contraceptive that was effective for a period of two years. These implants could be applied at any time of the year, even to pregnant females that would, after giving birth, remain sterile for the rest of the period. Females from all the groups are presently being implanted with the contraceptive, leaving a few to rear young so as not to disrupt the cohesion provided by the interactivity of sexes and ages within the groups. The ability to work throughout the year and the duration of the implants has reduced the cost of the exercise and made it viable. At the time of writing eleven females have been implanted.

14.5 Routine Management

In the 'Martin Plan', Prof. Martin made a number of suggestions that GONHS listed as a number of recommendations. These are reproduced here together with the action that has been taken.

a) Feeding of the six groups should be in set locations. At present the sixth group (Formerly at Rock Gun) has no set location. This should now be relocated at the bottom of Green Lodge Road. The MOD is now considering the acceptability of this option as regards radiation hazards.

The sixth group moved down from Rock Gun to the Upper Galleries and was then enticed down to a fixed feeding point at Farringdon Battery. This group was exported to Wildpark, Daun, Germany in 1998, but re-formed from some animals that had evaded capture and a

few additions apparently from Middle Hill. They are still provided for at Farringdon's.

b) Feeding should be twice a day, at 07:00hrs and 16:00hrs.

This practice was not fully adopted. The need to have staff on duty further hours was costed, but the funds were not provided. Instead, a second feeding of seeds and grain is carried out at 13:00hrs.

c) Only natural foods should be used and should include native species such as figs *Ficus carica*, and the fruit of the strawberry trees *Arbutus unedo*, when in season.

Natural foods have been encouraged since then whenever possible, and when in season. Figs have been supplied but strawberry tree fruits are not grown for commercial purposes, and therefore it has been impossible to find these. The groups have been provided with fresh fruit and vegetables and this has been augmented with grain that the macaques quite enjoy.

d) Two of the groups should be out of bounds to tourists and other visitors except for approved research purposes.

Obviously, it is very difficult in a Reserve the size of the Upper Rock Nature Reserve to restrict visitations to not one, but two groups, particularly as there is no direct on-site management or wardening. The only group that fulfils this criterion is at Middle Hill, where the security fences erected by the military have shielded the interaction of this group with humans to a large extent. This does not restrict the movement of this group within that area and interactions with tourists and other visitors do occur outside. However, this is limited. This group, therefore, is considered the most suited for research purposes that do not involve interaction with man, as they remain in a fairly wild state. Since the summer of 2003, members of this group have been frequenting the east side down by the Caleta Hotel where they interact with humans. Twenty-seven members of this group were culled between July and August 2003. Despite this, individuals of this group continue to visit the area.

e) One group should be accessible to visitors only on foot.

This would have been an ideal concept were it not for the fact that Sights Management and the Tourism Agency allowed the taxis access to all the upper roads on the Rock, which had been exclusively for essential military vehicles, and the only area where visitors could walk free of traffic pressures. The few groups that could have been accessed on foot, the Anglian Way group and the remnants of the Farringdon Battery group, were enticed with food away from those areas by taxi drivers and can now be found at the road by Hayne's Cave pumping station and the lookout and entrance to Princess Caroline's Battery.

f) Three groups should be visited in rotation only for one month at a time.

So as to avoid too much visitor pressure, GONHS recommended that all visitors should be allowed access to only one site for a month at a time. This proposal was never adopted, as it would have involved too much traffic congestion at the single site and would not have been favoured by the tour operators, although the proposal was sound.

g) Feeding of the monkeys is at present contracted out to Sights Management Ltd. This will have to continue while the contract lasts, but direct supervision of this should now be contracted out to GONHS in a manner similar to the gull cull arrangement where GONHS supervises a team from Community Projects Ltd. The post of Ape Keeper, recently vacated by resignation, should therefore not be filled by Sights Management and the money saved should be redirected to GONHS to employ a person to supervise year round macaque management.

Shortly after this report was submitted to GONHS the Tourist Board ended its contract with Sights Management Ltd. The Tourist Board continued the management of the monkeys, engaging the staff employed to feed the macaques for a further two years, after which management of the Barbary macaques was contracted out to GONHS. The experienced feeding staff was kept on and Mr. Eric Shaw, who had formed part of the MEDAMBIOS management plan back in the 1990, was appointed to take charge of supervision, feeding and management. This arrangement continues at present with the support of the Gull Cull unit, which supplies manpower to provide cover at weekends.

h) GONHS should also be entrusted, under contract, to establish an interpretation centre exclusively on macaque biology, to produce an up to date brochure on the macaques and to provide trained guides.

An interpretation centre in at least one or two of the most visited sites is essential. At the Queen's Gate site there is sufficient area to build a covered/indoor centre that would provide all the required information on the history, biology and future of the macaques. This should also focus on the commercial aspect of these animals, where you have the opportunity to sell souvenirs and additional information on the biology and natural history of the macaques. It is unfortunate that the Gibraltar Tourist Board has not taken this recommendation on board and has not budgeted for this. Indeed, creation of interpretation facilities should have been

provided for by the Gibraltar Tourist Board as part of the current management contract with GONHS. Instead, we still have the old souvenir vendor at his rundown wooden kiosk at the Ape's Den.

14.6 Other Recommendations

1) Steps should be taken, always in consultation with the Anthropological Institute of Zurich, to import a number of macaques from Morocco in order to introduce new genetic material.

This is a step that should be taken, given that recent studies have demonstrated that the population of macaques on the Rock are beginning to show the effects of inbreeding, although there still is a high level of genetic variability, showing that there is still time to counter its effect before it is to late.

2) It is proposed that the British Government, through the Convent, formally make contact with the Government of the Kingdom of Morocco to attempt to organise a re-introduction programme of Gibraltar animals to Morocco.

This proposal should counter the problems of inbreeding and ensure genetic variability that will maintain future populations of macaques in a healthy state. With the right contacts, GONHS should be able to achieve this venture and there should be fewer problems and a greater chance of success than that endured at the Spanish frontier, with exportation problems. There should ideally be a two-way exchange of animals to increase genetic variability in both populations. This is now being studied by GONHS and the Institut Scientifique in Rabat as part of the INTERREG IIIA Programme.

Eric Shaw / GONHS

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15. The Yellow-legged Gull

15. The Yellow-legged Gull

This chapter consists of a summary of the history and current situation regarding the status of the yellow-legged gull, Larus michahellis, *in Gibraltar. A more complete appraisal of the current status of this species in Gibraltar can be gathered from Cortes et al.* (2004) *and the annual reports that the GONHS prepares for the Ministry for the Environment.*

15.1 History

The yellow-legged gull *Larus michahellis* (formerly *Larus cachinnans*) is the most common, and certainly most conspicuous bird that nests in Gibraltar, but this has not always been the case. Although it was recorded in the 19th and early 20th Century by several writers, amongst them Saunders (1871), Irby (1895) and Verner (1909), it was not until 1934 that Rait-Kerr mentions definite breeding (Cortes *et al.* 2004). Since then, the population of this species has slowly increased, mainly breeding on inaccessible sea cliffs around the ridge of the Upper Rock and the south district.

In the 1970s the nesting population was estimated to be 600 breeding pairs (Cortes *et al.* 1980). Nesting extended to roofs in the town, and exposed areas within the Upper Rock became the focus of the gulls as they extended their breeding grounds. One particular site, Rock Gun and the adjacent cliffs on the North Face of the Rock, was the cause of grave concern to the Royal Air Force. The first flight of the fledged chicks would take them down to the runway where the risk of a collision with an aircraft was menacing. In fact due to several bird strikes and the resultant damage to aircraft, the RAF decided to carry out a gull cull. This cull, which commenced in the spring of 1979, focused not only on the eggs and chicks, but also on adult birds using the stupefacient alpha chloralose, and took place during the birds' breeding season. The main area covered was the northern end of the Rock, which posed the greatest threat to the aircraft landing on or taking off from the runway. This obviously did not curtail the increase in the population, as other areas were not covered, and the yellow-legged gull continued its expansion throughout the rest of the Upper Rock and other areas around Gibraltar.

In 1982, as a result of a substantial and visually obvious increase in the population, the RAF extended its operation to include other areas of the Upper Rock and the south district. This practice continued on a yearly basis during the breeding season, targeting eggs and chicks almost exclusively (a method that is known to be largely ineffective) until the MOD reduced their presence in Gibraltar. Finlayson (1992) estimates the population at 2500 pairs, although Cortes *et al.* (2004), gives a much higher estimate based on a survey by Mr. Peter Rock (*pers. comm.*), of 30,000 birds at the end of the nesting season. The Royal Gibraltar Regiment then continued with the venture, but by 1999 a combination of ineffective methods and reduced culling meant that the gull population had grown to enormous proportions.

GONHS had been monitoring the situation and was well aware of the detrimental effects this increase could have on the stability of the natural environment within the Upper Rock Nature Reserve, as has occurred elsewhere. It was also conscious of the problems the gulls were causing to the residents of the town area, and presented some suggestions to the authorities. These arguments were accepted and a contract was awarded to GONHS. The Gull Control Unit was therefore created in July 1997. This unit was tasked to control and cull the gull population throughout the whole year as opposed to culling only during the breeding season as had taken place in the past.

15.2 Control

All areas in Gibraltar were targeted, but obviously the upper reaches of the Nature Reserve and the eastern slopes were the most densely populated. Several methods were examined and used, and for the first three years poison, hand nets, nest raking in the breeding season, and catapults were the main techniques employed. Results during this period were insufficient to make any significant inroads into the large population. Finally in 2000 the acquisition of air rifles greatly improved the situation. Nest raking and the destruction of eggs continued during the breeding season, but by far the most successful method was the targeting of adult birds. By killing the adult bird, the nesting success of the pair had been eliminated, whereas birds that are relieved of their clutch of eggs very often lay a second brood. The yearly results to date, shown in table 1, demonstrates the efficient and substantial elimination of a large percentage of the population.

Table 1. Methods and totals of gulls eliminated during the period 1997-2003.

Year	Method	Total Culled (including chicks and eggs)
1997 (Jul. to Dec. only)	Poison; hand nets; catapults	50
1998	Clap nets; catapults; nest raking	1760
1999	Catapults; nest raking	2498
2000	Shooting	4298
2001	Shooting	3952
2002	Shooting	4056
2003	Shooting; nest raking	5025

The effects, as shown in table 1, have been quite noticeable. From an observer's point of view, 2003 saw a considerable reduction in the yellow-legged gull population. There was one passing comment of the gull problem in the press and call-out requests for removal of gull nests dropped from 47 in 2001 to 22 in 2003 (Cortes *et al.* 2004).

Other methods of control have been considered by GONHS. A captive breeding programme of the red fox, *Vulpes vulpes*, with the intention to re-introduce the animals, commenced in 1992. These animals would consume large numbers of eggs and chicks and the occasional adult bird. Moreover the disruption caused to the breeding colony would deter many pairs from nesting, as evidenced from the effect of foxes on seabird colonies in other parts of the world. The programme has so far been unsuccessful, but in mid 2003 an adult was released after having been fed constantly on a diet of gull chicks. It has now set up territory and hopefully will continue to wreak havoc on the gulls.

A pair of ravens, *Corvus corax* nested in Gibraltar until 1972. These large crows predated on the chicks and eggs of the yellow-legged gull, and it was unfortunate to lose them probably due to poisoning in Spain, just as the gull population was increasing. GONHS had thought of a re-introduction programme and two were secured from Jerez Zoo for captive breeding purposes. As luck would have it a pair was seen in early 1999 and shortly after, attempted to breed below Royal Anglian Way. The pair was unsuccessful but during their stay they were seen to harass the breeding gulls and must have fed on many of the eggs and chicks available close by. What is certain is that these birds have taken a liking to feral pigeon chicks (another problematic species) and regularly feed on these in the area behind Catalan Bay (V. Robba, *pers comm.*). Since then, the pair of Ravens has remained in the vicinity, returning to Gibraltar and attempting to breed every year since. In the process, they have now become a major predator of the gulls, especially during the breeding season when they cause the most disruption.

Another form of control that was successfully utilised as from 2000 by GONHS included the use of the raptors of the GONHS 'Bird of Prey Unit'. A Harris hawk, *Parabuteo unicinctus* was trained to catch juvenile and immature gulls, mainly at the runway, Hole-in-the-Wall and Windmill Hill. The following year a female goshawk, *Accipiter gentilis* and two hybrid gyr x saker falcons, *Falco rusticolus x F. cherrug* were also used against the gulls. A female Bonelli's eagle, *Hieraaetus fasciatus* was also flown along the eastern side sand slopes causing immense disruption of the breeding pairs of gulls there. This eagle was subsequently released in early July 2003, after a substantial diet of young gulls, and remained in the area until early August when it was last seen. The hope is that this eagle will return in the breeding season to the Rock and entice a male to set up a breeding territory, but that has so far not happened.

In 2002 a group of observers from the Royal Air Force Ornithological Society participated in a project, formulated by GONHS, to determine the breeding population of yellow-legged gulls in Gibraltar. The survey, which accounted for non-breeders, placed the total figure at 20,090 birds (Cortes *et al.* 2004). Compared to less comprehensive surveys carried out by GONHS in 1998, 2001 and 2002 that estimated the population at 30,000 birds, the figures display a 39% reduction of the population and augers well at maintaining and controlling the numbers of yellow-legged gull in the future.

Table 2. Estimated number of gulls present at end of nesting season. RAFOS Survey.

Adult nesting birds	8036
Non-breeders	4018
Fledged young	8036
Total	20,090

15.3 Discussion

It is gratifying to see that the Gibraltar Government has had the confidence to confer the responsibility of the management of the yellow-legged gull population to GONHS. In the past, culling was launched primarily to safeguard the aircraft landing at RAF Gibraltar. This did not stem the huge increase in the population, which was due in part to the expansion of the human population in the region. This resulted in several rubbish tips that were targeted as a food source by the gulls. However, the Los Barrios tip may soon close, and this could have a serious and welcome impact on the gull population in Gibraltar. This factor may contribute to the eventual decrease in numbers, but the authorities must not be complacent. The problem needs continual control and systematic culling if these numbers are to be maintained at an adequate level that will ensure the impact to the general public is kept at a minimum.

15.4 Recommendations

1) There is a need to reconfigure and analyse the gull cull strategy of the last decade in order to prepare the ground for the next ten years. This analysis has been partly done in the paper by Cortes *et al.* (2004) 'The Control of the Yellow-legged Gull in Gibraltar', which deals with the matter more thoroughly than the overview that this chapter provides.

2) Prepare a gull control management programme based on the research and experience gained over the last few years. This plan to collaborate with the general management plan for the Upper Rock Nature Reserve, since a large proportion of Gibraltar's gull population breeds in or around the Nature Reserve.

yellow-legged gulls

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16. The Lower Slopes

16. The Lower Slopes

The lower slopes of the Upper Rock extend in a north-south direction for about 300m, from the area know as Calpe to Devil's Gap. They run from an elevation of about 160m above sea level below Queen's Road down to 90m above sea level behind Arengo's Palace and Sacred Heart School. The site covers about 30 000 m/sq. (7 _ acres), sits on a bed that is partly shale (Rose & Rosenbaum 1991) and is an extremely interesting and important area for local flora (Linares 1990). Its position relative to the Upper Rock Nature Reserve can be seen on the map below.

Figure 1. Map of Gibraltar, showing the position of the lower slopes in relation to the Upper Rock Nature Reserve. The Nature Reserve is shaded in green, whilst the area shaded in yellow represents the lower slopes.

The lower slopes are intercepted by two gullies that run from east to west, and cliffs bind the southern end. A number of habitats occur on the lower slopes, including some that are practically unique to Gibraltar, such as open, grassy areas, shady, damp areas, rocky outcrops and cliffs, and the garigue and maquis that are characteristic of the Upper Rock (Linares 1990). It is this that makes the area such an important one for flora, and about half of Gibraltar's plant species can be found growing on the lower slopes. Of these, 27 species are protected under Part II, section 11 of the 'Nature Protection Ordinance 1991' (L/N 11 of 1991) in that they are not specified under Schedule 2 of the Ordinance (Schedule 2 specifies all plant species found in Gibraltar that are *not* protected by law). These include most of the orchids found in Gibraltar, and these are discussed in the section below. Other than orchids, some rare plant species are also found on the lower slopes. These include:

Scandix pecten-veneris L.	(shepherd's needle)
Parentucellia viscosa (L.) Caruel	(yellow bartsia)
Lavandula multifida L.	(cut-leaved lavender)
Linum bienne Miller	(pale flax)
Lathyrus setifolius L.	(narrow-leaved red vetchling)
Anagyris foetida L.	(bean trefoil)
Selaginella denticullata (L.) Spring	(clubmoss)

Of these, *Scandix pecten-veneris* is found nowhere else in Gibraltar.

16.1 Orchids

The lower slopes are particularly rich in, and important for orchids. The following species of orchid occur on the lower slopes:

Ophrys lutea (Gouan) Cav. subsp. *lutea*	(yellow-bee orchid)
Ophrys fusca Link subsp. *fusca*	(brown-bee orchid)
Ophrys speculum Link subsp. *speculum*	(mirror orchid)
Ophrys bombiliflora Link	(bumble-bee orchid)
Serapias parviflora Parl.	(small-flowered serapias)
Spiranthes spiralis (L.) Chevall	(autumn lady's tresses orchid)
Gennaria diphylla (Link) Parl.	(two-leaved gennaria)

Ten species of orchid occur in Gibraltar. Seven of these are found on the lower slopes. This makes the lower lopes the stronghold for the orchid family in Gibraltar. Of the seven species that grow here, one species, *Ophrys speculum*, grows nowhere else on the Rock.

The more open habitat that is provided by the lower slopes is ideal for the growth of orchids, and these grow mainly below cliff-faces and north-facing sides of gullies, where shaded, damp conditions that are important for these plants prevail (Linares 1988, 1990, 1994). A map showing the distribution of orchids within the lower slopes is shown is Fig. 2.

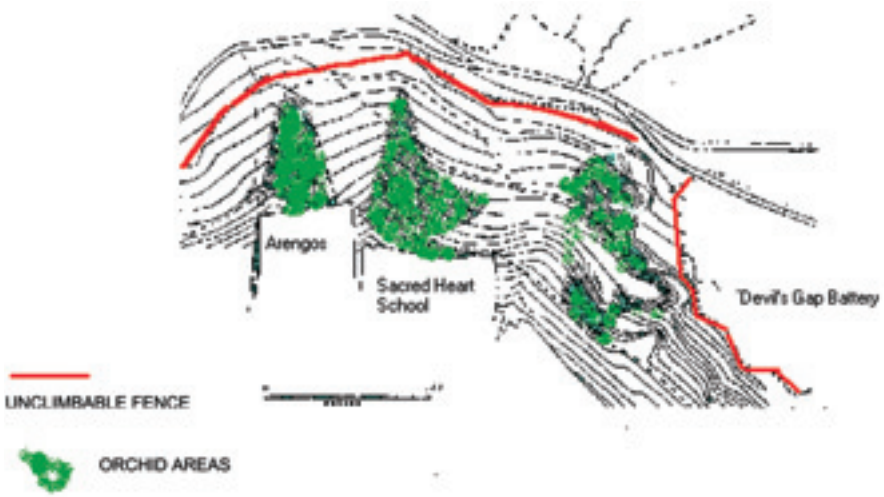

Figure 2. Map showing the distribution of orchids within the lower slopes area. Sites where orchids grow are shaded in green.

In addition to the lower slopes, the deep gully that runs south of Willis's magazines (above and to the north of the lower slopes) is also important for orchids (Linares 1988), and this area falls within the Nature Reserve boundary. The complete distribution of orchids in Gibraltar can be seen on the map in Fig. 3.

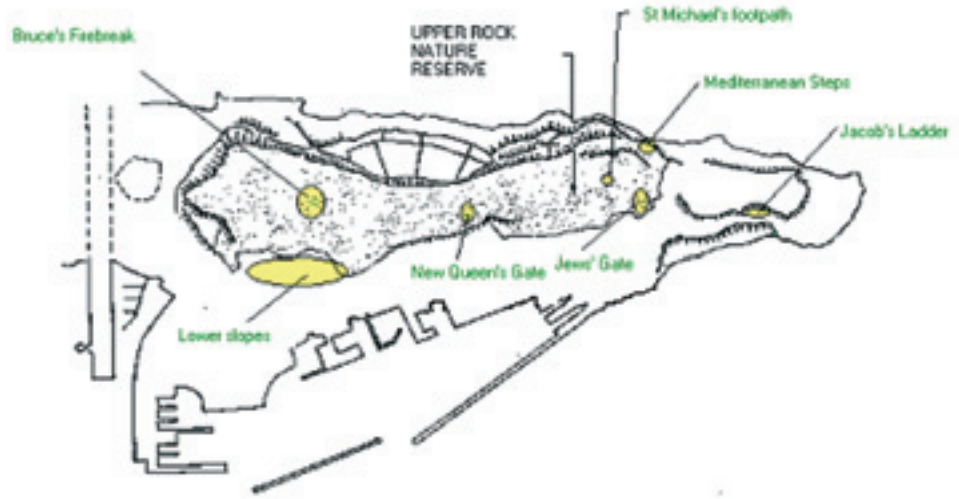

Figure 3. Map showing distribution of orchids in Gibraltar. As can be seen, there are scattered populations on the Upper Rock and one on Jacob's Ladder, but the most extensive site where orchids are found is the lower slopes area.

The three other species of orchid that are found in Gibraltar all occur within the Upper Rock Nature Reserve. These are listed below, together with an account of their distribution.

Anacamptis pyramidalis (L.) L.C.M. Richardson (pyramidal orchid)
Only three plants found along the Mediterranean steps up to the mid 1990s (Linares 1994). Now thought to be extinct.

Ophrys tenthredinifera Willd. (sawfly orchid)
Very Rare in Gibraltar. Only found in Willis's Gully and along St. Michael's Path.

Ophrys apifera Hudson subsp. *apifera* (bee orchid)
A few individuals of this locally very rare plant can be found along St. Michael's Path and at Jew's Gate.

In most European countries, all orchid species are protected by law (Linares 1990). This is the case in Gibraltar, where all ten orchid species are protected under Part II, section 11 of the 'Nature Protection Ordinance, 1991'. For more information on the status of orchids within the Nature Reserve, see Appendix 2.1.

16.2 Fauna of the Lower Slopes

The lower slopes are also important for indigenous fauna. As with the rest of the Upper Rock, this area is of unquestionable importance for birds, particularly passerine migrants. It is also one of the only sites in Gibraltar where the woodchat shrike *Lanius senator*, (which is given a SPEC category of '2' and is deemed to have a 'vulnerable' European threat status by BirdLife International (Tucker & Heath 1994)) is suspected to have bred in the past. Given the impressive diversity of its flora, the lower slopes are also of extreme local importance for invertebrates, and in particular phytophagous insects. A combination of this area's features (and in particular it's relatively open habitat) also make the lower slopes an important habitat for local herpetofauna. The ocellated lizard *Lacerta lepida*, once considered abundant on the Rock (Ayala 1782; Cortes 1982), has now all but disappeared due to the changing nature of the vegetation (Cortes 1982) and the lower slopes area, with its open habitat, could be one of the few places where this species continues to survive in Gibraltar.

16.3 Habitat Succession on the Lower Slopes

Since the late 1700s, the whole of the Upper Rock and the lower slopes were bare of trees, these having being removed by the garrison to use as fuel during times of siege (Cortes 1994; Linares 1994). Subsequently, goats roamed the whole of the Upper Rock, keeping the vegetation low and treeless. The lower slopes were eventually cut off from the Upper Rock through the erection of the 'unclimbable fence'. Goats remained on the lower slopes, but were excluded from the Upper Rock. This led to an increase in the height of the vegetation of the Upper Rock that eventually led to the present maquis, but the habitat on the lower slopes remained open due to the continued presence of goats (Linares 1994), as well as persistent clearing of the lower slopes by the military, who managed the area for security reasons. This can be seen in Fig. 4.

Figure 4. The lower slopes in the early 20th Century.

Although the habitat on the lower slopes is still more open than the majority of the Upper Rock, there are now very few goats in the area (and these were introduced relatively recently, having been absent for about forty or fifty years) and the vegetation is no longer cleared. Therefore, the vegetation is gradually becoming taller and thicker. This will eventually become maquis like that of the Upper Rock if nothing is done to control it. Some form of habitat management is therefore important for this area if it is to remain such an important site for local flora (Linares 1994). The development of the lower slopes from the 1970s to the present day is shown in Fig. 5.

Figure 5. The photograph on the right shows the vegetation on the lower slopes during the late 1970s, whilst the one on the left shows the same area in 2003 (photos courtesy L. Linares).

16.4 Other Threats

In 1993, some local developers, notably RLS, together with the Japanese firm Kumagai Gumi, expressed an interest, which was entertained by the Gibraltar Government, to construct a road that would link the Calpe area with Green Lane. This road would take traffic from the Upper Rock and direct it to Europa Road by the entrance to the Casino, after passing through a new tunnel under Devil's Gap. The construction of this road would have gone hand in hand with major urban developments, as it was intended to construct houses on both sides of the new road. The project would have obliterated virtually all the lower slopes. GONHS strongly objected to these plans and held a number of discussions with the developers and Government. At these discussions, the value of the lower slopes to plants and animals was highlighted, as well as the possibility that the intended outcome would not be achieved. Traffic would have to take a sharp right turn on entering Europa Road, and the residences planned would generate considerable traffic themselves. GONHS argued that it appeared more like a moneymaking exercise for those involved than a true attempt at solving the traffic problem. The high cost of the works and the impact on the upper town were also arguments used. Eventually, these arguments won through and the plans for the road and associated development were shelved. Furthermore, Town Planner Mr. Paul Origo recently suggested to us that the construction of a relief road at Willis's could be avoided with the proper management of traffic within -and consequently descending through the Upper Town area from- the Nature Reserve. This could include redirection of traffic through the Great North Road.

16.5 Recommendations

Given the unquestionable importance of the site for flora, the lower slopes of the Upper Rock should be protected under Part III of L/N 11 of 1991, *i.e.*, it should be regarded as an area of special interest that is protected for the purpose of nature conservation. Thus, the present boundary of the Upper Rock Nature Reserve should be extended to include the lower slopes.

It would be advisable to manage the vegetation of the lower slopes, as this would ensure that the vegetation remains open and does not develop into the thick, virtually impenetrable maquis that is characteristic of large parts of the Upper Rock. This would improve the area's value for flora. This action is essential if the lower slopes are to remain such an important site for indigenous flora. It would also benefit animals that are dependent on open areas such as the ocellated lizard *Lacerta lepida*, which may still survive in the area. A reintroduction programme would also be of considerable benefit to the local population of ocellated lizard. In this sense, the introduction of a large herbivore such as the Barbary sheep *Ammotragus lervia* (*see* Chapter 13) may be beneficial to the management of the vegetation of the Lower Slopes.

Given the rarity of all orchid species in Gibraltar, the level of legal protection afforded to the orchid family (Orchidaceae) should be elevated so that all species of orchid are included in Schedule 3 of the 'Nature Protection Ordinance, 1991'.

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17. Research, Monitoring and Education

17. Research, Monitoring and Education

Bruce's Farm Field Centre

Research and monitoring programmes are fundamental tools in the development of the management of the Upper Rock Nature Reserve; these rely on the Nature Reserve for their data, with the Nature Reserve in turn benefiting from their results and conclusions. Their application allows the researcher to obtain the necessary information on different aspects of the environment and their inter-relationship with socio-economic factors. These can then form the basis for the planning and use of the resources within a Nature Reserve (EUROPARC-Spain 2002), thus ensuring that activities occurring within the Nature Reserve are compatible with the sustainability of the 'products' of the Nature Reserve (i.e., wildlife and heritage in the case of the Upper Rock).

Only monitoring programmes with continual research and investigation can assess the impact of decisions taken in the management of a Nature Reserve. These will serve to diagnose changes in environmental and socio-economic activities, and in the long term will provide indicators to continually upgrade the development of the Reserve and its management plan. The results of these programmes will indicate the level of success and effectiveness of the objectives set in the management plan (EUROPARC-Spain 2002), as well as any subsequent decisions made and plans put into place by the management of the Nature Reserve. It is crucial that adequate funding is set aside to address these two factors as a fundamental part of the overall plan, in order to guarantee the success of a properly structured and well managed Nature Reserve.

In addition to research, the Upper Rock Nature Reserve has a lot of potential as a site within which to base school and university field trips and excursions. All aspects of research, monitoring and education are discussed within this chapter.

17.1 Research

Scientific research has over the years been carried out in Gibraltar on a wide variety of subjects, but has mainly centred on fauna, flora and other natural aspects. This has often formed part of the work carried out by university students, but Gibraltar-based amateurs have also carried out other studies that have been just as important to the Upper Rock. These studies have together resulted in a wealth of information that has allowed us to evaluate the principal resources that can be applied to programmes dealing with conservation and sustainable development. The application of these results was fundamental in the designation of the Upper Rock Nature Reserve, and today research on both natural and historical aspects continues on a regular basis.

Amongst locals, studies on the Upper Rock are carried out almost exclusively by GONHS, and recently by the Gibraltar Museum in archaeological digs in caves. In recent years numerous students from foreign universities and institutes have been carrying out research on a number of disciplines on the Upper Rock, in cooperation with and co-ordinated by the GONHS. The acquisition of Bruce's Farm was instrumental in the development of a research centre where these students can effectively carry out their studies within the confines of the Nature Reserve. The different forms of research that take place within the Upper Rock Nature Reserve are highlighted in this chapter, and ways in which to improve the Upper Rock for these purposes are examined.

17.2 The Biological Reserve

As part of GONHS's on-going work in the field of conservation, negotiations had been taking place with the MOD to use the area of Rock Gun and Middle Hill as the prime location for the introduction of large species of mammals, such as the Spanish ibex *Capra pyrenaica* or Barbary sheep *Ammotragus lervia*, with a view to introducing them to other areas of the Upper Rock Nature Reserve. This locality was identified as suitable because of the restricted and isolated character of the area, and also because the topography suited these species.

The area of Rock Gun and Middle Hill also harbours most of Gibraltar's endemic and endangered species of flora, and holds stable populations of the Barbary partridge *Alectoris barbara*, a pair of peregrine falcon *Falco peregrinus*, and notably an eagle owl *Bubo bubo*, a species that nested in this particular area until the early 1900s, and has recolonised the Rock. It also supports the group of macaques that is commonly known as the 'wild' pack, which has been studied intensively by numerous university students from around the world.

Taking into account the importance of its biological wealth and the isolated nature of the area, where flora and fauna flourish with relatively little interference by man, it was decided to propose this area as a Biological Reserve. Biological Reserves are found in many Nature Reserves. They

are composed of special areas of particular importance to the flora and fauna of the locality that require that extra amount of protection. They also serve as control areas where, due to the restriction of visitors, monitoring and research programmes are carried out with little external interference. One of the aims of Biological Reserves is also to promote these research programmes, as these will ultimately benefit the rest of the reserve. Access is, quite naturally, strictly controlled in these areas.

In April 2004, the MOD handed a large percentage of their land holdings to the Gibraltar Government. Rock Gun and Middle Hill were included within this package, with the final hand-over date being April 2005. It is imperative that the Gibraltar Government realise the ecological importance of this area and take on board the authors' suggestion to designate the area as a Biological Reserve. The rest of the Upper Rock Nature Reserve is already under intense visitor pressure, and as a result bears the scars of years of neglect. This area can do without this. It has much to offer in the way of providing an isolated location for the re-introduction of flora and fauna that can then be relocated to other parts of the Nature Reserve. It also provides a unique opportunity for conserving healthy, untouched populations of Gibraltar's most important and endangered taxa.

The Rock Gun and Middle Hill area is already one where much biological research is taking place, in conjunction with GONHS and it's research facility at Bruce's Farm. The site could bring many more people to study a wide variety of subjects concerning the biology and conservation of Gibraltar's special wildlife. However, this can only be sustainable if the focus of the study is kept free from interference and interaction by man, particularly if visitor densities are high. Having said this, there is scope for visits for a limited number of people. Authorised, guided visits to the Biological Reserve could be available to small groups. The guide, preferably a Nature Reserve warden with experience and knowledge in the field of natural history, would conduct these visits along approved routes, preferably along the roadway. No interaction with the macaques or any other animals would take place and an appropriate distance would be maintained from these. Visits should not take place on a daily basis, and should be pre-booked. Visiting frequency and visitor numbers should vary according to the seasonal requirements and sensitivity of the wildlife of the Biological Reserve, and should always be kept low. Visitors wishing to enter the Biological Reserve should pay an extra fee, the proceeds of which should all be invested in the maintenance of the site.

A scientific body should supervise and administer the Biological Reserve as part of the Nature Reserve. This body would perform the role of natural history consultants to the Management Board of the Upper Rock Nature Reserve. At the moment this role is performed by GONHS for the whole of the Nature Reserve. This should include, not only consultation, but also discussion, arbitration and decision making processes.

The Biological Reserve should be conditioned to meet the needs of a biological centre. With this in mind, some of the old buildings at Middle Hill should be provisioned with facilities that provide, encourage and meet the basic requirements of researchers working in this area.

Provisioning of watering and feeding areas for the macaques would continue to be supplied and maintained by the Gibraltar Government or their contracted or authorised managers. Watering holes for the large herbivores must be constructed to suitable dimensions and the area must meet the approval of the scientific body before the animals are introduced.

17.3 Monitoring

Monitoring should begin as soon as the management plan comes into effect. This should address both environmental and socio-economic aspects of the Nature Reserve. The development of monitoring programmes should form an integral part of the management plan and its application. The requirements of this monitoring would be structured around certain objectives and problems that need evaluation and diagnosis over the long term, providing an indication of the effectiveness of management programmes. Monitoring of certain aspects of the environment, heritage and socio-economic problems have been accomplished by the authors in an effort to analyse and assess the overall state of the Nature Reserve. This should form the template for ongoing, long-term monitoring programmes for conservation and sustainable development in the future. All projects and developments within the Nature Reserve should be monitored closely, and their effect on all aspects of the Nature Reserve taken on board in any future plans and actions.

17.4 Field Courses

Several factors make the Upper Rock Nature Reserve an ideal place in which to host field courses by both schools and universities. However, until now, this resource has been underexploited. Facilities for hosting these field courses do exist within the Nature Reserve. The Gibraltar Trust for Natural History's premises at Bruce's Farm are ideal for hosting small field courses (of up to sixteen persons). However, although individual students and researchers have been using the facilities on a fairly regular basis for a number of years (mainly for work on macaques)

university field courses have been lacking. In fact, the first field course to be hosted at Bruce's Farm took place over the end of March and the beginning of April of 2003, during which the University of Leeds, liasing with GONHS, held its undergraduate Ecology field course here for the first time, and did so again in 2004. Dr William Kunin, senior lecturer in Ecology at the School of Biology of the University of Leeds, led this field course. We asked him for his opinions on the Upper Rock and Bruce's Farm as a place at which to hold field courses, and his views are given next. Since Dr Kunin commented on a range of aspects, and not just matters of research and monitoring, all of his comments have been included in the following section.

17.4.1 Dr Kunin's Views

"The Upper Rock is very useful as a venue for field courses. It has a range of habitats, all of which are at an easy walking distance from the field centre at Bruce's Farm. The Nature Reserve also holds several species that are charismatic and accessible (such as the Barbary macaques), and these appeal to the students. The Bruce's Farm field centre is particularly useful. There are very few places in the Mediterranean that have adequate facilities and have easy access to the sites at which the research is being carried out. Bruce's Farm is one of these places, and is particularly important in this respect. Also, many global conservation problems are happening in Gibraltar in a visible way, albeit on a smaller scale. It is thus a good place for students to get a visible picture of what is the bigger problem."

"Some improvements could be made to the field centre, such as increased bed space or more showers[1]. More can be done with the grounds at Bruce's Farm, particularly the garden where representations of indigenous habitats can be simulated and these can be utilised for the purposes of manipulative field experiments (although this would take a lot of work!). Local endemics can also be grown. The same can be said of the nearby former plant nursery, which can also be utilised to grow trees that were presumably once present on the Rock in order to repopulate the Rock with its original trees and replace some of the Maquis with Mediterranean woodland. The reintroduction can also be carried out experimentally, and students can use this in itself as an area of study."

"More generally, the Upper Rock Nature Reserve faces several challenges. Firstly, the Nature Reserve seems to be quite an earner, and some of the money made should be used to improve the park. As the saying goes, 'You have to keep feeding the goose for it to keep laying golden eggs'."

"The management of the Upper Rock Nature Reserve should be improved. In particular, stronger enforcement of existing laws is required. This is particularly the case with the macaques. The worst offenders should primarily be targeted, and these seem to be tour operators such as coach drivers and taxi drivers. Only responsible people should be allowed to conduct tourist tours, and thus it may be an idea for taxi drivers and coach drivers to have a tour licence that is independent of their taxi or coach licence. This can be suspended temporarily or permanently if they or their clients are caught feeding the macaques. This would force them not only to stop feeding the animals, but also to discourage their clients from doing so. There should generally be slighter fines for these offences (since fines that are too expensive run the risk of not being enforced), and there should be wardens within the Upper Rock Nature Reserve who are empowered to hand these out. If penalties were enforced once or twice, then this behaviour would cease. Furthermore, the German example (at Wild Park, Daun, Germany) shows that people are quite happy to observe the macaques without feeding them."

"It would be desirable to depopulate the Nature Reserve gradually. This can be approached in different ways. For example, residents can only pass houses on to their offspring, or if the houses are to be sold then the park could have the right of first refusal."

"The native invasive plant *Acanthus mollis* is a problem. It may be an idea to investigate why it isn't as common in nearby Spain as it is here. The answer may lie with some disease or herbivore (insects to mammals) that is not found in Gibraltar. One idea may be to introduce large grazers such as ungulates into the Upper Rock Nature Reserve. Ibex may stick mainly to cliffs, and could even pose a threat to local endemic plants that grow mainly or exclusively on cliffs. One idea could be to introduce Barbary sheep, as these are severely endangered within their native range. Thus, this could also be an exercise of '*ex situ*' conservation as well as habitat management. It may also be an idea to look at archaeological records of Gibraltar to determine which ungulates were originally present here (North African roe deer? This is a maquis species). An effort could also be made to re-establish some of the native woodland. There may be some way of finding out what tree species were originally here from archaeological or historical records, or it may be an idea to examine the woodland of nearby limestone mountains."

"Pedestrian use of the Nature Reserve should be encouraged, and a more extensive trail system might be a way to go about this. This could include circle walk paths, and a good map of the Upper Rock trail system could be made and handed out free at the gate with the admission fees.

[1] There was only one shower when the Leeds group visited due to problems with the plumbing, but this has now been resolved and there are now two working showers (20/09/2004)

An improved system of paths would also facilitate student projects. But then again, encouraging dispersal of people may spread human impact that at present is concentrated mainly around tourist traps. If some roads are closed other than to licensed individuals, then this would lessen the general impact of humans on the whole Nature Reserve."

17.4.2 The Role of GONHS

Although GONHS has been very successful in attracting Barbary macaque researchers and students, little effort has so far gone into establishing Bruce's Farm Field Centre as a place at which field courses regularly take place. This is unfortunate, given that the location is of such obvious value to universities. It must be said that the field centre at Bruce's Farm has not received enough promotion around universities, and in this sense GONHS would do well to adopt a new strategy of promotion and advertisement, focusing on universities in the UK, which are the institutes that are most likely to visit. This could include posters, leaflets, etc., as well as more formal approaches. It is interesting to note that field courses to Mediterranean countries are popular amongst British universities, with many of them running courses in southern Spain. Given this fact, a lot more could be done to attract field courses in Gibraltar.

On the other hand, GONHS has been very successful in attracting visitors to their Jews' Gate Field Centre, where bird-ringing activities take place. Although accommodation facilities are limited there has been a steady flow of ringers and birdwatchers mainly from the United Kingdom, but also from Germany, Sweden, the Netherlands and France. This has placed Gibraltar firmly on the map as a destination where ornithologists can observe and ring interesting birds and as a base from where to visit neighbouring areas in Spain (*see* 17.5).

17.4.3 Local Schools

Field trips to the Upper Rock by local schools do not occur as frequently as they should (in fact, they hardly ever occur at all). In particular, comprehensive schools carrying out GCSE or A-level field courses could make better use of the Nature Reserve and Bruce's Farm Centre, rather than visiting nearby Spain every time that there is a field course to be held (although the current state of the Nature Reserve makes this understandable). However, it was encouraging to see in 2003, that the Ministry for the Environment and Health and the Ministry for Education and Culture jointly launched a series of environmental education modules for primary and secondary schools entitled 'Action – Research for Sustainable Development'. This programme includes a module on 'Conservation in Gibraltar and the Surrounding Area', which will include one or more field visits within Gibraltar, and examples on conservation management include the firebreaks on the Upper Rock and the setting up of nature reserves such as the Upper Rock Nature Reserve (which it would be useful to explain to students that whilst designated a nature reserve, the Upper Rock is certainly not managed as one). It has long been our opinion that schools do not do enough to promote and educate on local conservation, and this has therefore been a very positive step. It must be said that although better than in the past decades, there is a particular ignorance amongst Gibraltarians and other local residents regarding conservation and general environmental matters, and young students are the best people to target and make aware of these issues. It is after all from amongst these young people that the conservationists and environmentalists of the future are most likely to emerge.

Finally, since local schools regularly visit nature reserves and natural areas in Spain as part of their curriculum (such as the 'Parque Natural Los Alcornocales' or dune systems on the Costa del la Luz), it may be an idea to encourage schools in nearby Spain (particularly those within municipalities that are most cooperative with Gibraltar, such as Los Barrios) to hold field trips to the Upper Rock Nature Reserve, particularly since it offers features that cannot be seen in nearby Spain. These include the Rock's geology, its flora (which largely results from the Rock's basic soils) and of course the Barbary macaques. However, if this were to occur, then it would be important to clean up the Nature Reserve of both its litter and its graffiti if the impression that the Upper Rock makes on visiting schools is to be a good one.

17.5 Bird Ringing

Sporadic bird ringing studies were first carried out in Gibraltar by visiting MOD personnel during the 1940s and early 1970s. Members of the Gibraltar Ornithological Society also started ringing during the 1970s. GONHS has been running an intensive bird-ringing programme, based mainly at the Jews' Gate Field Centre since 1991. This basically consists of catching birds (mainly small passerines), putting a small, very light ring around their leg, recording biometric data and then releasing the bird. In this way, if a bird is re-trapped, it is possible to find out where the bird came from, how much it weighed, etc.

Two licences are required in order to ring birds in Gibraltar. The first, obtained from the British Trust for Ornithology (BTO), is the actually ringing licence that ensures that those who ring are competent in both handling birds and collecting data. The second licence is granted by the Deputy Governor under the 'Nature Protection Ordinance, 1991' (L/N 11 of 1991),

and this grants holders of a ringing licence permission to trap and ring birds in Gibraltar for scientific or conservation purposes.

17.6 Macaques

As explained more fully in the Chapter 14, research into our macaques takes place on a regular and continuous basis. This is carried out largely by foreign universities and institutes, such as the University of Zurich, the Chicago Field Museum, the German Primate Centre, the University of Vienna and Notre Dame University in Indiana, as well as other individual researchers. In addition, GONHS carries out research of its own, consisting mainly of keeping a database of group sizes, social structures and identity and a record on each individual macaque. In 2003, GONHS contracted a young postgraduate, Mr Brian Gomila, to carry out some behavioural research into the macaques. As a result, Mr Gomila is now undergoing a Masters course (M.Res.) in Primatology that includes further work on Gibraltar's macaques.

The ongoing research on the macaques and of interest in the species was reflected in a very successful conference in the Calpe Series (Calpe 2003) funded by the Government of Gibraltar's Ministry for Heritage. Entitled '*The Barbary Macaque – Comparative and Evolutionary Perspectrives*', it attracted most of the prominent macaque researchers in the world. The lectures and workshops were useful too in improving management of the Gibraltar macaque population, as well as in focusing the needs for conserving the species in a wild state in Morocco. Overall, it was extremely positive in promoting Gibraltar and scientific work on the Rock. This shows the added value of proper research and management, something that could be extended to other fields in an improved Upper Rock Nature Reserve. Research into the macaques will continue under the Gibraltar Barbary Macaque Programme, which includes work on behaviour, ecology, diseases, and macaque-human interaction. Summaries of some of the ongoing projects are given in Fig. 1.

The Gibraltar Barbary Macaque Project is a collaborative research project of the Gibraltar Ornithological & Natural History Society in association with the German Primate Centre, the Gibraltar Veterinary Clinic, the University of Vienna, Notre Dame University and the Institut Scientifique Rabat.

The aims of the project include the increase in knowledge of the genetics and behaviour of species, of its ecology in Gibraltar so that, among other things, the future management of the Barbary macaques of Gibraltar can be conducted in a way that is consistent with their needs, bearing in mind also the position that they occupy in Gibraltar as a tourist attraction.

Completed, ongoing and planned projects:

Characterization and functional significance of sex skin swelling
Ulrike Moehle: German Primate Centre and Institute of Evolutionary Anthropology, Leipzig.
Completed November 2003
Funding: German Research Council

Population genetics and demography
University of Zurich, PhD project
Period: till 12.2004
Funding: University of Zurich

Factors determining paternity
German Primate Centre, PhD project.
Period: 04-2003 till 03.2006
Funding: German Research Council

Functional significance of copulation calls
Dana Pfefferle: German Primate Centre and Institute of Evolutionary Anthropology, Leipzig, PhD project
Period: 09.2003 till 08.2006
Funding: German Research Council

Secondary sexual characters and sexual attractivity as determinants of female social status
University of Vienna and German Primate Centre
Period: 07.2003 to 06.2006
Funding: Austrian Research Council

Macaque-human interactions
University of Notre Dame, Indiana, USA
Period: 11.2003 to 01-2004 (pilot phase); 05-2004 to 04.2005 (main phase)
Funding: University Notre Dame

History, Demography and Ecology
Macaque Study Unit
The Gibraltar Ornithological & Natural History Society
Period: ongoing
Funding: GONHS, Gibraltar Trust for Natural History

Figure 1. An overview of the Gibraltar Barbary Macaque project, including current research and main participants.

17.7 Archaeology

There is a wealth of historical heritage on the Upper Rock dating from early man right through the Moorish and Spanish occupations, up to the present time, (*see* Chapter 7). Recently, excavations at Bray's Cave have revealed an Iron Age burial site together with numerous important artefacts. The potential for further excavations, research and investigation into other caves and historical buildings and structures is great, and will no doubt form part of the ongoing research and development programme of the Gibraltar Museum. It is important, however, that researchers into archaeology are sensitive to the ecology of the caves and adjacent areas.

17.8 Others

In addition to the above, other forms of research take place within the Nature Reserve. Bird monitoring is regularly carried out for example; soaring bird migration and ringing in particular are covered extensively. GONHS is currently carrying out surveys into Gibraltar's biodiversity with the aim of cataloguing the Rock's fauna, flora and fungi. As part of this, the Upper Rock has over the past year been surveyed for its invertebrate fauna, particularly the Lepidoptera (butterflies and moths), Coleoptera (beetles) and Odonata (dragonflies and damselflies). The vascular plants, molluscs, reptiles, amphibians, birds and mammals of the Upper Rock have already been well documented, but much remains to be learnt, and it is the aim of GONHS to try to secure the kind of funding for equipment, books, etc., that will make the research into cataloguing our entire flora, fauna and fungi a realistic aim. There will be clear benefits to the Nature Reserve resulting from all this work.

17.9 The Future...

It is clear that, whereas some aspects of research such as bird ringing and the macaques receive regular attention, others are fairly neglected. The management of the Nature Reserve should take a proactive approach towards encouraging research within the Upper Rock. This is currently not the case. Research on all aspects of the Nature Reserve should be promoted. However, problem areas should receive priority. In this sense, research into such matters as traffic flow, the effect on macaques of visitor numbers and interactions, control and maintenance of macaque populations, monitoring and management of habitats to maximise their value to vulnerable or endangered species and general biodiversity should take priority. Other areas of research, such as archaeology and geographical aspects (e.g., geology, speleology), should also be given special attention due to the importance of Gibraltar for these. Furthermore, the management of the Nature Reserve should make every effort to give publicity to research within the Upper Rock. Thus, for example, panels at some of the macaque sites highlighting the main findings on aspects of macaque behaviour should be erected, with references to the institutions that have been and still are involved in macaque research on the Rock. Similarly, some sort of reference to the Iron Age burial site found at Bray's cave would illustrate to the tourist both the historical importance of the Nature Reserve and the type of work in which the Gibraltar Museum is involved. These, and numerous other examples, would show visitors that serious and useful research is carried out and encouraged on the Upper Rock.

It would be of great benefit to the Upper Rock – and indirectly to Gibraltar - if the Upper Rock Nature Reserve were to gain a reputation as a centre for academic research. If this is to be achieved, the Nature Reserve should be managed in a manner that will facilitate such studies, with some areas specially protected for this purpose. It is recognised that such research may not bring as much money to the Nature Reserve as tourism. However, both can easily be accommodated. Tourism already brings a great deal of money to the Reserve, and there is no need to expand the areas that are exposed to tourists. In addition, the Upper Rock, and Gibraltar in general would gain a reputation as a centre of academic excellence. As such, we would urge that every effort be made to ensure that the Rock Gun and Middle Hill Area be conserved as a special Biological Reserve, carefully managed and accessed, and free of the excessive visitor pressures that affect most other areas of the Upper Rock.

A system whereby grants are awarded by the Ministry for the Environment for projects that are in Gibraltar's interest could certainly be looked into. This would of course require experts within or outside the Ministry (perhaps a panel) in order to determine which are the Nature Reserve's, or more generally Gibraltar's needs before planning a project outline and granting funding to the most successful applicant(s) (who may or may not be from Gibraltar). In addition, the option should be left open for applicants to present their own project proposals, which would then be considered by the panel. Projects on any aspect of the Nature Reserve should be welcomed, and a system should be put in place whereby grants are awarded to an equal proportion of projects covering all subjects. This would fulfil two roles; it would allow Gibraltar to tackle its environmental needs effectively and would give the Government of Gibraltar a reputation of promoting academic excellence.

17.10 Recommendations

1) The establishment of lines of communication and a common forum between research and management bodies. Whereas the work of these two bodies is essential towards the formulation of working protocols they each have differing priorities and objectives. The researcher should work on medium to long-term specific projects achieving hypothetical and academic results. The managers should work towards practical, short-term decision-making processes, based as far as possible on the findings and recommendations of research and monitoring programmes. The basis of a common forum is to provide the scientific committees, i.e., the Nature Conservancy Council, GONHS, and other specific bodies the opportunity to take decisions as part of the fruits of debate involving the managerial sector of the Nature Reserve.

2) Emphasis should be placed on a sound, stable and continual long-term relationship and collaboration between researchers, the Gibraltar Government and the management of the Upper Rock Nature Reserve. This will ensure that the work of scientists and researchers will continue to provide the necessary recommendations to focus on the problems for a rapid assessment and solution to managerial, evaluation and monitoring programmes.

3) The provision of funding for research projects related in particular to the Upper Rock Nature Reserve and the purchase of the equipment and instruments necessary in obtaining, consulting and analysing the data produced by researchers. Research undertaken by foreign students is provisioned by their respective universities. A lot of research carried out by locals has been self-financed or supported wholly or in part by GONHS. GONHS has provided its support to both local and foreign students through the use of reference material from their library, supplying essential scientific equipment and offering sound advice and recommendations. The authorities should meet this financial burden, as the results of research are of benefit not only to the Nature Reserve, but also to Gibraltar's environment as a whole.

4) The establishment of an on-going monitoring programme once the management plan has been instigated, in order to identify, diagnose and address problems that might occur in the near future. It is important to stress that this must be carried out by trained personnel, or persons with experience in their respective fields.

Monitoring is recommended for the following:

- State of monuments, structures, heritage, paths, roads etc.
- Species with unfavourable status, e.g., invasives, vulnerable or threatened, restricted distribution, etc.
- Macaques, e.g., status, population, feeding etc.
- Human impact, e.g., visitor numbers, refuse accumulations, traffic, pollution etc.

5) The promotion of multidisciplinary studies to improve the definition of conservation and management objectives. This should include all thematic areas, i.e., environmental education, recreational use, relationship with the local population, legislation, environmental accounting, arbitration and decision making processes and monitoring and evaluation (EUROPARC-Spain 2002).

Among the principal areas of interest are:

- Landscape ecology.
- Cave geography and ecology.
- Ecosystems management.
- Establishment and use of ecological indicators.
- Establishment and use of socio-economic indicators.
- Disturbance and regeneration cycles.
- Macaque/visitor interactions and macaque population management.
- Repercussions of public use: environmental impact, tourism and services and the effect of visitor numbers.
- Conflict resolutions and managerial processes.
- Relationship of the Nature Reserve with the rest of the territory.

6) The dissemination and publication of the results of research and monitoring programmes, both from a scientific and a managerial aspect. This will result in a better understanding of the values of the Nature Reserve from a public perspective, will serve as a useful tool in environmental education and provide the means for the future development of managerial strategies.

7) The development of environmental educational programmes for schools that will make use of the resources of the Upper Rock, and provide a better understanding of the ecology

and requirements of the Nature Reserve. Schoolchildren should primarily focus on their homeland's environment before embarking on rural and environmental trips to Almoriama, Chiclana, etc. This should serve to support and recognise the wealth of knowledge and facilities that the Upper Rock should provide. Any such programme should be developed by the Department of Education and Training, in conjunction with the management of the Nature Reserve.

8) The establishment of a Biological Reserve in the current (2004) MOD area of Rock Gun and Middle Hill, once this land holding is handed to the Gibraltar Government in April 2005. This is already an area where much research is currently taking place in conjunction with GONHS and its research facility at Bruce's Farm. The site could bring many more people to study a wide variety of subjects, but only if the focus of the study is kept free from interference and interaction by humans.

9) Members of the public should be allowed to appreciate the beauty and tranquillity of the Biological Reserve. However, the sensitivities of this site should be highlighted as a priority in any plans to allow persons within the area. Therefore, authorised guided visits to the Biological Reserve should be limited to small groups, and the frequency with which visits take place should be low. Visits should be led by a warden with ample experience on the natural history of the Upper Rock, who would act as a guide. Visits should ideally be conducted along the roadway, or clearly designated pathways. No interaction with any of the animals of the Biological Reserve should take place, and an appropriate distance should be maintained from these.

10) The Biological Reserve should receive special management, conducted by a scientific body that includes experts on diverse subjects relating to the site. Facilities should be granted to this scientific body to ensure the smooth management of the site. The Biological Reserve should be conditioned to meet the needs of a biological centre. Some of the old buildings at Middle Hill should be provisioned with facilities that provide, encourage and meet the requirements of researchers working in this area. In addition, a fee for visitors can be introduced, the proceeds of which would all go towards the upkeep and management of the Biological Reserve. These funds should not replace, but rather complement money allotted to the Biological Reserve by the management of the Upper Rock Nature Reserve.

11) The Biological Reserve should be managed to the benefit of all wildlife found within this site. Feeding and watering sites for macaques and any introduced herbivores should be installed and properly maintained. In addition, any measures that are deemed beneficial to the wildlife of the Biological Reserve should be put into action. This would be carried out using Biological Reserve funds.

12) Research, monitoring and management should take place throughout the whole of the Nature Reserve. The existence of a Biological Reserve should in no way undermine the importance of the whole of the Upper Rock Nature Reserve to natural history and heritage. Environmentally sound management, after carefully considered research and monitoring, should take place within the entire Nature Reserve.

References

- **EUROPARC-Spain (2002)** *Action Plan for the Protected Natural Areas of the Spanish State.* Madrid, Spain: Fundación Fernando Gonzàlez Bernàldez. 168pp.
- **Gibraltar Gazette (1991)** Nature Protection Ordinance, 1991 (L/N 11 of 1991).

18. MOD sites

18. MOD sites

The Upper Rock was once totally controlled by the military, where they installed numerous batteries and searchlight emplacements that operated during WWII. The area was fenced off by what was popularly known as the 'unclimbable fence'. This area became a total exclusion zone to the resident population, but soon after the war the area was again opened to the public but only during daylight hours. The Upper Rock was controlled by the 'Security Police', (now the Gibraltar Services Police), and firebreak and vegetation maintenance on the lower slopes and Upper Rock was carried out by the MOD. . However, most of this was eventually handed over to the Government of Gibraltar. Consequently, four main sites within the Nature Reserve remain under the control of the MOD. These are Rock Gun and Middle Hill, The aerial farm and firebreak above Bruce's Farm, Ince's Farm and Spyglass. The map in Fig. 1 shows existing MOD sites within the Nature Reserve.

Figure 1. Map of Gibraltar. MOD sites (as at 2003) are shaded green. Those that fall within the Upper Rock Nature Reserve are highlighted. Map provided by the MOD.

It is important to point out that Gibraltar nature conservation legislation, including the 'Nature Conservation Area (Upper Rock) Designation Order, 1993' (L/N 51 of 1993), equally applies to these sites.

The handover, according to recent information from MOD sources, consisted of everything that remained on this land, including all military installations. Although this was said in reference to disused pipelines, the same logic would dictate that all other military installations, including guns and batteries, would fall under the administration of the Government of Gibraltar. The authors of this report therefore cannot comprehend why the 9.2" guns at Levant and Spur Batteries were removed by the MOD after the handover, given that these were on Government of Gibraltar land. It would be interesting to find out what happened to these guns. If they were sold, then who kept the money? If on the other hand the removal of these guns by the MOD was legitimate, then they should likewise remove all other redundant former MOD installations, disused pipelines and cables that mar the aesthetic value of the Nature Reserve.

Some of the MOD sites within the Nature Reserve are of considerable importance to the fauna, and in particular the flora of Gibraltar. The firebreaks and aerial farm above Bruce's Farm and the old Rock Gun water catchment hold breeding Barbary partridge *Alectoris barbara*, as well as populations of rabbits *Oryctolagus cuniculus*, and other animals that rely on open areas. Similarly, plants that favour open areas grow well on the firebreaks, and the area above Bruce's Farm is in fact the most important of all firebreaks on the Upper Rock in terms of floral diversity (*see* Chapter 11).

Some of the 'special' plants of Gibraltar find their strongholds within MOD sites. The Gibraltar campion *Silene tomentosa*, which is endemic to the Rock, was rediscovered at Rock Gun in 1994, having last been seen nearby nine years earlier. It is possible therefore, that apart from a few plants that have been cultivated at the Alameda Botanic Gardens and reintroduced elsewhere, the only wild *Silene tomentosa* in the world may still be found with-

in MOD land. Similarly, the endemic Gibraltar chickweed *Cerastium gibraltaricum*, grows very well at both Spyglass and Rock Gun.

The conservation management of all MOD sites in Gibraltar, including those on the Upper Rock, is covered extensively in Bensusan & Perez (2003). Here, we will give a brief account of what conservation measures are required on MOD sites within the Upper Rock Nature Reserve, based on our previous report. Costings are not included, as these have already been provided in Bensusan & Perez (2003), and are in any case for the attention of the MOD and not the Government of Gibraltar.

18.1 Rock Gun and Middle Hill

Rock Gun and Middle Hill constitute what is by far the largest MOD site within the Nature Reserve. It is situated at the northernmost end of the Rock and is extremely important for a variety of flora and fauna, particularly species of open and rocky areas. Important populations of some of the special plants of Gibraltar occur in this area, particularly on the cooler, north-facing ledges and cliffs. *Silene tomentosa* our most endangered special plant, was rediscovered at this site in 1994 (having last been seen in 1985 in this same area), and very small, wild population probably still occurs here.

This area that served as a water catchment was once frequently cleared, but the practice ceased once the catchment became redundant. The vegetation still remains more open in this area than in most parts of the Nature Reserve, and is thus an important breeding site for Barbary partridge *Alectoris barbara*, and wintering site for birds such as black redstarts *Phoenicurus ochruros*, and alpine accentors *Prunella collaris*. Plants of open areas, especially those that favour rocky areas, also find strongholds on this slope. However, clearing of this area ceased many years ago, and vegetation now covers the slope to such an extent that the area may soon be covered by the dense maquis that is typical of the Upper Rock if nothing is done to prevent this. Fig. 2 shows how the vegetation on the Rock Gun water catchment has developed over recent years.

Figure 2. The photo shows the Rock Gun catchment during the 1980s, whilst the photo below shows this same area in 2003. As can be seen, the vegetation is rapidly growing denser (taken from Bensusan & Perez 2003).

The development of maquis on these slopes is detrimental to the maintenance of the biodiversity of the Nature Reserve. Given the importance of this area for both flora and fauna, every effort should be made to clear this slope. Once cleared, the low vegetation could be maintained with the introduction of large grazers such as Spanish ibex *Capra pyrenaeica* or Barbary sheep *Ammotragus lervia*. Sources from which to obtain these animals have already been identified by GONHS, and individuals are readily available. Furthermore, perhaps some sponsorship could be sought to reduce the cost of introduction (or reintroduction, in the case of the ibex). There is no doubt that, apart from maintaining vegetation low, large grazers, easily visible from roads and paths, would add to the aesthetic appeal of the Upper Rock Nature Reserve. However, a herd of feral goats is presently found at this site, having been introduced illegally several years ago. These would have to be eliminated prior to the introduction of wild ungulates to avoid competition and interbreeding.

Barbary macaques are also resident in this part of the Nature Reserve. Until the summer of 2003, Middle Hill and Rock Gun held the largest (and most thoroughly researched) pack of macaques in Gibraltar. However, of the 65 individuals that were found at this site before this period, 27 were culled after the whole pack took to descending to Catalan Bay on an almost daily basis (*see* Chapter 14, section 14.5). In order to ensure the continued well-being of the macaques at this site, it is necessary to provide proper tiled and roofed feeding areas and a watering site (e.g., a pond) in order to improve conditions for the macaques and maintain the feeding site clean.

The Rock Gun area is of special importance to wildlife. This, at least in part, is due to the isolation of this site from visitors. Although at present access is restricted due to the presence of the MOD, this may no longer be the case when the MOD eventually hand the site (or most of the site) over to the Government of Gibraltar. (An announcement was made in mid April 2004, that this site would become the property of the Gibraltar Government in April 2005).

It is important to stress that an increase in visitor numbers would be very detrimental to the wildlife of this site, including the endemic, near-endemic and endangered plants and animals that exist at Rock Gun and Middle Hill. With this in mind, it is recommended that, should a hand-over take place, this area should be designated a 'Biological Reserve', with access restricted to researchers and administrators. Furthermore, wardens of the reserve (should these be employed) could lead guided tours of the site to small groups of a limited size. These tours would be particularly attractive if ibex or Barbary sheep are introduced at this site, and if the wardens leading these tours have a good knowledge of the flora and fauna of the Nature Reserve.

A recent development since this report was being compiled is the proposed Funicular Project. This funicular railway would run from Grand Battery at Casemates, up through the lower Rock, through a proposed tunnel 230m in length coming out at the bottom of the road leading up to the Upper Galleries, as seen in Fig. 1. It would then cut directly through the open area of former catchment to a top terminal station to the south of the summit at Rock Gun. This proposal is in conflict with the environmental importance of the area and incompatible with the proposals for the Biological Reserve stipulated in this document.

Figure 3. Proposed Funicular route from Casemates to Rock Gun.

The contractors have presented a 'Technical Feasibility Report No.2'(P. Glassey 2003), where they have tried to integrate the trackway into the landscape, by lowering the rails to the ground wherever possible and diminishing the visual impact of the line through afforestation. Even in a photograph of the view of Rock Gun from the city, they have doctored the picture to include more vegetation around the proposed line, as seen in Fig. 4. This is in totally against the recommendations put by the authors of this report for the clearing of the vegetation of this area in an effort to restore the habitat for the survival of important species of flora and fauna in the Nature Reserve.

Figure 4. Proposed Funicular route from Casemates to Rock Gun.

18.2 Aerial Farm and Firebreaks

Firebreaks are extremely important to the maintenance of floral diversity within the Nature Reserve. About 213 species of vascular plants (some 37% of Gibraltar's flora) have been recorded on the firebreaks (Linares 1994). Those that occur within MOD land, and in particular the firebreak above Bruce's Farm, are of most importance to the flora of the Nature Reserve. It is important to stress here that, although the status of the Bruce's Farm firebreak seems ambiguous to most people we have spoken to (both Government of Gibraltar employees and MOD staff), this area clearly falls within MOD land. This is clearly shown on the map in Fig. 1, which was provided to us by the MOD. The clearing of these firebreaks is discussed in both Bensusan & Perez (2003) and in Chapter 8 of this report.

18.3 Spyglass

Spyglass, situated at the southernmost peak of the Rock (just north of O'Hara's battery) is a small area that is controlled by the MOD. In spite of its small size, this site contains populations of some of the special plants of Gibraltar, most notably the endemic *Cerastium gibraltaricum*, a plant whose population within Spyglass is of national, and therefore international (given that this species is found only in Gibraltar) importance. It is therefore very important that the sensitivity of the flora of this area be taken into account when works are being carried out.

An area on the cliffs below and to the east of Spyglass that is only accessible from this site, known as Monkey's Alameda, has recently been explored and found to contain a large stand of sweet bay or laurel *Laurus nobilis*, (J.P. Latin, *pers. obs.*; Bensusan & Perez 2003). The sensitivity of the flora of this site should also be considered, and further investigations into the flora and fauna of this isolated site may yield some interesting results.

18.4 Ince's Farm Residential Area

The Ince's Farm residential area is divided into two main areas; one of these is the Girl Guide camp and the other was until recently the home of the American Liaison Officer, who earlier this year was moved down to North Front due to security implications. While not of such outstanding importance to the wildlife of the Nature Reserve as some of the other MOD sites, it is certainly no less so than any other section of the Upper Rock. In past years there have been records of nesting Barbary partridges within the garden areas which are fairly open in nature. Moreover, all laws contained within the 'Nature Protection Ordinance, 1991' (L/N 11 OF 1991) and the 'Nature Conservation Area (Upper Rock) Designation Order, 1993' (L/N 51 of 1993) apply to this area. Furthermore, this area has a less steep gradient than that of most of the Upper Rock, and so would be a good area to replant with Mediterranean woodland tree species, should a regeneration programme take place. Indeed, olive trees *Olea europea*, are taller in this area than in most other areas of the Nature Reserve, and typical herbaceous woodland species such as the Italian arum *Arum italicum*, do particularly well here. Ince's Farm is also one of the problem areas highlighted in Chapter 8, which deals with invasive flora, and all of the recommendations made in this chapter should be applied to this site.

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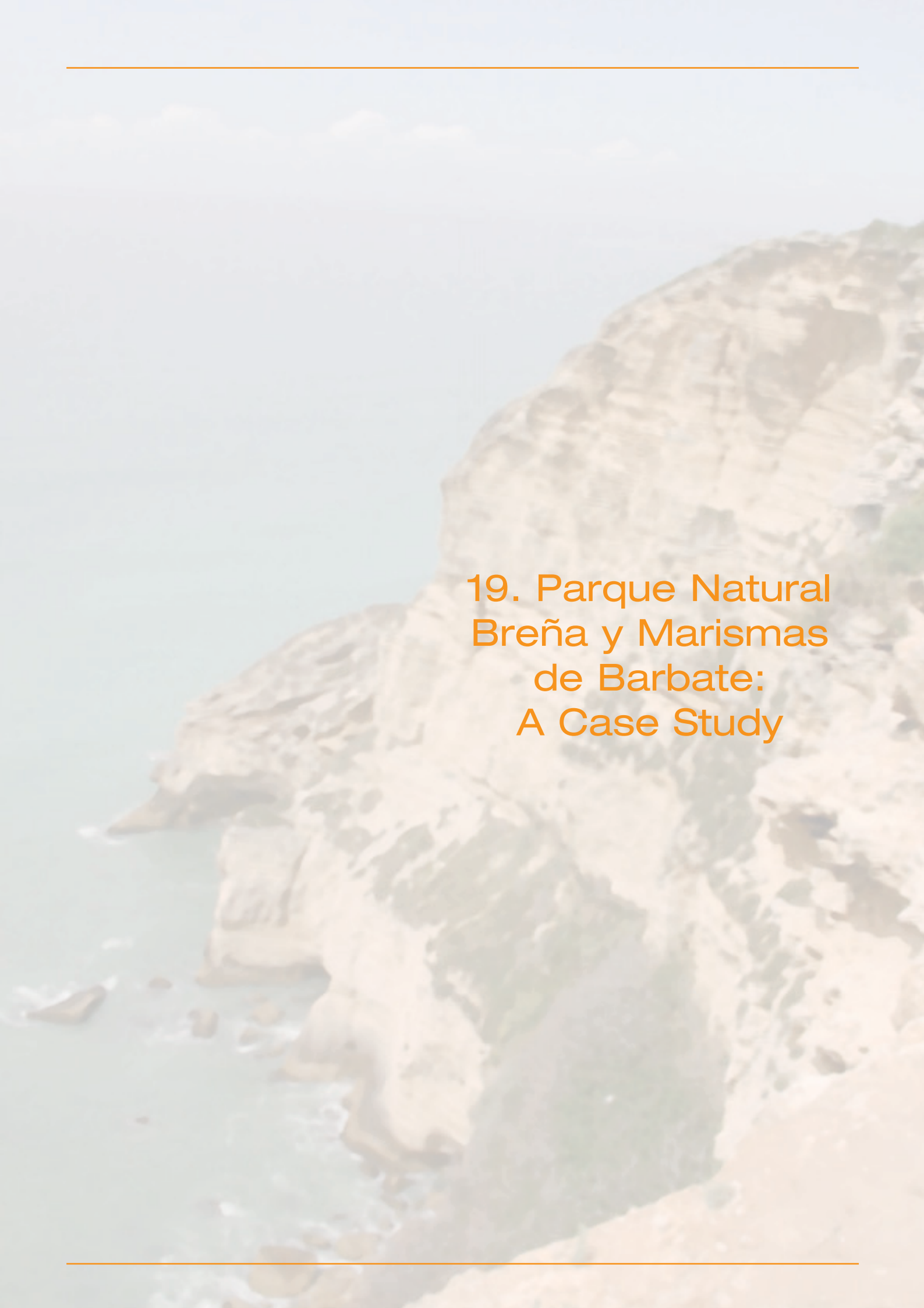

19. Parque Natural Breña y Marismas de Barbate: A Case Study

19. Parque Natural Breña y Marismas de Barbate: A Case Study

The Pinewood at Parque Natural Breña. Notice the wooden boundary fence.

One of the objectives we contemplated would give us a better understanding of the requirements of the Upper Rock Nature Reserve was to visit a nature reserve of similar size to ours. This should have similar urbanisation pressures, economic activities within the reserve and an ample tourism and visitor base, which would enable us to compare the type of management structure required to manage the same and provide us with a background in the way other reserves cater for their needs.

With these aims in mind we found that the 'Parque Natural Breña y Marismas del Barbate' suited our needs. Although this park encompasses an area of marismas which has no comparison to the Upper Rock, the town of Barbate is sandwiched between this and the 'Parque Natural Breña' that is composed of an extensive pinewood forest, and compares favourably in size and structure to the Upper Rock Nature Reserve.

Rio Barbate

19.1 The Breña Reserve

Zone A. Maximum protection for its cultural and ecological value.

Zone B. Medium protection. Economic and commercial interests permitted.

Zone C. Still protected but minimal vigilance and full access to the public.

Terrestrial Zone

Maritime Zone

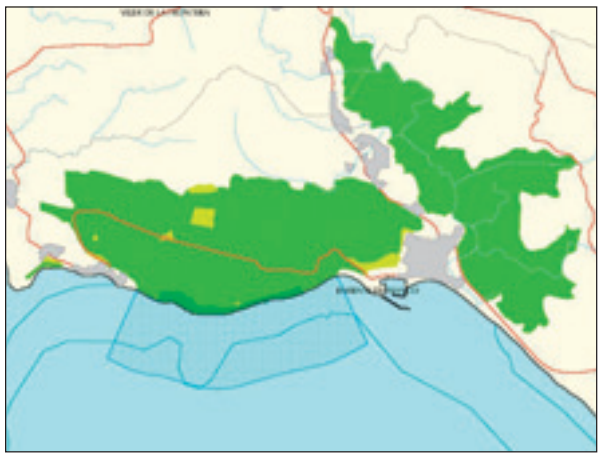

Figure 1. Map of the 'Parque Natural Breña y Marismas de Barbate' (Taken from Junta de Andalucía (1994)).

The 'Parque Natural Breña y Marismas de Barbate' is situated mid-way between the towns of Tarifa and Cádiz, and just south of the town of Vejer. It forms part of the very ridge upon which Vejer is located and runs in a north-south direction down to the town of Barbate. The reserve is composed of a large pinewood bordered to the south by impressive sandstone cliffs, which rise up from the Atlantic to a height of 50m. These cliffs were famous for its breeding colony of herons from the 1960 to 1990s when little egrets *Egretta garzetta*, and cattle egrets *Bubulcus ibis*, that had been displaced by the draining of the immense lagoon of La Janda, found suitable nesting sites on the ledges along the cliff (Francisco Bravo, *pers. comm.*). Most of the herons have now left and have been replaced by yellow–legged gulls *Larus michahellis*, and western jackdaws *Corvus monedula*, with some pairs of rock dove *Columba livia*. These cliffs afford magnificent views of coastline to the east where Barbate is situated and to the west where one can contemplate Cape Trafalgar, steeped in the history of the famous naval battle which bears its name, and the 'Caños de Meca', a small urbanisation, progeny of the camp-site which is situated there. The park is bordered on the eastern side by the road that runs from the crossroads near Vejer to Barbate and is dissected by another road that runs from Barbate to Caños de Meca at Cape Trafalgar. From these two roads numerous sandy tracks run into the park that can only be traversed on four by four vehicles or on foot.

Caños de Meca with Cape Trafalgar, as seen from the Breña reserve.

19.2 Flora and Fauna

The 'Parque Natural Breña' is situated on a large ridge of sandstone, which is covered in a vast plantation of pine trees. This is composed mainly of stone pine *Pinus pinea*, with some Aleppo pines *Pinus halepensis*, and just a few maritime pines *Pinus pinaster*. There is a small belt of *Eucalyptus* trees of many different species that were planted in the Franco era to assess the precise species that was best suited to the habitat in order to establish plantations. This stand of *Eucalyptus* is now an important asset to the park. The underlying vegetation is controlled to a large extent to prevent fires from raging out of control. However, large areas are allowed to flourish with bushes of the prickly juniper *Juniperus oxycedrus*, and Phoenician juniper *Juniperus phoenicata*, strawberry tree *Arbutus unedo*, *Osyris quadripartita*, numerous broom species and a large variety of wild flowers that colour the understory surrounding the pine trees.

The pinewood habitat that dominates the Breña reserve.

The proximity of the reserve to the western entrance of the Strait of Gibraltar provides the area with a notable influx of migrant birds in spring and autumn. Nest boxes are provided in many areas of the pinewoods and a variety of passerines take these up. There is also nesting booted eagles *Hieraaetus pennatus*, long-eared owl *Asio otus*, and Eagle owl *Bubo bubo*. Pinewoods are a favourite habitat of the red-necked nightjar *Caprimulgus ruficollis*, and this area is no exception with a good population of this species. The cliffs provide a good vantage point to observe seabird passage and the ledges serve as an ideal nesting habitat for the few species mentioned previously.

The waters surrounding the Parque Breña also form part of the protected area and therefore constitute a marine reserve, and are afforded the same protection as the terrestrial reserve itself.

19.3 General Management

Reserves in Spain have a very complex management structure that mainly works quite well, but this has no comparison to the management structure of the Upper Rock Nature Reserve. Notwithstanding, it is useful to understand the way in which the reserves are managed in Spain, as it could perhaps form the basis on which to constitute a similar structure in Gibraltar.

The 'Parque Natural de Breña y Marismas de Barbate' comes under the authority of the 'Delegación Provincial de Medio Ambiente'. This is an official Government body of the 'Junta de Andalucía' namely its Environment Department, which is headed by a specific Regional minister. The autonomous region has its own office in Sevilla, and in turn this is further divided by provinces. The Delegación Provincial de Medio Ambiente de Cádiz deals with many problems of an environmental nature and carries responsibility for the numerous protected areas that it has at its disposal. These are divided into three separate degrees of importance.

• Reserva Natural: Areas nominated as such are fully protected and public access is totally restricted. Authorisation to those areas is only granted for scientific purposes.
• Parque Natural: These areas are fully protected but access is open to the general public. Economic and commercial interests within the park are permitted.
• Paraje Natural: Full protection is still afforded but with minimal vigilance and with full access to the public.

The Cádiz office employs a Director in charge of all the protected areas of the three types mentioned above. He is Francisco Bravo and we were very grateful to have him at our disposal throughout the tour of the reserve. His knowledge and experience in the management and day to day running of this reserve was extremely useful to us. Sr. Jose Manuel López, who is his technical advisor, accompanied him. He also holds the office of Director of the Parque Jardín Botánico San Fernando, and also heads the Bald Ibis project (a proposed reintroduction of this endangered species into the Parque Natural de Breña from captive stock held in Jérez Zoo.). His knowledge of the area and the historical background together with his vast experience of plantlife was particularly beneficial providing comparisons with the biodiversity of this area and Gibraltar.

Each one of the network of reserves has a Board of Directors (Junta Rectora), which is constituted to advise on all interests within the reserves and parks. It is formed of members of the public who have a vested interest in the running of the affairs of the park, be it economical, social or environmental.

Policing of the reserves and parks is carried out by a contingent of Guarda Forestales, (wardens), who do not come under the authority of the Delegación de Medio Ambiente. They have under their responsibilities very large areas as far away as La Janda and Paterna and including this reserve. They work in co-ordination with the needs of the Delegación de Medio Ambiente and report back on all aspects of the reserve including areas which may need maintenance, tree cutting, visitor co-ordination, fire break maintenance, control of pest species and act as fire lookouts during high risk periods. In this respect they are in touch with the forest fire control agency in Spain, 'INFOCA'. They also liase with the 'SEPRONA', the environmental liaison officers of the Guardia Civil, on infringements of local wildlife laws. We were fortunate to have as our driver and guide the top warden, 'Jefe de Guardas Forestales', Sr. Juan Sanchez. He was to our mind a charismatic person with profound knowledge of wildlife, for he had spent most of his life in the role of warden in many areas of Spain, as far away as Segovia, down through Jaén, and has now returned back to his homeland at Barbate. He spoke of the area as if it was his own; then again it was, for the passion with which he described the plants, trees and scenery of this wonderful area created a sense of admiration within us, but also brought to us the realisation of the failings within our own Upper Rock Nature Reserve.

Furthermore the Delegación Provincial de Medio Ambiente formed the company EGMASA sa, (Sociedad anonima). This limited company was supposed to accelerate the bureaucracy that slowed down the endeavours of the Agencia de Medio Ambiente (Environmental Agency), the precursor of the Delegación Provincial. It was meant to co-ordinate and manage the economic interests held within the Parques Naturales. It is administered by many ex-oficio government officials and political candidates who are not elected in municipal elections and has since also acquired the rights to all works within the areas held by the Delegación, even those going out to tender. It has been found to be in breach of the European Directive in contravention of unfair competition procedures, and will be undergoing a complete restructuring after sanctions were brought against them.

19.4 Environmental Management

There is a certain amount of environmental management that takes place within the reserve on an annual basis. This consists mainly of trimming of young pine trees, removal of trees around denser areas to allow for expansion of the canopy of stone pines *Pinus pinea*, and the maintenance of the undergrowth around the woodland and the upkeep of firebreaks. This work is done in keeping with the economic interests of the pinewoods following recommendations from the Guarda Forestal who surveys the condition of the reserve. With this in mind the Delegación de Medio Ambiente retains a small herd of cattle in this reserve that is allowed to graze around areas that are in need of vegetation maintenance. This is a good, environmentally friendly way of managing the vegetation and should be considered in Gibraltar, perhaps with 'wild' species such as the Spanish ibex *Capra pyrenaeica*, or Barbary sheep *Ammotragus lervia* (*see* Chapter 13, section 13.1).

Firebreaks are a common sight within the Barbate pinewoods. They form an intricate network needed to prevent the spread of fires. These are constantly maintained with a small

workforce with tractors and heavy plant that removes most of the vegetation. An observation tower is situated in the middle of the reserve, which serves as a vantage point from which the Guarda Forestal maintains a watchful eye for fires during the high-risk period from the end of May until the end of September.

19.5 Economic Interests

The most valuable asset the Parque Natural Breña has is its immense pine woodland. This is mainly made up of the species 'stone' or 'umbrella pine', *Pinus pinea* that provides a valuable natural resource, namely the 'piñon' or pine nut. The average annual harvest of pine cones is usually about 1500kg and in a good year can reach as much as 2000kg. The thinning and cutting of trees also provides firewood, which is sold locally, and some heads of cattle from the local herd of the reserve are also sold annually to the local market. Profits made from these resources are re-invested back within the reserve.

19.6 Visitor Provisions

The Parque Natural Breña has several areas designated as picnic sites. These are always within easy reach of the main road and provide fresh water, seating fashioned out of the excess wood in the area and suitably located fireplaces. The area provided is located under large, mature pines that provide the visitor with adequate shade and the vegetation around the picnic site is kept to a minimum to prevent any fires. There are suitable parking facilities and the picnic site is bordered by fencing made of pine logs thereby maintaining an aesthetic environmental appeal and preventing the encroachment of vehicles. Obviously these picnic sites are mainly used in the months of low fire risk periods. During the high risk periods no fires are allowed within any reserve in the area and access is sometimes limited and controlled at entry points where a record of your car's number plate is taken by the Guarda Forestal at the point of entry.

We noticed many foreign visitors taking a pleasant walk around the woods and the cliff area, and were surprised to encounter a party of schoolchildren enjoying a ramble along one of the glades in the pinewoods, as shown in Fig. 2. Having seen this activity we asked the Director Francisco Bravo if there was extensive literature and pamphlets with maps describing the reserve, and if they had established a centre that would provide information about the reserve and describe the interesting commercial activities taking place within it. Unfortunately he told us that none of these were available and it was the only and most important factor that was missing from what we found to be a well-managed and administered reserve.

Figure 2. A party of schoolchildren enjoying an educational walk through the Breña reserve.

19.7 Urbanisation Pressures

The 'Parque Natural Breña y Marismas de Barbate' is made up of two separate areas with the town of Barbate sandwiched between the two. The town's main economic activity has always been fishing with a large fleet, which operates in the Moroccan banks and two separate tuna fishing traps that run from the shoreline to a distance of a mile and interrupts the migration of these large fish. They are penned into a holding net and are then sold to Japanese fishing boats for enormous sums of money. The Moroccan authorities have now rescinded permits to fish in their waters and the tuna catches are decreasing annually. This has meant a decrease in the growth of the town with many of the younger inhabitants leaving to find a better future elsewhere. This has taken some of the pressures of encroachment on the reserves away for the time being, although there are plans to build an educational facility within the eastern borders of the reserve. The Director told us that even though this was going ahead, the land would remain within the administration and management of the Delegación de Medio Ambiente. With this exception the growth of the town has taken place along the narrow margin that borders the two reserves, but growth is slow at the moment, although the tendency of the municipality is to invest in tourism as the alternative.

This is not the case at the western end of the area where the Caños de Meca, which was a small hamlet with a campsite, is now growing at a very fast pace with many buildings being erected without the necessary municipal building permits. Encroachment at both these places is difficult since the terrain rises steeply up to the ridge where the reserve is situated. Yet the reserve boundary starts at the base so there is the danger of not only illegal buildings being built but also the problem of invasive species, pests and fires affecting the well being of the reserve. The problems are very similar to what we find in Gibraltar, but so far we have the Lower Slopes as our buffer zone. How long will they last and how will it affect the Upper Rock Nature Reserve if and when this area disappears?

19.8 Comparisons

With the designation of the Upper Rock Nature Reserve in 1993 (L/N 51 of 1993), no formal management structure was implemented to address the problems and complexities of the area. The Gibraltar Ornithological & Natural History Society (GONHS) has acted in its capacity as the consultative body, at no expense to the Government, in providing advice and suggestions on matters concerning natural history and the environment. This advice has been heeded in some cases and not in others, but the problem lies in that there is no formal body where all matters can be discussed and dealt with expeditiously. In the same way as the Breña reserve, the Upper Rock Nature Reserve should have an advisory Board made up of members of the community with vested interests in all the affairs that concern the area. These should deal with the economic, environmental, cultural and historical aspects of the reserve to ensure a viable and adequate management solution.

The Upper Rock Nature Reserve has no restrictions for public access except for entry after 22:00hrs. There is only one type of Reserve designation in comparison to the three in Spain, and the only areas out of bounds are within the MOD properties of Rock Gun, Middle Hill aerial farm and Spyglass. As and when these areas are handed to the Gibraltar Government, GONHS suggests that in the same way Spain holds on to Reserva Natural for scientific research purposes, these areas that are now used by GONHS for those same purposes should be retained as restricted areas for the public (*see* Chapter 17). This would enable the ongoing research on the Middle Hill group of Macaques to continue protected from public and touristic interaction, and would provide the ideal area for the introduction of either the Spanish ibex *Capra pyrenaeica*, or the Barbary sheep *Ammotragus lervia*, which would then be used, as foraging animals, to control firebreaks and areas of dense vegetation and would enhance the attractiveness of the Reserve (*see* also Chapter 13). This would be Gibraltar's equivalent to the herd of cattle used in Spanish reserves.

The Breña Reserve has a team of Guardas Forestales that constantly inspects the conditions of the reserve and administers some of the lesser tasks that take place within the area. Gibraltar's Upper Rock has *no one*. GONHS employs a supervisor specifically for the macaques, who is assisted by a team of two people that feed and water the Macaques. Another four persons use the Nature Reserve as part of the control area for the gull cull effort. These people have a good environmental background and are particularly concerned with the condition of the Upper Rock Nature Reserve, yet it is not within their remit to undertake warden duties, nor do they have the time to neglect their responsibilities, nevertheless GONHS does get plenty of feedback from these keen and concerned workers who spend most of the day appreciating nature on the Reserve and seeing the degradation that is taking place. The implementation of wardens as stipulated in the 'Nature Conservation Area (Upper Rock) Designation Order, 1993' (L/N 51 of 1993) is paramount if the Upper Rock Nature Reserve is to have a future.

Economic interests within nature reserves are always most welcome as this takes the pressure away from the cost of maintaining a reserve in an adequate condition. In the United Kingdom most reserves charge a small fee on entry that is usually re-invested in the upkeep of the area. In the Breña Reserve entry is free of charge but economic activity generated within the Reserve together with an adequate management structure ensures a good turnover that is also re-invested into the Reserve. In Gibraltar the economic activity generates so much money that, I am sure, we are the envy of most Nature Reserves or National Parks in the world! Yet what percentage is re-invested back into the Nature Reserve? Very little.

Apart from contracting 'Master Services' for the cleaning of the roadways, the occasional maintenance of the Tourist sites, and the sporadic clearing of some of the firebreaks, little else has been done to the rest of the appearance of the Upper Rock Nature Reserve. This basically constitutes a cosmetic facelift for the benefit of the tourists, but our Upper Rock is a sick patient in need of antibiotics and not just an aspirin. At the very least a large percentage of the entry fees should return to the Reserve in the way of maintenance and repairs to all the different aspects of the Reserve, be it environmental, historical or just aesthetic appearances.

The economic activity generated has a bearing on the visitor pressure the Upper Rock Nature Reserve has to endure, and the amount of traffic this generates. The Breña Reserve in comparison has few visitors so there is not much erosion of the sand tracks in the area and litter is easier to control. In Gibraltar, the majority of visitors are taken into the reserve on tour buses or taxis and thereby stick to a specified route. The sites are frequently congested and the traffic on the roads is extremely heavy, making it impassable with blockages lasting a long time. Pollution from the diesel engines makes walking unhealthy and coats the vegetation in the proximity with soot. The Upper Rock Nature Reserve has reached saturation point in view of the amount of vehicles being allowed up the Rock, including the extra ten coach licenses granted recently.

Urbanisation pressures are very similar to the Breña Reserve. Barbate has a thin strip of land with which to expand whereas the possibility of land reclamation from the sea is impossible due to the deep coastal waters and the Atlantic breakers that pound the coastline. In Gibraltar the possibility of further land reclamation is viable within the harbour area, whilst still allowing the use of the port facilities. Therefore the pressure from urbanisation on the lower slopes should be minimal because the expense of building on the lower slopes and providing a roadway to communicate with the buildings would be greater than the previous option and building costs on level ground are more economical than on a slope. Residential areas within the Upper Rock should be closely monitored to ensure that extensions to buildings are not carried out without planning permission and that there are no new buildings. Government should relocate those residents who live in Government houses to other areas within the Government estate.

The cliffs at Barbate.

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20. Tourist Sites

20. Tourist Sites

The tourist sites are an integral part of the Upper Rock Nature Reserve that serves to bring large numbers of visitors to Gibraltar. It requires a reliable infrastructure in place to ensure that smooth running of that aspect of the Nature Reserve. The human resources involved are employed directly by the Gibraltar Tourist Board, at a cost equivalent to using a substantial amount of the proceeds from the Nature Reserve. To portray a better understanding of the processes the authors have provided a breakdown of the revenue and expenditure involved.

Visitors to the Upper Rock Nature Reserve pay an entrance fee, and the sum of the fees collected in 2002/2003 amounted to about £2.1m, with expenditure on the sites for the same period calculated at £1.2m. The total number of persons in employment dealing directly with the Upper Rock is thirty-eight. This is divided into six administration staff, nine cleaning and maintenance crew (over and above those contracted with Master Services), and twenty-three site officers. Apart from the salaries of the employees, there is also the added cost of the maintenance of firebreaks and other slopes, the Group 5 security arrangements, miscellaneous expenses and a small amount for the maintenance of exhibits (P. Canessa, *pers. comm.*). The Master Services contract falls under the responsibility and budget of the Ministry for the Environment. After taking all this into account there is still a sum left over of approximately £750,000.

A total of £750,000 was invested in the new sound and lighting display for St. Michael's Cave, but apart from the recurrent costs little else has gone into a repairs and maintenance programme for the sites (P. Canessa, *pers. comm.*), and as such there are several aspects that have deteriorated and need attention. In this chapter we highlight some of those deficiencies and propose changes and improvements to some of the sites. Finally, we list a series of recommendations under each site which we feel would drastically improve the situation and provide value for money to the large number of tourists visiting the Upper Rock Nature Reserve.

20.1 Access

How well is the Upper Rock Nature Reserve depicted on signposts on roads leading up to the entrance? In the past these signs were inadequate, due to their small size and scattered location. We have recently seen an improvement, with the first graphic and text signs (as opposed to the old signs) providing directions on arrival to Gibraltar as early as Winston Churchill Avenue. The bottleneck at the Queen's Hotel and the road leading up from Southport Gates have large signs indicating the route to the Nature Reserve, yet it is surprising how many tourists miss this turn and head up towards Prince Edward's Road instead. An additional sign on the left, at the bottom of Europa Road would prevent lost tourists the harrowing experience of negotiating not only the narrow Prince Edwards Road but also Willis's Road with the prospect of oncoming traffic. Some will eventually arrive at the Moorish Castle barrier from where they will only be able to access the City under Siege and the Upper Galleries and of course, the Tower of Homage.

Once on Europa Road a large sign opposite the Casino directs the tourist up Engineer Road where a more comprehensive sign with substantial information is located. Here at the beginning of Engineer Road, especially during the peak months, a security guard will redirect the tourist back down to town and advise them to use public transport. This usually happens between the hours of 10:00hrs and 16:00hrs when the Nature Reserve is saturated with traffic.

Continuing the journey past this point, the tourist arrives at the entrance gates to the Upper Rock Nature Reserve. Here, another sign provides information on entrance fees and opening and closing times. There is no excuse then for the tourist not willing to pay when he arrives at the ticket booth, for this information is made substantially clear. Despite this, many tourist vehicles that are unwilling to pay the entrance fee, reach Jews' Gate, and then have to be redirected down through Lathbury Barracks.

20.2 Jews' Gate

The Nature Reserve's ticket offices are located at Jews' Gate. These were moved here from another location further down Engineer Road, where the problems of redirecting tourists back to Town against the traffic made the siting of the ticket booths unsuitable. Now the booth is located in the middle of the road to access taxis and coaches to the west and tourists and local vehicles to the east. Recently, in mid 2003, a further booth was placed on the side of the road adjacent to the central booth. This has alleviated the cramped conditions that the Tourist Board workers had to endure. An additional booth was transformed from a container and is used as the restroom of the security guard; although this is, at the time of complet-

ing this chapter, not in operation, it continues to be used as the restroom for both the security guard and the Tourist Board workers. This container has been aligned in a northerly-southerly direction and located alongside the roadway leading up from Lathbury Barracks. It has finally been refurbished to conform to the appearance of the original booth. Its large size has taken up valuable parking space, and its orientation hinders the manoeuvrability of large vehicles, especially coaches.

Figure 1. Second ticket booth at Jews' Gate, with bollards protecting the structure.

To prevent damage to the container, several bollards were installed, again reducing parking. These bollards have been the cause of several accidents whereby taxi drivers backing their vehicles have gauged their distance to the container and backed into the bollards. They should be removed and a metal barrier placed on the outer wall of the container visible to taxi drivers parking their vehicles.

For the last few years the roadway down through Lathbury Barracks had been primarily used to redirect tourist vehicles. However, with the disappearance of the security guards at Lathbury Barracks in the last 20 months, it now is also utilised by public service vehicles heading to the Nature Reserve from Europa Point, and increasingly by locals, especially during weekends. The Tourist Board has plans to direct coach traffic up Lathbury Barracks and the taxis up Engineer Road (P. Canessa, *pers. comm.*). That is why they have refurbished the container and relocated it.

The parking area at Jews' Gate is extremely limited and the area is frequently saturated, with taxis and coaches arriving together and frequently stretching all the way down the road. Local vehicles trying to access the vacant parking area close to the viewing point frequently have to wait, causing a traffic jam, until the taxis and coaches move on.

Figure 2. Traffic at Jews' Gate. Bollards protecting booth, forcing cars to park further into the road.

This Jews' Gate area is in need of refurbishment. Better still, a totally new concept is required for this area. The rather cheap and fake-looking fibreglass 'Pillars of Hercules' based on top of the Battery should be replaced with a more suitable structure in keeping with the historical and scenic value of this site. This does not mean that the significance of the Pillars of Hercules is lost, but rather that a better use is made of the area, as this is the first

stop tourists make and so the site should provide a window to the rest of the natural and historical attributes of the Nature Reserve. The possibility of transferring one of the 9.2" guns down to Jews' Gate Battery, (something which has already been proposed in the past), would greatly enhance the area. It would also provide the visitor with the opportunity to see this otherwise inaccessible historical heritage, given that O'Hara's and Lord Airey's Batteries are behind locked gates. The additional shelter provided at this location, away from the levanter cloud, would substantially increase the gun's' life.

There are other aspects of this site that could be developed. Emphasis, together with information, should be given to the historical background and significance of the Jews' Cemetery. The importance of Gibraltar as a bottleneck in the migration route of most western European birds across the Strait could also be exploited. No information plaques are provided at this site apart from those mounted on the Pillars of Hercules, this being accompanied only by a couple of old rundown telescopes that are also located here. These are covered by numerous layers of red paint and seem to be the only maintenance they receive, and the telescopes are hard to swivel and turn. The quality of the optics is extremely poor and their condition is such that they detract from the value of an already rundown site.

A welcome addition at the viewing platform was the location of a water drinking fountain. Tourists frequently used this, especially during the summer months. However, the fountain stopped working in 2002.

The siting of a garage and mechanical workshop, which is situated below this main tourist structure in full view of visitors, is something we have never been able to understand. It is illogical and totally out of character with sound tourism practises. It is also incompatible within a Nature Reserve. There are usually some repairs to vehicles undertaken there in full view of tourists, and the situation gets worse when the mechanic is operating drills and compressors. You can hardly hear yourself speak. There is now ample space at Lathbury Barracks to relocate this facility. The space vacated could be converted to house interpretation facilities.

Figure 3. Jews' Gate viewing point, Pillars of Hercules and Garage and workshop.

As soon as you arrive at Jews' Gate, problems regarding the illegal feeding of macaques are sometimes visible. One macaque frequently visits this site; he is called 'Lonely', and his name reflects his somewhat introverted character. He sometimes eats scraps around the Jews' Gate area, and is also fed by tourists and the security guard. There is no sign here warning that feeding macaques is illegal. Furthermore, security guards should refrain from feeding the macaques, as this sets a bad example. The current management of the Nature Reserve should ensure that security guards are informed that feeding of the macaques is strictly prohibited.

Toilet facilities are available at Jews' Gate. These were refurbished by Community Projects three years ago, yet these facilities are inadequate for three reasons. Firstly, there are no signs pointing out the location of these toilets. Also, they are inadequate due to the number of tourists that descend on Jews' Gate at any one time, with queues sometimes developing. This problem is exacerbated due to the fact that security guards and the Tourist Board's workers have to share these toilets with tourists. It must be very frustrating for employees to have to wait at the end of a long line of tourists in order to use the toilets. The condition of these toilets is also poor, with one lavatory and a line of urinals that suffers daily from a loss of water pressure (water is supplied by MOD), and therefore does not flush as regularly as it should. They are cleaned, or rather hosed down every morning by Master Services, but every effort should be made to improve the sanitary conditions at this site.

20.3 St. Michael's Cave

The tourist is provided with a map of the sites at the ticket office. Nevertheless, some are always confused and turn in towards Mediterranean Road despite a small sign indicating St Michael's Cave on the left of the turn off. A second, very large sign is provided just before arriving at the Queen's Lookout. The sign is perfectly adequate, although some vandalism and graffiti has tainted it for a long time now. In addition, part of the black paint has been peeled back and should be repaired or replaced.

Figure 4. Vandalised sign close to Queen's Lookout.

Once on Cave Branch Road the tourist is back on track, but has to be careful to avoid oncoming traffic and the protection barriers at the top indicating subsidence of the road.

Figure 5. Road subsidence at the top of Cave Branch Road.

If the tourist is lucky he will not have to queue behind a long row of stationary taxis that prefer to line up along the road rather than use the vacant spaces in the car park, despite all efforts by the security guards. Once through this obstacle the security guards will indicate parking facilities, not at the Cave but halfway up Spur Battery Road. This is understandable because the coaches utilise most of the space within the cave car park, but is indicative of the serious saturation problems suffered by the Nature Reserve (see Chapter 21). It is also unsightly because there is a constant two-way traffic flow of cars and coaches immediately in front of the cave entrance. Finally, with a parking space secured the tourist can then proceed down the one hundred or so metres of road to the cave entrance. Here, the site is shoddy compared to the exit of the cave at the cabin. There is a porta-cabin located outside and the ticket office and the Tourist Board's workers park their mopeds and cars on the brow of the hill leading down towards Lower St. Michael's Cave.

There are also numerous cats at this location and at the top of Cave Branch Road, with up to sixteen individuals counted. These animals, and the food provided for them are unsightly. Cats also pose a grave threat to wildlife in the Nature Reserve. As such, these should be removed. Instead, they are being encouraged and regularly fed, a practice inconsistent with the proper function of a Nature Reserve (*see* Chapter 5).

One or two groups of macaques regularly visit this site and the animals await tourists to alight from the vehicles. These animals are also encouraged in the area and are illegally fed even, as witnessed by the authors, by the security guards themselves. Signs warning visitors not to feed the macaques are not present here. To make matters worse, the authors have seen chickens running around the entrance to the ticket office, obviously in full view of tourists. The introduction of any non-native species to the Upper Rock Nature Reserve is strictly illegal without a licence. The presence of chickens is particularly worrying given that these compete with Barbary partridges *Alectoris barbara*, for food, and that chickens can often be the source of health problems in humans.

The ticket office at St. Michael's Cave has been improved with a suitable covering for tourists queuing in the rain. Numbers of visitors to the cave were once monitored by the Tourist Board (J.C. Finlayson, *pers. comm.*) but this practice has, regrettably, now ceased. A control on the numbers of visitors into the cave should be established, to ensure that the cave does not deteriorate any further. Visitors to the cave are allowed to wander about on their own, but there should also be the option of a guided tour at regular intervals, especially for groups from coaches. The information within the cave is limited and there is ample scope to increase this both at a historical and geological level. The lighting system was refurbished at the cost of approximately one million pounds (P. Canessa, *pers. comm.*) and two light shows are presented at 10:00hrs and 12:00hrs. This places the onus on taxis and coach operators to arrive *en masse* at these times, with the resultant congestion.

On occasions, rats are reported within the cave. This is a natural habitat for these animals, where they look for warmth during the winter months. Unfortunately they sometimes cause damage to the lighting cables and have to be controlled. It only takes the sighting of one or two of these animals, which is then reported to the Tourist Board, for panic bells to ring. The Environmental Agency is then called in and tackles, what it calls 'an infestation', with rat poison. This is totally incompatible with the function of a Nature Reserve, as these poisons are totally indiscriminate and can be ingested by any other animal within the cave. The poisoned rat can also die outside the cave and be consumed by other animals that will also succumb. This practice poses a threat to the cave ecology of St. Michael's and other nearby caves. The very fact that this practice is illegal under the 'Nature Protection Ordinance, 1991' (L/N 11 1991) has not stopped either the Tourist Board nor the Environmental Agency from tackling the problem with poison. This practice must stop forthwith; there are other trapping methods which are not indiscriminate and that will enable the authorities to evaluate the problem and quantify the infestation, with no harm to the environment. With the removal of the cats, macaques and the chicken coop, proper disposition of refuse and macaque-proof bins, half of the battle against the rats would be won.

20.4 Apes' Den

We now retrace our route down Cave Branch Road again and along Queen's Road to the junction that leads down Old Queen's Road, in the direction of the Apes' Den. Before we reach this junction, we find another tourist stop, and this time an unofficial one where many coaches unload their passengers to observe another group of macaques, the Anglian Way group. Here, a small group of macaques was enticed a few years ago by Taxi drivers, presumably to avoid the congestion at the Apes' Den (they were also attracted to the top of Charles V Wall at Prince Phillip's Arch, which is where most taxis now choose to go). This stop, at the lay-by near Hayne's Cave, is mainly utilised by coaches and private tourist vehicles. The advantage of the group at this location is that they do alleviate traffic problems down at the Apes' Den, which does not have sufficient parking space, and once the visitors have seen and taken their photographs, they can then move on along Queen's Road. The site is provided with large (and rather unsightly) signs indicating that feeding the macaques is prohibited. However, the practise continues unabated despite the warnings, and as a result the ground at this site is frequently covered with peanut shells and other food items that have been fed to the monkeys. Large signs and hefty fines are of little use if the legislation is not going to be enforced.

Continuing on from here we arrive at three forks in the road. The sign there is confusing, for tourists believe that if they take the road down towards the Apes' Den they will miss out on the other sites directed down the centre road. The sign should indicate that the Apes' Den route rejoins the other and also leads to the rest of the tourist sites.

Figure 6. The ambiguous sign at the junction of Queen's Road with Old Queen's Road and Charles V Road.

Taking the left turn at the junction, a small sign indicates 'Apes, Monos'. We should try to use the correct terminology and use 'Monkeys', or better still 'Macaques'. This sign is a small one which directs the visitor to the 'Apes' Den', but by now he has probably already seen macaques at Jews' Gate, St. Michael's Cave and at the Haynes Cave lay-by.

Down the hair-raising, steep Old Queen's Road we arrive, if we are lucky not to encounter any traffic, at the Apes' Den. Parking here is scant and can only accommodate three coaches. The rest are forced to disembark their passengers on the hill; there is nowhere else to go. For the tourist caught in this jam in the middle of the summer months it can be quite hot and frustrating. The whole place is in dire need of a restructuring programme. This not only refers to the parking situation. Paint is peeling off all the buildings and structures, and the site shows a characteristic lack of maintenance. A paint job will help, but can only achieve a temporary solution. Again as recommended for St. Michael's Cave, on-site guides to provide information, instruct visitors not to feed the macaques and provide a guided tour of the site would complement the Nature Reserve tourist's experience and eliminate some of the careless interactions with the macaques that sometimes lead to bites inflicted.

One of the buildings at the Apes' Den should be converted into an interpretation centre, where there should be a permanent exhibition on the history of the macaques, together with adequate information and educational material available and on sale on the biology, distribution and welfare of these animals. There should also be ample space to include the sale of souvenirs and other paraphernalia connected primarily with the macaques, and also other related items in connection with the Nature Reserve. This site should also provide the only official tourist macaque-feeding occasion whereby only the shop can sell approved items of food to the tourists for their photo opportunity (*see* Chapter 14, section 8).

The souvenir vendor located at this site operates a shabby wooden stall from where he sells his wares. The appearance of this does nothing to improve the situation of this site. The area is cleaned by Master Services who hose down the site frequently and a team from this company has been clearing the refuse-strewn cliffs in the area. This last point is a step in the right direction, as the cliff below Apes' Den suffers from very large accumulations of litter. With an official presence at this site, (guides, attendants or interpretation centre manager), the condition, requirements and facilities of this site could be monitored on a regular basis and prevent the deterioration that has taken place.

20.5 Upper Galleries

Moving on from the Apes' Den, we follow the road down towards the junction with Devil's Gap and then proceed to join Queen's Road. Following this for another 300m we come to Princess Caroline's Battery and a sign indicating a turn off towards the Upper Galleries. We follow this and come to a lay-by where we are instructed by a security guard to park our vehicles. Up until mid-2003 taxis were allowed up to the top, but recently the road began to subside and the authorities had to close the road at the bottom of the hill until this was repaired. Many taxis are now not prepared to wait here for their fare to return from the Upper Galleries, as they have no control of them once they emerge from the tunnels and can therefore take quite a long time to return. From here we walk up the hill to the platform by the entrance.

Figure 7. Waiting area for tour operators at the Upper Galleries site.

The subsidence on the roadside has been repaired by Support Services but no consultation was sought for the wall structure, (*see* Chapter 7, section 7.6). The result is a horrendous stepped wall that is out of place with the surroundings and does not conform to any other wall or structure within the Upper Rock, and therefore looks totally out of place. Furthermore, the road has not been opened since it was discovered that the platform and walls surrounding the site are dangerous and also in need of urgent repairs. One would have thought that all works would have been carried out at the same time, thereby consolidating the work effort and reducing the disruptive effects to tourism.

The ticket office has recently been refurbished with a new covered walkway into the Galleries, the provision of air-conditioning for the workers and the erection of toilet facilities.

A new, extended, semi-circular terrace on a cantilever basis should be constructed to incorporate the views to the north and east over the North Face of the Rock. Part of the terrace should be covered and include the ticket office and toilets. The toilets would flush into septic tanks in the cavity below the terrace to eliminate costly pipelines and related works. This could then be easily emptied on a regular basis.

Once inside the tunnels we come to an area where we can have a photo opportunity in period costume, the brainchild of Mr. and Mrs. Derek and Giselle Duarte. This enterprising venture, 'The Great Siege Tunnels Photo Experience' is a bold move in the development of this site and as such has received the approval and encouragement of the authorities. However, due to the road closure and the length of time it is taking to begin repairs, this enterprise is suffering from a vast reduction in the tourists accessing this site.

The last large refurbishment to this site was undertaken by the old Gibraltar Tourist Office, who developed the use of life-size human models in period costume located around the guns to good effect. This enterprise was most noteworthy and successful and was completed by Sights Management when they took over the management of the Upper Rock. Since then, the models have endured the damp and humid conditions of the tunnels for various years and are in need of refurbishment.

The tourist can only access the tunnel as far as St. George's Hall, since the wooden platform at the opening over the east side of the Rock was fraught with problems, mainly because of the serious issue of rock falls. Access from this tunnel down to the lower level would enable the visitors more scope in this experience and provide them access to Jock's Balcony, after which they could exit via Princess Anne's Battery at the bottom of Princess Caroline's Battery. This location would be an ideal collection point for the fare as there is ample car parking space. Otherwise, the visitors could walk up to the top at Princess Caroline's Battery where they can join their tour vehicles. This would certainly alleviate congestion at the top of the Upper Galleries. Not only this, but it would also extend the tour to include the WWII installations at this site. These have been wonderfully restored but have as-yet not had the benefit of being used for the development of the tourism product. Such a long tour would require the employment of site guides who would rotate on a regular basis throughout the day to accommodate the groups of tourists. This tour could also work very well in reverse and finish at the interpretation centre and viewing platform we propose at the Upper Galleries. More extended combined vehicle/pedestrian tours could incorporate the Lower Galleries and even end down at Grand Casemates Battery, in the process incorporating the Kings and Queen's Lines of the Lower Rock.

20.6 Princess Caroline's Battery

Although not an official tourist site, we have already talked about the possibilities and opportunities available to this and the corresponding batteries further down from this site, under the Upper Galleries development. Princess Caroline's Battery is specifically the battery situated at the extreme north of Queen's Road, at the junction of the road leading up to the Upper Galleries. However, the whole area leading down from here, and incorporating Princess Royal's, Princess Ann's and Princess Amelia's Batteries has been popularly referred to as 'Princess Caroline's Battery'. The Tourist Board refurbished this area in 2002, at a substantial cost. It was equipped with CCTV cameras to prevent vandalism, but it has remained closed to the public since then. Due to lack of monitoring and vigilance, the area has again been open to vandalism despite the cameras. This area should be opened to the public and form part of the official tourist sites, with official presence throughout the daylight hours to ensure security and provide the infrastructure to the tourist product. In addition, a picnic site could be situated in the large, open areas that this site contains (*see* Chapter 5, sections 7 & 8).

Let us begin with the Princess Caroline's Battery proper. Parking is again extremely limited, with only enough spaces for three vehicles. Coaches park alongside the west viewing area and occasionally cause traffic jams. Any more vehicles than this, and you can rest assured that you will have to endure a long wait in a queue stretching back along Queen's Road, which in summer is not particularly pleasant, especially for the residents of the area.

The viewing platform is the base of another group of macaques that frequently sun themselves at the back of this area. It is also the base of a WWII gun battery, yet there is no information available to the visitor on the significance of this and the other batteries in the area including the old siege gun located close by. A small and useful WWII exhibition was once provided by Sights Management in the vacant rooms available below this battery, but this has unfortunately been closed for many years now. This viewing point is in need of attention. The numerous olive trees surrounding and obstructing the view should be considerably pruned (but not cut down, as this would encourage erosion).

Many of the visitors wanting to see the macaques, wander to the back of the site and are immediately confronted by the view of the dog kennel. This unsightly structure should be removed forthwith and the owners provided, if necessary, with an alternative and appropriate site outside the Upper Rock Nature Reserve. The impact of howling and barking dogs, flocks of pigeons, and chickens running about in the area is totally incompatible with the proper function of a Nature Reserve. To make matters worse, the waste from this compound has often been dumped on an open area across the road from the kennel. This constitutes a health hazard.

It seems incredible that Princess Caroline's Battery and the access road leading down, including the dog kennel and the other military installations there, did not form part of the costly refurbishment to this area. If and when it is eventually opened to tourism, these areas will have to be tackled. Work should, however, start immediately so that the opportunity is not wasted. In addition, the provision of toilet facilities in this area in the form of septic tanks, as explained in the Upper Galleries sub-chapter, should be a priority.

20.7 City Under Siege

From Princess Caroline's Battery we continue down the hill, down Willis's Road, towards the City Under Siege exhibition. Half way down we pass the lime-kiln, an old remnant of Gibraltar's heritage located at this point. There is a unique, elaborate information panel here. Although this is greatly welcomed, the site could do with a more graphic interpretation of the processes involved in the preparation of the lime together with the uses they were put to in those days. This would certainly be appreciated by all visitors who encounter this structure.

At the City Under Siege site, parking is again at a premium. A proposal for solving this site's, and the Moorish Castle's parking problem is to utilise part of the entrance roadway and surface area of the Waterworks entrance as the parking area for the two sites. Visitors to the City Under Siege would be dropped off at the site. After their tour they could then walk, not down the hill, but along a path provided along the disused water catchment area to the car park, whilst the Moorish Castle visitors could access the entrance via a stairway down from the car park, thereby providing safety away from the road.

At the City Under Siege site, we find the Tourist Board employee in a cramped ticket office. This area needs to be developed to provide more room for the workers, whilst at the same time provide an insight to the historical features found within. This will stimulate more visitors to enter. The site needs additional information about the period in which it was built and utilised. This should be provided by the Gibraltar Museum.

The life-size human models in period costume have endured the weather conditions over the years and have been restored recently, but due to the exposed location of some of these the authorities should have replacements at hand, whereby they can send the soiled ones back for restoration. A small amount of habitat management is also required in the area to allow adequate space around the buildings. This should be done by trained personnel or under supervision of a person with an adequate knowledge of the habitats and natural heritage of the Nature Reserve, such as GONHS personnel. A section of the vegetation should be cleared to resemble the vegetation of the Upper Rock immediately after it was denuded. In addition, information and pictures depicting the impoverished vegetation during the Great Siege and describing the conditions endured by the garrison and the people of Gibraltar should be provided. The Heritage and Planning Division should carry out the monitoring of the condition of these buildings and all other historical heritage within the Nature Reserve, with assessments at least bi-annually. The results would be presented to the Management of the Upper Rock Nature Reserve who would then pass on any necessary action to the competent authorities.

20.8 The Moorish Castle

The proposal under the section on the City Under Siege covers the question of car-parking. The parking area, we believe, would have sufficient space to accommodate toilet facilities for both. Here, the proximity to sewerage pipelines eliminates the need for septic tanks.

The Moorish Castle, or to be precise, the Tower of Homage, lies at the very boundary of the Nature Reserve but is included as it parties one of the official sites located on the Upper Rock and has a direct bearing on much of the development and future plans for the Upper Rock Nature Reserve. During 2003, the Tower underwent restoration, which was carried out on behalf of the Gibraltar Museum. The site has been closed to the general public since the 7th April 2003 and will remain closed until works have been completed. The announced move of the Prison to a new location at Lathbury Barracks will release an important part of the Castle which, according to the Museum Director Prof. Finlayson, will open up a huge section of the Moorish Castle with historical connotations through several periods of Gibraltar's history. The prospects of this news should encourage the authorities to sit with the Gibraltar Museum's experts and commence discussions on the way forward in the development of this new venture, which encompasses the whole of the Moorish Castle.

There remains little to say, as the interior will have undergone a tremendous transformation and the prospects for the rest of the Castle is encouraging. There is, on the other hand, a particular facet that remains and this is the external appearance. The area around the tower needs a certain amount of habitat management, otherwise the vegetation will encroach to such an extent as to shield the base of the Tower from view. This should also apply to the Castle walls running all the way down towards Casemates. This area was cleared of all vegetation a number of years ago during 'Operation Steep-slope' by volunteers from various bodies including youth clubs, Scouts and the Heritage Trust, and the walls illuminated. Since then the vegetation has grown back extensively due to absence of maintenance. The walls and the tower do not require any clearing of herbaceous plants, many of which are protected species, for these lend an aesthetic appeal that enable the viewer to appreciate the age of these structures (C. Viagas *pers. comm.*). However, woody plants such as the olive *Olea europea*, or in particular fig tree *Ficus carica*, growing on the walls should be removed immediately since the roots of these shrubs will eventually cause extensive damage to these structures and walls.

20.9 Cable Car Top Station

The Cable Car is one of the means by which tourists access the Upper Rock. Approximately 140,000 visitors used this method in 2003[1], the majority between the months of April and October inclusive. The Middle Station is the drop off point for visitors wanting to see the Apes' Den, and the Top Station is clearly the prime location for the visitors, where they have magnificent views over both sides of the Rock.

The Top Station has evolved throughout the years. Built on an anti-aircraft battery that was manned by the Gibraltar Defence Force, it has a unique historical value. Initially it consisted of the main block incorporating the arrival area and a coffee and shop facility on the top floor. Part of the roof area was utilised as a terrace that overlooked the town centre to the west. Since then, a new cable car was put into service with the capacity to carry more passengers and a new, semi-circular terrace was built to the north of the main building. This provides the visitor with spectacular views of the north area and both sides of the Rock. A restaurant now provides adequate food and drink and the whole building has now received a new coat of green paint, which tends to blend better into the environment than the former bright white.

A pack of macaques, the Prince Phillip's Arch group, is based one hundred metres south from here and is accessed by the visitors to the Top Station. Since the middle of 2003 about fifteen individuals partially split from this group and established themselves on the WWII installations to the

[1] Data provide by the Gibraltar Tourist Board.

south of the Top Station. They now regularly frequent the Station itself and are to be found there on a daily basis. The management of the Cable Car, M.H. Bland, has now provided a feeding and watering area built to design that should be copied in the official sites.

The Gibraltar Government installed a ticket booth immediately outside the station to target tourists entering the Nature Reserve, for they only pay a specific amount for the Cable Car and extra if they want to access the sites. This booth has not been used, as the vendor at the Bottom Station in fact provides tickets for access to the Nature Reserve. With the macaques based at the Top Station, tourists no longer need to pay extra for this privilege. That said, the macaques do cause some disruption on the terraces where they snatch at bags and steal food from tourists having their meal. Signs should be erected to remind tourists not to feed the macaques. It is encouraging to note in this respect that the Cable Car management have taken steps and entrusted one of their employees to controlling human-macaque interaction.

The terraces at the Top Station are equipped with the same old telescopes as found at Jews' Gate. Here again the management should replace these with new, better quality, and value for money scopes. The ones found there are very old with many layers of paint and are very stiff and do not pan and tilt properly.

After consultation with GONHS, the management of the Cable Car Station is preparing some panels that will provide information on the macaques, historical heritage and the fauna and flora of the Upper Rock, especially birds of prey, as this site is used for the observation of the migration throughout the southerly passage period of these birds. Birdwatchers from many countries worldwide come to Gibraltar in the late summer and autumn and are regularly seen spending many hours at the Top Station observing the migration.

The Cable Car Management has also produced palm-held interpretation facilities in the form of a virtual tour with ample information on Gibraltar and the site, a most welcome pioneering step within the Upper Rock, which should be emulated by the Upper Rock Management.

The area to the south of the Top Station is of historical importance. This was the site of the signal station during the 19th Century, and was also converted to an anti-aircraft battery during WWII, remnants of which lie below the foundations of the Top Station and the north terrace. This site, which is visited by the majority of visitors to the Cable Car, is in a derelict state, with part of the wall along the cliff boundary in a state of collapse. It is used by spotters for smuggling operations and their rubbish is strewn everywhere. Master Services clean the roadway to the top, but accumulations of refuse can be seen over the sides of the road, in corners of the military installations and down the cliffs on the east side. This is obviously more apparent in the summer months when the vegetation has dried, as this reveals all the accumulated refuse. This occurs during the time of the year when greater numbers of tourists frequent Gibraltar. There is an opportunity to facilitate this site with all the paraphernalia of the period and equip it with life-size models, a gun and an interpretation centre with ample information on the period together with graphic information panels and educational material. Unfortunately, at the moment one of the buildings is used as a chicken coop, with chickens running all over the place. The smell is terrible, the place is a health hazard and the whole site is an embarrassment to anyone with any pride in trying to portray Gibraltar as a tourist destination.

20.10 Recommendations

Jews' Gate

1) Bollards to be replaced with a visible barrier with a view to saving valuable space and preventing accidents.

2) Access to the Nature Reserve via Lathbury Barracks must be closed at 22:00hrs on a daily basis and opened again at 07:00hrs in the same way as the main entrance at Engineer Road.

3) Complete rethink and restructuring of the Jews' Gate site, with a proposal of the transfer of one of the 9.2"guns to this site. This should include information panels and interpretation centre possibly using the garage space that should be relocated.

4) Toilet facilities to be upgraded and if possible relocated.

5) Water drinking fountain to be connected to the mains again and water pressure for this and the toilets to be increased.

6) Telescopes to be replaced with newer versions with the authorities ensuring regular maintenance and replacement of these on a regular basis.

7) Garage and workshops should be relocated.

St. Michael's Cave

1) Priority must be given to the repairs at the top of Cave Branch Road.

2) Proper control of taxi queues so as not to block access to the upper roads.

3) Resurfacing of the road leading down to New (Lower) St. Michael's Cave to allow space for the parking of the workers' vehicles, and remove them from sight of the entrance to the cave.

4) Porta-cabin to be removed and ticket office to be extended to replace the cabin space.

5) A programme for the eradication of cats from within the Nature Reserve.

6) Consideration should be given for the removal or transfer of the macaque group from this site. Otherwise the installation of notices advising against feeding, and the provision of macaque-proof bins.

7) The chicken coop to be removed immediately and the persons responsible advised against the installation of the same again.

8) Annual census and control of visitor numbers into the Nature Reserve, St. Michael's Cave, and all other sites.

9) The introduction of Tour guides in the Cave, together with improved information panels.

10) Rat control to be regularly undertaken within and outside the cave using environmentally friendly methods.

Ape's Den

1) Provide an adequate sign at the top of Lower Queen's Road indicating the 'Ape's Den' or preferably a sign saying 'Macaques, Queen's Gate Group'.

2) The complete refurbishment of this site that will hereafter include an annual repairs and maintenance programme.

3) The provision of an interpretation centre to provide an exhibition on the macaques, together with information and educational material on the same. This building to also accommodate a shop to replace the shabby cart, and provide souvenirs and other material in relation to the Upper Rock Nature Reserve.

4) Provide this site as the only point where you can officially feed macaques with authorised food items sold *only* by this shop with instructions to be adhered to forbidding feeding by hand.

5) Employ a number of guides/wardens to provide guided tours, monitor feeding, interaction with tourists, and report back to the Board of Management.

Upper Galleries

1) Repair the subsidence of the road close to the entrance to the Upper Galleries.[2]

2) Construct a large new terrace and enclosed entrance complex, to incorporate the views to the north and east, part of which will be covered to provide an area for the ticket office, and toilet facilities.

3) The toilet facilities to flush to septic tanks beneath the terrace.

4) Employ guides/wardens who would conduct tours, monitor aspects of the Upper and Middle Galleries (interior and exterior), and report back to the Board of Management.

5) Provide a regular repair and maintenance programme and assess the condition of the displays within the tunnels with a view to replacing when necessary.

6) Connect the Upper to the Middle Galleries via a lift or spiral staircase, with a view to extending the touristic opportunity to include Jock's Balcony, terminating at Princess Ann's Battery and include the refurbished area below Princess Caroline's Battery.

City Under Siege

1) Parking facilities for the site to transfer down the road to the Waterworks entrance. (*see*

[2] Repairs have been carried out but road still closed since the balcony structure is unsafe.

Moorish Castle). Visitors will be dropped off at this point.

2) Ticket office should be enlarged to accommodate a rest area.

3) Toilet facilities for this site to be located down at the Waterworks area.

4) Employment of guides/wardens for this and the Moorish Castle to rotate on a regular basis, and provide tours and relevant information to visitors.

5) Replacement life-size models should be available in stock, to substitute those that are sent back for cleaning and repairs.

6) Habitat management of the area around the site should take place on an annual basis by suitably trained staff and an area several metres from this site should provide a firebreak.

7) A path should be provided along the old catchment area of the waterworks down to the parking facility and entrance to the Moorish Castle. This will provide a safe means for visitors to transfer on foot to the next site.

Moorish Castle

1) Parking facilities for this and the City Under Siege site to be constructed within the area of the entrance to the Waterworks.

2) A building that will incorporate the ticket office for the Moorish Castle should be sited here and access the Castle via a bridge over the road.

3) The building to include toilet facilities and a shop for this and the above site.

4) Guides/wardens employed for this and above site.

5) Establishment of a programme of habitat management and clearing of vegetation around the Castle walls to be carried out or supervised by trained personnel.

Cable Car Top Station

1) Information on the history of the site as a WWII anti aircraft battery together with details of the flora and fauna and especially the birds of prey on suitable large panels should be provided (currently being dealt with).

2) Removal or replacement of the telescopes with better quality ones.

South of Cable Car Top Station

1) Complete refurbishment of the area in question.

2) Development of this area into an open-air exhibition of the WWII installations there, including life-size models and related paraphernalia of that period.

3) Immediate clearing of all refuse on the east cliffs and the western slope of this area.

Finally, at the end of the tour the coaches and taxis should provide a leaflet, to be filled in by visitors, in the form of a quality and value for money control poll that would permit the Upper Rock Nature Reserve authorities to gauge the response of visitors to the Nature Reserve and the quality of its products. This feedback would allow the authorities enough response time to address any failings that might occur without their knowledge, and address these issues before any further deterioration occurred.

The Upper Galleries

References

• **Gibraltar Gazette (1991)** Nature Protection Ordinance, 1991 (L/N 11 of 1991).

21. Transport, Traffic and Tourism

21. Transport, Traffic and Tourism

21.1 Roads

The network of roads on the Upper Rock Nature Reserve is not suited to the large quantity of traffic that has ensued since the opening of the border with Spain. These roads were built by the MOD on some of the existing pathways and tracks that were used during the 18th and 19th Century with the sole objective of communicating with the military installations that can be found there. All the roads are single lane except for Cave Branch Road, which was widened recently in the 1990s, and the northern end of Queen's Road, which is opened to two-lane traffic during the evening for access for residents on the northern end of the Rock.

Until the early 1980's, the Upper Rock roads above St Michael's cave were the responsibility of the MOD and were only used by military vehicles, as well as authorised civilian vehicles with specific interests, e.g., Cable Car management and GBC engineers for maintenance to television and radio transmitters. They were also frequently patrolled by the GSP (Gibraltar Services Police). On the whole, however, these roads were relatively free of traffic and were enjoyed by the general public who partook of tranquil walks, particularly in the weekend winter months, before retiring to the St Michael's Cabin for afternoon tea. This situation changed drastically when responsibility for the upper roads passed to the Gibraltar Government.

The managing company in charge of the reserve at the time, Sights Management Ltd., was under pressure from the Taxi Association to provide them with an alternative area for viewing the macaques, as the one at Ape's Den clashed with the tour buses with the ensuing traffic jams. Despite objections from GONHS, Sights Management, in conjunction with the Gibraltar Tourist Office, opened the upper roads to taxis. The taxi drivers enticed the macaques to the area of Prince Phillip's Arch at the top of Charles V Wall, where the animals established a group, but also to the top of Anglian Way, and therefore had two new groups to access. This decision now in effect opened up all roads on the Upper Rock Nature Reserve to traffic.

Increased density of vehicles, bottlenecks at Jews' Gate and St Michael's Cave and the unavailability of adequate close and safe parking soon prevented the local population from enjoying their walks on the Upper Rock. Tourists accessing the Rock via the Cable Car who walk down to St Michael's Cave are now subjected to a virtual assault course, avoiding oncoming traffic and manoeuvring around the rows of taxis parked at Prince Phillip's Arch.

In an attempt to resolve the problem at St Michael's Cave, the Government at the time (1994) proposed to build a multi-storey car park cantilevered out over the woodland area below St Michael's Cabin, and proposed to co-fund this with European Union funds. GONHS objected to both the Government and the Deputy Governor, on the grounds of the unacceptable effect on the landscape if the Upper Rock, and carried out a traffic survey at the Cave to establish whether there was a need for the car park. This study concluded that the main problem was not the lack of parking, but the fact that only a single line of cars was possible on Cave Branch Road. Widening the road would enable cars to travel back down (and not along the upper roads) and would allow taxis on that stretch to wait for passengers without blocking access. GONHS also recommended that there should be parking provided along Spur Batter Road. This last recommendation was implemented, and Cave Branch Road was widened, also avoiding earlier plans for a new road to access the Cave from the south (see below). While the overall problem was ameliorated for a while, the upper roads remained in use and taxis chose to await passengers on the part of the road nearest the Cave where the road was not widened and therefore traffic jams continued to occur.

Obviously, the roads of the Upper Rock are totally inadequate to accommodate both vehicular traffic and pedestrians, and this applies to all the roads on the Upper Rock. There is no safe way to venture around on the Upper Rock, since no consideration has been given to pedestrian usage. Pavements do not exist and walkers on the roads are subjected to walking along the drainage ditches to avoid traffic. This, together with exhaust emissions from the high density of vehicles (particularly on steep hills), makes a walk on the Upper Rock a somewhat hazardous and unhealthy endeavour. It is quite possibly due to this that most locals now rarely walk around the Upper Rock, and only partake in a weekend vehicle circuit on Gibraltar's roads that includes the Nature Reserve. An alternative would be to use the Upper Rock paths, but Mediterranean Steps is considered dangerous by the Gibraltar Tourist Board (although they will not address the problems that exist) and the rest of the paths are overgrown, strewn with refuse and, in the case of Martin's Path, obstructed by fallen trees and with a regularly broken sewerage pipe.

In the majority of cases, the road surface in the Nature Reserve is tarmac. This surface tends to soften during the summer months from the excessive heat as the hard, aggregate material sinks very slowly to the bottom. This tends to make the surface very slippery, especially in wet conditions. On slopes, the surface has a tendency of running and forming wavelike shapes. In the winter months the tarmac tends to shrink and sometimes crack, allowing rainwater to penetrate and weaken the structure. This has the propensity to eventually break with the continual passage of vehicles over these sections, causing potholes to appear. These potholes are eventually repaired with tarmac. However, it has recently been the case that potholes are marked with painted squares prior to repair. The time lag between identification and repair has sometimes been so long that the authorities have had to resend their man to repaint the squares, as the original paintwork had practically worn away (*see* Chapter 5).

The Military had obviously identified the problem of road surfaces on hills and therefore applied a different method to tackle the ascent up Queen's Road. In the section of Queen's road between Jews' Gate and the bottom of Cave Branch Road, they removed the tarmac surface and applied a corrugated concrete base to allow for water run off and maximise grip. This venture, which was carried out in the late 1960s, obviously took a long time to apply. However, it had the advantage that this surface did not require short-term maintenance. In fact this section of road has not required attention until recently when some potholes have appeared and been repaired by the highways section, (B. Bagu, *pers. comm.*).

A suggestion was made by us to the Support Services Section to have this type of low maintenance road surface applied on the Upper Rock, but the reply was that it would require the closing down of large sections of the Upper Rock roads for long periods of time while the surface was applied, and in some cases the complete closure of the Nature Reserve. Obviously, residents would be able to access their homes via the Moorish Castle entrance, but the tour operators would be adversely affected, as although the sites could be accessed in a loop via Cave Branch Road up to the Cable Car and back down Signal Station Road, the access up to the Moorish Castle via Willis's Road would not be able to endure the heavy two way traffic of public service vehicles. The other possibility is to effect repairs and road maintenance during the nighttime when vehicular traffic has *supposedly* stopped.

Another aspect is the deterioration of roadsides with the degradation and slippage of road edges. This can be seen at the top of Cave Branch Road, where the road has been protected by a series of posts to prevent vehicles approaching too close to the edge and thereby exacerbating the problem. Bright orange plastic netting surrounds this area, highlighting the obstacle as a precaution to drivers but at the same time emphasising the poor condition of the roads of the Nature Reserve to the many tourists arriving at the cave.

The road at the bottom of Signal Station Road is in an even worse state of disrepair. This section is situated upon a retaining wall that is located 6m above an area of water catchment and is beginning to subside. The area has been closed to vehicular traffic since early 2002, and posts and orange plastic netting demarcate the danger zone. The Tourist Board, realising the dangerous situation, notified the Taxi Association and organised an alternative route. They placed 'No Entry' signs at the crossroads leading along Signal Station Road towards Rock Gun to the north, but this was blatantly ignored time and again. Notwithstanding the signs, some taxi drivers incessantly bypassed this dangerous area in an effort to circumvent the alternative route and thereby avoid traffic congestion at the junction with Queen's Road. Eventually, the Tourist Board placed chained, padlocked barriers at either end of this obstruction, but on several occasions the chains and the padlocks were cut, and some taxi drivers took this opportunity to resume this dangerous route. In October 2003, the authors witnessed that a huge boulder had been placed, as a last resort, in the middle of the road at the top of Signal Station Road, to prevent further incursions. This only lasted a few days until the boulder was moved sufficiently to allow vehicles through. Since then the chained padlocked barriers have been restored.

Finally, the top section of the road leading up to the Upper Galleries has also suffered from the problem of slippage. This was repaired at the end of 2003 and a large unsightly wall erected on the side of the road. Since then, the authors have heard that the balcony area, which was in need of repairs, will now have to be replaced since the supporting pillars have become dilapidated. In connection with these works, the Tourist Board has closed the road off for all vehicles, and visitors wishing access must alight at the parking area at the bottom of the road. Obviously, this includes taxis, and many taxi drivers are not prepared to wait for the lengthy period of time it takes their customers to walk to and from the site. Hopefully repairs will be rapid and the site back and running in a short period of time.

Many roads do not have balustrades or railings, and those that do are in need of repairs. Some are composed of metal piping whereas wires hold others. In many places these are broken, rusty or non-existent. In some areas the MOD has made use of the railings to anchor their

communications cables, creating an unsightly roadside. In other areas they have hidden these cables below the road level. This practice is far more acceptable from an aesthetic point of view, and is to be encouraged.

Queen's Road, from Jews' Gate to the Queen's lookout at the bottom of Cave Branch Road, is only demarcated along this section by a series of white 'guide' stones. Although this helps the drivers keep within the road section, especially at night, the road has no protection whatsoever on its western flank, where a precipice of over one hundred metres drops away. Fortunately enough no accident has occurred along this stretch of road, but the necessary safety requirements, in the way of a low strong wall, needs to be constructed before we lament a catastrophe. Similarly, the (roughly) 250m section of Engineer Road leading up to the ticket offices at Jews' Gate lacks any protection for vehicles and pedestrians. It is surprising, given that two accidents have already happened along this stretch in the last few years, that the Tourist Board has not addressed this serious issue. In one case a motorcyclist was knocked over and fell 2m down, with his motorcycle, onto a concrete base that once held a water tank. He sustained serious injuries and was conveyed to hospital. In the other case an elderly tourist also fell at this same place and suffered minor injuries and was also conveyed to hospital (P. Acolina, *pers. comm.*). This area lies adjacent to the ticket office and very often tourists have to walk between the vehicles and the edge of the road to access the viewing point, putting them at risk. The last section of Queen's road at its northern end, nearing Princess Caroline's Battery also has no protection, but in this case the topography of the area does not require immediate action as the sides of the road do not drop off steeply and could just do with a railing or balustrade.

We have now identified several problems with roadsides, so how best to approach these? It seems that Sights Management identified a solution to this, but before it could be applied totally to the Upper Rock their term ended. They procured and placed the black, rustic, wooden-style plastic railing that one can see at the Ape's Den. This has all the appearance of the real thing. This type of railing is certainly more attractive than the metal piping or the wire balustrade that one can see mainly on the upper roads, and it has the advantage that it is weather proof, long lasting and maintenance free. It would be ideal to have all the metal railings replaced by this type wherever possible, as this would enhance the Upper Rock Nature Reserve's image. In areas where a stronger structure needs to be erected, the authors suggest that low strong walls or rectangular solid structures be built. This will blend in with the existing rectangular stone wall structures that can be found lining the roadsides along the middle section of Queen's Road.

Roads and roadsides are frequently cleaned by Master Services, on contract to the Tourist Board. They do a good job. A maintenance team from the Tourist Board also tackle encroaching vegetation, and cut this back from the sides of the road. This is perfectly reasonable except when they tackle the steep inner sides of the road when, in their zealous nature to maintain a spotless image, they denude the vegetation totally, causing erosion and frequent rockfalls that block the gutters and drainage ditches. Removal of encroaching vegetation, including bushes and overhanging branches is certainly what is required, but many of the smaller plants must not be removed. These not only add colour and aesthetic value, but many of the plants that grow in these situations are extremely interesting biologically and in some cases rare, and their roots prevent soil erosion. Even when dry, these plants do not pose a fire risk.

Figure 1. Removal of plants increases soil erosion and leads to rockfalls.

Some of the roads on the Upper Rock operate a two-way traffic system. The Cave Branch Road leading up to St. Michael's Cave was enduring very heavy traffic and causing traffic jams, and a suggestion for the construction of a new road was made in the late 1980s. This would have been extremely expensive and intrusive, and the alternative was to widen the existing road, which only had a few lay-bys where traffic could pass. Some time later, with the added consideration of the thwarted plans to build a multi-storey car park at St Michael's Cave, the works commenced and were mainly carried out at night to avoid the daily traffic density. This proved a useful exercise and the problem was partially solved in a short period of time. Another area where two-lane traffic is in operation is the section of road from the Moorish Castle to the residential areas on the Upper Rock. However, this is only the case after the gate on Engineer Road leading to Jews' Gate is locked, whatever time that may happen to be.

The final area in question is Engineer Road, from the Upper Rock Nature Reserve entrance to the ticket office at Jews' Gate. This section of road endures all traffic arriving at the bottleneck at Jews' Gate, and frequently many tourist cars unwilling to pay the fees are either now normally sent down Lathbury Barracks road or down Engineer Road. Lathbury Barracks is a two-lane road but Engineer Road is single lane and can only accommodate two vehicles in very a few places. Vehicles often have to back uphill to allow oncoming traffic through and not all tourists have that capability. The road is winding and there is one blind corner above Air House that is particularly dangerous, and traffic accidents have taken place there. Although there are signs warning drivers that this section of road is two-way, when negotiating this particular corner there is no opportunity to see what is behind the bend. Drivers heading downhill solely depend on sounding their horn and take a great risk. Bearing in mind that further down this section of road, the road was shored up due to slippage, it would be beneficial if the bend were straightened out, and the road constructed further in, avoiding any further potential slippage. The rock in this area is not limestone, but rather shale and mudstones that could easily be removed and there is ample space between the existing road and the base of the cliff to construct this new section.

Figure 2. Engineer Road bend, looking north. Same bend looking south.

21.2 Access

Up until the end of 2000 there were two official points of vehicular entry into the Upper Rock Nature Reserve. The main entrance at the southern end of the Rock on Engineer Road, at the back of Mount Alvernia and the northern entrance at Willis's Road, by the Moorish Castle. These two entry points were controlled by the ticket offices at Jews' Gate and Moorish Castle, providing access to visitors to all the sites on the Rock.

Entry times, or rather opening times of the gate to the reserve are at 07:00hrs until it is officially closed at 22:00hrs by the security guard who then proceeds to the northern post at Moorish Castle where he mans the barrier to allow residents and their guests access to their homes. The security guard should check for vehicles as he proceeds north along the Upper Rock and amicably request that they leave the Nature Reserve, for the Nature Protection Ordinance (L/N 1991) states that no persons shall remain within the Nature Reserve after sunset. Obviously he is unable to check every road and this problem is covered in Chapter 3. Unfortunately the security guard does not challenge persons entering via Moorish Castle at night and this exacerbates the problem. In spite of this, the Upper Rock was relatively quiet at night until a third entry point was recently opened.

The entrance via Lathbury Barracks was, until recently, controlled by security guards at

the Lathbury Barracks guardhouse, who would allow public service vehicles through during the day. In the evening the gate beside Jews' Gate giving access to the Upper Rock Nature Reserve was closed until the following morning. Since the construction of the industrial park and other facilities at Lathbury Barracks, the gate is no longer closed in the evenings and access to the Upper Rock Nature Reserve remains uncontrolled, despite the laws that maintain that no one must be allowed or remain within after sunset. The Tourist Board has been informed but nothing has been done despite the continued high cost of security.

This entry point has had such intense usage that a second ticket office/restroom has been adapted from what was once the eyesore container that provided the restroom to the security guard. At least some effort has gone into restoring a semblance of rural appearance to this structure although having said that, it does look like part of a set for a 'Western'. This entry point, as communicated by the Tourist Board (P. Canessa, *pers. comm.*), is intended to take the coach traffic whereas the Engineer Road will carry all smaller vehicles including taxis. At the moment the majority of coaches do enter via Lathbury but all other vehicles including private cars make use of both. The security guard used to send tourist cars, not willing to pay the entry fee, down via Lathbury but now with an increasing amount of traffic, often blocking this hill, congestion often forms at the ticket offices, often for several minutes until he can solve the traffic problem.

There is one other point of access to the Upper Rock, albeit a private one. This is Green Lane, a road that runs behind the Rock Hotel and is leased to the owners of the Hotel. This road is used, on a verbal arrangement, by the emergency services, and in particular the City Fire Brigade, when they need access to the Upper Rock in case of emergency when tackling serious fires (A. Almeida, *pers. comm.*). Under the circumstances this arrangement has proved beneficial and we hope that this compromise continues in the future. The possibility of using this road for evacuation of vehicles in the case of fire or similar catastrophe should be noted by the authorities and should form part of our proposal to set up an 'Upper Rock Fire Disaster Plan'. (*see* Chapter 11).

21.3 Recommendations

1) Immediate reparation of areas of subsidence on Cave Branch Road and Signal Station Road.

2) Establishment of an annual road repairs and maintenance programme.

3) Straightening of bend on Engineer Road.

4) Provision of paved areas along roadways for pedestrians where possible.

5) Replacement of, improvement and addition of road signs, site signs, road painted signs and fire hazard signs.

6) Cleaning of roadside vegetated areas to be carried out with care and attention to flora. Plants may be cut but not uprooted, to avoid erosion, and overhanging shrubs to be pruned back.

21.4 Tourism

Since the opening of the border in 1982 for pedestrians, and fully in 1985, the number of persons crossing into Gibraltar has increased dramatically, from 2 million to over 7 million in 2002. Obviously this number includes daily crossings of a workforce of Spaniards and Gibraltarians who live in Spain, as well as locals who shop and spend leisure time in Spain. Notwithstanding this, the figures still point to a very sharp increase in the number of tourists visiting the Upper Rock. Most of these are day visitors from the Costa del Sol who arrive on organised tour buses and as part of their package transfer to local tour buses for the Rock tour, which includes the Nature Reserve. Others make use of the Taxi Association's facilities and a considerable number also travel in their own vehicles.

A total of 7,375,112 persons were counted crossing into Gibraltar in 2002. Of these a daily workforce of 2374 registered Spanish workers, (as at 31st December 2002, courtesy of the Ministry of Employment), plus a couple of hundred Gibraltarians living in Spain and working in Gibraltar, and locals shopping and spending leisure time in Spain need to be subtracted from the grand total to be able to have a reasonable idea of the number of tourists arriving at Gibraltar through the land frontier. Table 1 shows annual totals into Gibraltar by land, air and sea since 1970.

The numbers of visitors by air has dropped slightly since the late 1980s. These figures relate largely to Gibraltarian passengers and visitors on transit, with only a few tourists who

occupy hotel beds in Gibraltar. This total is insignificant in relation to that of persons arriving through the land frontier, even when eliminating non-tourists from the equation. Visitors arriving by sea are composed primarily of tourists disembarking from cruise ships and a relatively small number arriving at the yacht marinas. The figures have remained fairly stable in 2001 and 2002 with 117,183 visitors in cruise ships and 17,659 visitors in yachts (Statistics Office 2002). Significantly, the majority of cruise visitors tour Gibraltar as part of a pre-arranged package whereas the remainder are taken on Rock tours by taxis. The number of visitors arriving on cruise ships has substantially increased in the last thirty years (*see* tables 1& 2).

Table 1. Visitor arrivals to Gibraltar by land, sea and air from 1970 to 2002.

Year	By Air	By Sea	By Land	Total
1970	47,726	92,943	0	140,669
1971	48,255	83,754	0	132,009
1972	49,109	90,169	0	139,278
1973	57,460	77,140	0	134,600
1974	53,399	86,525	0	139,924
1975	53,958	75,685	0	129,643
1976	44,490	80,729	0	85,219
1977	43,585	77,584	0	121,169
1978	47,066	72,300	0	119,366
1979	54,079	94,369	0	148,448
1980	51,035	102,721	0	153,756
1981	47,528	84,845	0	132,373
1982	46,180	81,063	46,595	173,838
1983	45,565	93,456	643,609	782,630
1984	47,813	80,654	477,571	606,038
1985	73,664	77,952	2,260,039	2,411,655
1986	89,842	83,808	2,634,250	2,807,900
1987	123,287	97,955	2,963,248	3,184,490
1988	156,075	85,539	3,529,005	3,770,619
1989	162,438	78,014	3,743,725	3,984,177
1990	132,468	84,815	4,155,975	4,373,258
1991	92,829	63,655	3,909,741	4,066,225
1992	87,826	92,312	4,096,033	4,276,171
1993	80,449	81,560	4,117,986	4,279,995
1994	70,180	87,857	4,011,370	4,169,407
1995	72,017	102,924	5,329,717	5,504,658
1996	66,219	113,988	6,270,235	6,450,442
1997	73,698	87,043	5,834,434	5,995,175
1998	76,477	111,172	6,516,934	6,704,583
1999	81,922	145,211	5,917,946	6,145,079
2000	85,255	159,097	7,031,221	7,275,573
2001	92,553	145,987	7,048,108	7,286,648
2002	96,439	136,910	7,375,112	7,608,461

Courtesy Gibraltar Government Statistics Office.

Table 2. Visitor arrivals by land 2000-2002.

	Persons			Motor Vehicles			Coaches		
	2000	2001	2002	2000	2001	2002	2000	2001	2002
January	481,212	492,126	505,046	125,119	129,464	132,451	587	666	584
February	507,167	504,911	483,337	125,676	128,190	121,635	850	843	766
March	584,973	571,687	565,678	132,705	142,307	132,610	1,317	1,416	1,197
April	602,004	586,251	620,623	126,991	133,789	145,037	1,483	1,405	1,306
May	589,039	614,651	650,833	130,146	142,418	155,518	1,593	1,569	1,372
June	571,807	554,929	581,788	129,563	128,130	137,351	1,260	1,468	1,074
July	606,867	656,416	668,174	135,571	151,004	157,911	1,176	1,243	938
August	710,620	715,361	763,598	145,934	155,861	158,667	1,205	1,202	948
Septemb.	652,972	621,760	664,206	136,082	137,624	156,104	1,621	1,418	1,316
October	650,227	650,739	700,965	140,196	145,257	161,613	1,730	1,550	1,421
Novemb.	558,418	553,557	593,041	132,898	131,495	146,973	1,170	1,029	867
Decemb.	515,915	525,720	577,823	128,229	129,999	152,590	771	619	618
Total	7,031,221	7,048,108	7,375,112	1,589,110	1,655,538	1,758,460	14,763	14,428	12,407

Courtesy Gibraltar Government Statistics Office.

So what is the potential tourist total that Gibraltar receives annually? Working on the statistics provided by Government up to the end of 2002 and the employment figures, together with visitor arrivals via land, sea and air, we have calculated an estimate for that year. This is shown in Fig. 3 below.

- Total visitors through the land frontier at the end 2002 = 7,375,112. *as per statistics.*

- Total Spanish registered workers = 2374. *as at 31st December 2002.*
- Estimated total Spanish unregistered workers = 200. (*our own estimate*).
- Estimated total Gibraltarians living in Spain and working in Gibraltar
- Minimum = 100 and Maximum = 300
- Total workers minimum = 2474 Total workers maximum = 2874
- Multiplied by 5 weekdays and 48 weeks to allow for four weeks leave:
- 2474 x 5 x 48 = 593,760 minimum workers crossing the land frontier in 2002.
- 2874 x 5 x 48 = 689,760 maximum workers crossing the land frontier in 2002.

Estimated number of Gibraltarians crossing for shopping and leisure per week
- Minimum = 1,500 and Maximum 5,000
- Minimum = 78,000 and Maximum 260,000 *per annum*

Estimated number of Spaniards entering Gibraltar per week for shopping, i.e. petrol, tobacco, sugar etc.
- Minimum = 1,500 and Maximum = 5,000
- Minimum = 78,000 and Maximum 260,000 *per annum*
- Total minimum entry = 593,760 + 78,000 + 78,000 = 749,760
- Total maximum entry = 689,760 + 260,000 + 260,000 = 1,209,760
- Total less minimum = 7,375,112 – 749,760 = 6,625,352
- Total less maximum = 7,375,112 – 1,209,760 = 6,165,352
- Total maximum plus cruise visitors = 6,625,352 + 116,918 = 6,742,270
- Total minimum plus cruise visitors = 6,165,352 + 116,918 = 6,282,270

Adding these two totals to the cruise ship arrivals we arrive at a hypothetical tourist figure for Gibraltar. Visitor numbers arriving by air is minimal and will probably not influence the final calculations. Even when a hypothetical minimum is considered, the final number remains extremely high. Let us inflate the following figures to an unrealistic hypothetical maximum to see what happens:

- Total Spanish registered workers = 2374. *as at 31st December 2002.*
- Total hypothetical unregistered Spanish workers = 1000. *Our own estimate.*
- Estimated total Gibraltarians living in Spain and working in Gibraltar = 1500.
- Multiplied by 5 weekdays and 48 weeks to allow for four weeks leave = 4874 x 5 x 48 = 1,169,760 workers crossing the land frontier in 2002.
- Estimated hypothetical number of Gibraltarians crossing for shopping and leisure: *per* week = 10,000; *per annum* = 520,000
- Estimated hypothetical number of Spaniards entering Gibraltar per week for shopping, i.e. petrol, tobacco, sugar etc: *per* week = 20,000, *per annum* = 1,040,000

- Total hypothetical maximum = 1,169,760 + 520,000 + 1,040,000 = 2,729,760 non-tourists.
- Total hypothetical number of tourist = 7,375,112 – 2,729,760 = 4,645,352
- Add to this the number of visitors from cruise ships = 4,645,352 + 116,918 = 4,762,270

So we arrive at three figures: high maximum = 6,742,270; conservative maximum = 6,282,270; hypothetical minimum = 4,762,270.

Figure 3. Estimates of total number of tourists visiting Gibraltar during 2002.

Fig. 3 demonstrates that even when using inflated figures, the potential catchment for tourists present in Gibraltar, most of whom could visit the Upper Rock Nature Reserve, may approximately stand between 5 million and 7 million. Given the unrealistic or inflated figures used in this last demonstration the final or true figure must lie closer to approximately 5.5 to 6 million tourists mark. Now that we have arrived at the potential number of tourists that can access the Upper Rock Nature Reserve and other tourist sites, what is the true figure?

Table 3. Monthly visitor numbers to the Upper Rock Nature Reserve.

	2000	2001	2002	2003
January		25756	21786	26193
February		32773	33134	32924
March		54038	53363	47289
April	77913	73046	65766	67422
May	86913	85759	77434	75909
June	74412	74242	63225	73027
July	80094	80324	83299	84664
August	92855	82810	104307	90257
September	88636	82738	89456	78834
October	89594	81715	96109	79018
November	48557	43390	42897	38702
December	25642	22376	26009	24680
Total	664616	738967	756785	718919

Data provided by the Government of Gibraltar.

By looking at table 3, we can instantly see that in relation to the estimate given above, a relatively low number of the potential tourist total visits the Upper Rock Nature Reserve. Yet we find that the Nature Reserve and especially the sites are fully saturated with both vehicles and tourists. On the Upper Rock we have found that in many instances several of the sites are at times overflowing with vehicles and tourists at certain times of the day. So how can the saturation levels be alleviated whilst at the same time maintaining visitor numbers at a sustainable level for both the environment and the tourist sites? Although alleviating the situation by reducing the number of visitors would seem difficult to achieve, an alternative would be to increase the quality of the tours, providing more time and a richer interaction with guides. This could include specialist tours such as historical or nature walks. Obviously, the price of these tours would be greater than a normal tour. This would mean that the Management would gain extra revenue *per capita*. If such a programme could be shown to work, then considerations on visitor number control could be made without a loss of income.

Part of the problem is, we suggest, the making of the Tourist Board. The special light show at St. Michael's Cave at 10:00hrs and 12:00hrs in the morning attracts an inordinate amount of taxis and coaches with several hundred tourists specifically at these times. The other problem is that all the tour operators undertake the same route as they pick up their fare from the coach park or the frontier. This means that all sites around Gibraltar receive the same amount of traffic at specific times. To make matters worse, the first vehicle to leave one site is very quickly followed by all the others. They sometimes try to outdo each other to be the first to arrive at the next site, and on occasions, rowdy discussions ensue. If these fares were staggered by sites, i.e., one coach goes to Europa Point first while the next visits the Nature Reserve, and then vice versa, the whole situation could be improved. This is especially true for coaches, as there are very few parking facilities at any of the sites for these large vehicles.

It is plain to see that although the number of tourists accessing the Nature Reserve is

small compared to the potential catchment available, the number already visiting the Upper Rock has reached just about saturation point. This cannot be increased without a detrimental effect on the sites and the environment, something that is already beginning to happen.

In the last decade visitor numbers have increased substantially (*see* Table 1), and this has seen a rise in the number of tourists visiting the Upper Rock Nature Reserve. However, although the Upper Rock's infrastructure for cleansing, maintenance and site control has improved, it is still not adequate. This has brought about negative consequences, not only for the tourist product and the visitors themselves, but also in the general appearance of the place and the environment as a whole. Basically, these are the consequences of a lack of vision of 'sustainable tourist development' (*see* Chapter 22) in that we are 'milking the cow dry'! There are responsibilities linked to any business enterprise to ensure that it continues to reap benefits and unfortunately these have been neglected. These responsibilities involve quality of the product, product information, continual maintenance and repairs of sites, paths and heritage, value for money, environmental management, general maintenance and cleaning of all areas and anything else to improve the product. This requires a great deal of investment, not only on the sites and the tourist product but also to the general appearance and well being of the environment of the Nature Reserve as a whole.

To put the Upper Rock into perspective, the ecological impacts of tourism are equally as important as economic concerns. If tourism destroys the resources on which the industry depends, then the activity cannot be considered a conservation tool (Ziffer 1989). The Galapagos National Park, once thought to be a model of conservation through tourism, became an example of how excessive and uncontrolled tourism can cause severe environmental degradation (de Groot 1983). The original management plan for the park called for a maximum of 12,000 visitors. When the demand for the park increased, government officials simply increased the visitor quota to three times the original allotment. Thus tourism has the potential not only to raise incentives for preservation but also to increase incentives for misuse. Even with good intentions, the sheer numbers of visitors can collectively lead to a resource strain.

Although hugely different examples, a comparison between impact to wildlife in the Galapagos and on the Upper Rock can still be made. When we then consider the Upper Rock Nature Reserve, which is a fraction of the surface area of the Galapagos National Park and with an uncontrolled number of over 700,000 visitors a year, plus an estimated annual total of over 60,000 vehicles, we can appreciate the magnitude of the problem. There is a saturation problem, and the best way to address this problem is to increase quality, diversify tours away from the Upper Rock, find an alternative environmentally friendly transport system and increase revenue without increasing visitors.

21.5 Revenue

The Upper Rock Nature Reserve made £1.7m in 2000/2001 and £2.2m in 2002, so we believe that there are sufficient resources to invest substantially both in the tourist product and in the natural environment and heritage, on an annual basis.

Table 4. Nature Reserve revenue and comparisons with visitor, concessionary rate and other.

	2001	2002	2003
Number of Visitors	738967	756785	718919
Actual Revenue	£2,248,571.50	£2,284,478.50	£2,139,850.50
Average per visitor	£3.04	£3.02	£2.98
If all Adults full fare	£5,172,769.00	£5,297,495.00	£5,032,433.00
If all Visitors pay concessionary rate £3	£2,216,901.00	£2,270,355.00	£215,675,700
Difference between concessionary and actual Revenue	-£31,670.50	-£14,123.50	£16,906.50

In table 4, the revenue for 2001 includes revenue for the 100-Ton Gun. The average earnings from this site are approximately £4,000 and are therefore insignificant when considering the Upper Rock in total. The total sum is made up of four core elements. These are given in table 5, together with the amount of visitors and money that each sector contributes.

Table 5. Breakdown of contribution of each of the main four elements to the Nature Reserve.

Vehicle Class	Number of Visitors			Income (£)		
	2001	2002	2003	2001	2002	2003
Coaches	322,161	305,932	287,533	966,483	917,814	862,599
Taxis	171,969	166,536	164,555	515,907	499,608	493,665
Private (Tourist)	83,381	77,937	73,576	610,301	570,383	537,921
Cable Car	155,490	196,621	184,172	260,652	250,398	199,976

Visitors accessing the Upper Rock on Coaches and Taxis are charged at the concessionary rate of £3. Tourists in private or hired vehicles pay £7 (£4 for a child) and £1.50 per vehicle. The authors believe this to be rather expensive, especially when taking into consideration a family party. Visitors via the Cable Car accessing the sites provide £3, with the rest contributing £0.50 as a royalty for using the Upper Rock. Pedestrian tourists wishing to access the sites are asked to pay the full amount (£7 adults and £4 children), which the authors again believe to be on the expensive side. Walking only within the Upper Rock costs £2 and the average total this sector brings per year is only £44,000.

In the last three years the Gibraltar Government has made £6,672,900.50 from the fees at the Nature Reserve entrance, including the Cable Car Upper Rock fees and royalty payments. At the same time the running costs of the Tourism sites re: Government of Gibraltar estimates 2002/03, as at forecast outturn 2001/2002, (Statistics 2002), were divided between running expenses costing approximately £110,000, Gibraltar Development Corporation Staff Services costing £738,000 and Contracted Services, i.e. security services, for £108,000. Since then Master Services have also formed part of the contracted services but, as a consequence, must have had a marked reduction in the wage bill for the GDC staff services. All told, if we take this to be the running costs of the tourist sites as at the present time, then the total annual running costs is £956,000 annually or £2,868,000 from 2001 to 2003 inclusive. Therefore, there is a surplus of approximately £3,804,900.5 in the last three years. This is a considerable amount taking into account that the recurrent costs have been accounted for and that this amount reflects the profit made from just the Upper Rock Nature Reserve in the last three years. This total is sufficient to initiate the management plan with the preliminary necessary works programmes listed and establish the groundwork for the annual recurrent works programmes.

One recommendation that we believe should be taken into consideration is the lowering of the fee for the private adult tourist. At the moment the private adult tourist pays £7. This should be reduced to £6 with the child paying the stipulated £4. Similarly adult tourist walkers visiting sites or the same accessing the Upper Rock on the Cable Car and visiting the sites should also pay £6. To lessen the impact on the total, the concessionary rate should be increased from the current £3 to £4. These changes are relatively small and would not impact greatly on the tour operators since the fees have remained unchanged for some years now, and they would still only be paying a child fare to the Government. This minor change would amount to an increase of approximately £500,000 per year to the total amount and could be justified if the tour operators saw a significant improvement to the Upper Rock Nature Reserve. To put things into perspective table 6 gives the total revenue for the years 2001-2003, and then applies the changes in fees and gives the new totals for comparison.

Table 6. Total revenue if concessionary rate is increased to £4 and adult private tourist reduced to £6.

	2001	2002	2003
Actual revenue	£2,248,571.50	£2,284,478.50	£2,139,850.50
Revenue with concessionary rate increased to £4 and adult private tourist rate down to £6	£2,861,992.00	£2,740,425.00	£2,648,159.50

21.6 Recommendations

1) There is a saturation problem, and the best way to address this problem is to increase quality, diversify tours away from the Upper Rock, find an alternative environmentally friendly transport system and increase revenue without increasing numbers of visitors.

2) Tour operators should diversify into quality, specialised tours, e.g., history, natural history or geology.

3) The Management Board of the Upper Rock Nature Reserve should provide specialised and knowledgeable guides to focus on the specialised tours.

4) Increase concessionary rate to £4 and reduce the private tourist rate to £6, *only* when all the priority recommendations in this report have been applied and the Upper Rock Nature Reserve is in the state where the authorities can then provide quality and value for money.

21.7 Vehicles Survey

In order to gain an indication of the total number of all vehicles entering the Nature Reserve and the main times of entry, the authors embarked on a vehicle survey at the beginning of 2003. The method chosen was to count all vehicles entering the Reserve between the hours of 09:30hrs and 18:00hrs during four separate days each month. Two weekdays, a Tuesday and a Wednesday of another week and a weekend, a Saturday and Sunday of another week were chosen. Vehicles were separated into five classes: locals, tourists, taxis, coaches and motorcycles. Pedestrians were also included at the beginning of the survey, but because the numbers were so insignificant and also difficult to quantify when large numbers of tourists dismounted before arriving at the ticket office, it was decided not to count them further. Some survey days coincided with particularly wet weather, including hail, whereas others were carried out in the intense heat of July and August. Some fell on days when cruise ships arrived in port (*see* table 6), whilst others were fairly quiet. The following section contains an analysis on a monthly basis, together with a synopsis of the traffic situation throughout the year. All the data collected are presented in electronic format in Appendix 3 (on a CD), together with bar charts that reveal the daily trends of the individual classes of vehicles and a pie chart showing the distribution of the classes of vehicles on a daily basis.

Table 7. Cruise arrivals during the traffic survey out of a total of 168 cruise ships for 2003.

Date	Vessel	Individual Potential Capacity	Total potential capacity during survey	Total potential capacity for the Month
Sat 29th Mar.	*Kristina Regina*	245	245	1145
Sat 12th Apr.	*Oriana*	1975	4201	6841
Sun 27th Apr.	*Carousel*	1012		
Sun 27th Apr.	*Noordam*	1214		
Sun 11th May	*Oriana*	1975	2506	23133
Wed 28th May	*World Renaissance*	531		
Wed 4th Jun.	*World Renaissance*	531	3231	11842
Tue 10th Jun.	*Monterey*	600		
Sun 22nd Jun.	*Costa Mediterranea*	2100		
Wed 16th Jul.	*World Renaissance*	531	2506	18356
Tue 22nd Jul.	*Oriana*	1975		
Wed 6th Aug.	*World Renaissance*	531	1031	12215
Sat 16th Aug.	*Van Gogh*	500		
Sun 7th Sep.	*Golden Princess*	2600	8222	21935
Sat 13th Sep.	*Funchal*	439		
Tue 16th Sep.	*Queen Elizabeth 2*	1531		
Wed 24th Sep.	*Oriana*	1975		
Wed 24th Sep.	*World Renaissance*	531		
Wed 24th Sep.	*Sundream*	1146		
Wed 8th Oct.	*World Renaissance*	531	5927	30101
Wed 8th Oct.	*Oceana*	1950		
Sat 18th Oct.	*Sundream*	1146		
Tue 28th Oct.	*C. Colombus*	400		
Tue 28th Oct.	*Millenium*	1900		
Tue 18th Nov.	*Oosterdam*	1848	7460	27331
Tue 18th Nov.	*Maxim Gorkiy*	788		
Tue 18th Nov.	*Van Gogh*	500		
Sun 23rd Nov.	*Noordam*	1214		
Sun 23rd Nov.	*Island Escape*	1512		
Sat 29th Nov.	*Van Gogh*	500		
Sat 29th Nov.	*Melody*	1098		
Sun 7th Dec.	*Costa Tropicale*	1022	1022	8731
Total			**36351**	**161630**

JANUARY

January is usually a month with few visitors accessing the Upper Rock, but it is also the time of the year when the Cable Car is closed for maintenance. Therefore, those tourists who want to visit the Upper Rock using public transport will avail themselves of taxis, or are already booked on tours by coach tour operators. Although numbers are small for the time of the year, the majority of visitors to the Upper Rock will enter the Reserve via the Jews' Gate entry point.

During weekdays, visitor numbers, although low, were relatively steady with 26 and 33 coaches respectively on the Tuesday and Wednesday and 68 and 82 taxis accessing the Nature Reserve. Coaches, conveying day visitors, were mainly observed during the morning and early afternoon between the hours of 10:00hrs and 13:00hrs, whereas taxis also peaked during the morning but continued with a small trickle of visitors during the afternoon. Private tourist vehicles maintained a steady flow during the whole of the period surveyed. Local vehicles arrived at the Upper Rock throughout the day with an average of 8 vehicles every half hour without any noticeable peak. The trend for motorcycles during weekdays seems to be notable in the mid to late afternoon when youngsters, using this form of transport, tend to ride up the Rock after work or school.

On weekends the pattern changes, with an increase of foreign visitors using their private vehicles and taxis, especially during the Sunday. Coach traffic was significantly lower with only one on the Saturday and 18 on the Sunday. Day-trippers prefer to book tours during weekdays, and weekends are also the departure and arrival times for tourists, hence the notable decrease in this type of visitor. Locals make up the most noticeable increase in traffic. During the winter months, it is customary for many locals to take a ride around Gibraltar after lunchtime when there is a monumental increase in traffic between the hours of 15:00hrs and 18:00hrs. A huge total of 699 vehicles were counted for the Saturday and Sunday, making up 72.5% of the total amount of traffic carried on the Upper Rock Nature Reserve roads. This is a very large number of vehicles on the road with a density which reached, on occasions, one vehicle every 30 seconds, bringing the total for local vehicles on that Sunday to 434. Similarly, the majority of motorcycles are local and therefore access the Upper Rock in a like manner to local cars. Although the Tourist Board carries out a count of vehicles entering the Nature Reserve, it does not take account of local vehicles. The significant totals for this sector have a bearing on road usage, pollution and deterioration of our roads. However, it is significant to note that, although local vehicles often make up the majority of vehicles on the Upper Rock, these peak during a different time of the day to tour operators (*see* Appendix 3). Therefore, the exclusion of local vehicles would do little to improve the problem of traffic congestion. The difference in pattern of peak times can be observed consistently throughout the year.

FEBRUARY

It is a policy of the Tourist Board that when a cruise ship is in port a prohibition on the flow of private tourist vehicles to the Upper Rock is activated until such time as it is deemed that this category of vehicle will not pose a traffic problem. This was the case on the 12th February when this type of vehicle was not allowed to enter until midday. There were only 26 such vehicles in the remainder of the day. However, 153 private tourist vehicles entered on Tuesday 25th February, significantly higher than on any day in January. The increase in visitor numbers is reflected in the taxi total for the weekdays, with a total of 224 taxis during the two days surveyed. Tour operators utilising coaches employed 26 and 54 vehicles respectively on the Tuesday and Wednesday, a small increase compared to a similar period in January. In contrast, local vehicles and motorcycles were down in numbers.

Weekends reflected the winter trend found in January. Taxi and coach numbers were down in comparison to weekdays, with a total of 99 taxis and 28 coaches; approximately half of those numbers recorded during weekdays. Again, maximum density for both these sectors was recorded during the morning and early afternoon. Private foreign vehicles were making far more use of this period to visit the Upper Rock than on weekdays, and numbers had increased from the January total during the similar period with 73 on Saturday and 110 on Sunday, a small increase on the previous month. Local vehicles and motorcycle numbers dropped, with a total of 413 vehicles and 29 motorcycles for the weekend. Again, as in January, most numbers of vehicles and motorcycles were recorded between the hours of 15:00hrs and 18:00hrs. During the winter weekends, a lot of locals make use of the scant parking area at Jews' Gate to take a walk in the Nature Reserve. Very soon this whole area is filled with parked cars, some blocked in, and access to the observation area by tourists is hampered.

MARCH

Numbers of private tourist vehicles remained consistent during weekdays in comparison

to the last two months. Tuesdays saw a larger number of this type of vehicle than on Wednesdays. The reason for this is not clear, but the trend follows this pattern throughout the year. The reverse is true for taxis and coaches. Taxi numbers were similar to February with 231 vehicles in March in comparison to 224 vehicles in February, yet coach activity increased from 80 in February to 117 in March, possibly reflecting small increases in numbers of tourists entering via the frontier. Local vehicles again were the largest sector of vehicles on the Upper Rock roads with a total of 323 vehicles for the two weekdays surveyed and an average of 8 vehicles every half-hour throughout the two days. Numbers of motorcycles were relatively insignificant with a total of 21 for the two days with the majority recorded in the afternoon.

Activity during the weekend continued along the winter trend with local vehicles making up the bulk, with 130 counted on Saturday and 268 on Sunday following the afternoon drive trend. Numbers were markedly less than in January and slightly less again than February. Motorcycle numbers were again fairly insignificant and so do not show any trend. Taxi numbers for the weekend remained consistent with the previous month, with a total of 105 for the two days. There was a drop in numbers between the hours of 12:30hrs and 13:30hrs which would imply either drivers or their fares going for a lunch break. Coach numbers remained high for the Saturday with 28 vehicles recorded but only 11 on the Sunday. Private tourist vehicles slowly increased in numbers as the spring season arrived with 66 vehicles on the Saturday and 130 on the Sunday. Most of these vehicles accessed the Upper Rock between the hours of 11:00hrs and 16:00hrs demonstrating the allowance made for arrival and departure times to and from Gibraltar.

APRIL

Easter fell in the middle of the month with the main official holiday period between the 18th and 21st inclusive, and obviously visitors to Gibraltar took advantage of this to visit the Upper Rock. Yet as we can see from our results, it appears that a substantial number of tourists spent an extended holiday in Spain and frequently visited the Rock throughout this month.

Private tourist vehicles numbers increased substantially during the weekdays with 153 on the Tuesday and 93 on the Wednesday. The highest density for this type of vehicle during both days was found after midday. This may be due to the long queues on the Spanish side of the frontier, preventing access to Gibraltar until mid morning. Taxi activity also increased this month with 137 vehicles on the Tuesday and 178 on the Wednesday. Taxi numbers were consistent throughout the day with just small fluctuations during mid morning and shortly after midday. Local vehicle numbers remained steady throughout these two days with 139 on Tuesday and 149 on the Wednesday. Motorcycle numbers were relatively low on the Tuesday, but 36 on the Wednesday was the largest weekday total since the beginning of the year.

The spring weather saw a substantial increase in local vehicle usage during the weekends with 241 on the Saturday and 281 on the Sunday. Again, numbers were concentrated during the afternoons with an average of one car a minute. Private tourist vehicles totalled 152 for both days, surprisingly lower than the weekend totals for the previous two months. However, taxis had their largest totals for the year so far with 83 on Saturday and 90 on Sunday. Coaches also reflected this upward trend with their highest totals, with 41 for Saturday and 29 for Sunday. Motorcycles achieved their highest total for the weekend with 76 vehicles, of which 50 were counted on the Sunday (mostly during the afternoon).

MAY

Near the middle of this month private tourist vehicles were banned from the Upper Rock because of repairs to Cave Branch Road and the area of St Michael's Cave. As a result, the survey of Tuesday 20th only produced 6 of this class of vehicle that managed to slip through the controls. By the end of the month traffic was back to normal with 83 private tourist vehicles on the Wednesday. Taxi numbers were down compared to the previous month with 116 on the Tuesday and 147 on Wednesday, but coaches maintained their numbers with a total of 114 vehicles for the two days. Local vehicles reached their highest total for the weekdays with 175 on the Tuesday and 158 on the Wednesday, with an average of 8 vehicles every half-hour throughout the day. Likewise motorcycles totalled 51, achieving their highest total since January.

Local vehicle numbers remained high for the weekends with 128 on Saturday and 251 on Sunday. Flow remained fairly constant during the Saturday with an average of 7 vehicles every half-hour, but this increased (as usual) on the Sunday afternoon to 22 vehicles every half-hour. Motorcycle numbers remained high with a total of 45 for the two days, reflecting the fair weather and warmer climate for the month. This also accounted for good numbers of private tourist vehicles with 78 on Saturday and 98 on Saturday. Taxi numbers were com-

paratively down with 72 on the Saturday and only 41 on Sunday, and the authors overheard one driver comment that this May had been relatively poor in comparison to the same period last year. Coaches on the other hand maintained their numbers and actually had their best Sunday in the year with 35 vehicles.

JUNE

Weekdays during this month again saw local vehicle numbers totalling 264 on both days surveyed, a decrease of 69 for the same period the previous month. The density remained relatively constant throughout both days without any discernible peaks. Surprisingly motorcycles totalled 78 with a large total of 59 counted on the Tuesday. This count was the largest weekday total for the year. The private tourist vehicle weekday trend was finally broken, with 99 vehicles on the Tuesday and 114 on the Wednesday. Numbers for the weekdays were similar to other months, yet taxi numbers had increased this month (after a decrease in May), indicating an increase in the tourist population in Spain as summer approached. Coach tour operations remained relatively stable, with only a slight drop in vehicle numbers, for a total of 96 vehicles for both days.

Significantly, local vehicle numbers decreased substantially as the fair weather signalled the start of the bathing season, and families now frequented the beaches. Vehicle numbers for the weekends had dropped to 95 for Saturday and 98 for Sunday, a result of the summer trend. Both these numbers must include the residents of the Upper Rock and vehicles providing services to the sites and residential areas together with military and official local vehicles. This core element will access the Nature Reserve almost on a daily basis, the rest composed of the usual 'drive around Gibraltar' elements. We only counted a total of 53 motorcycles, divided between 21 on Saturday and 32 on Sunday. Similar numbers of private tourist vehicles were encountered on these two days with 64 and 61, spread throughout the morning and afternoon with relatively little activity around lunchtime. However, taxis had their biggest turnout during the middle of the day with maxima of 8 vehicles in half an hour between 12:30hrs and 15:00hrs on the Saturday and a maximum of 20 vehicles on Sunday between 12:00hrs and 13:00hrs, for a total of 157 for both days. Coaches on Saturday reached 33 vehicles, but Sundays are usually lax for organised tours, consequently they only mustered 16 vehicles up the Rock.

JULY

Local vehicle numbers during the summer weekdays had now established themselves at around the 250 mark for both days. This compared favourably with the previous month, which saw 264 vehicles. This number was spread out evenly throughout the day, with a slight decrease during the lunch period. Motorcycle numbers saw a small decrease. The holiday period was now upon us and this resulted in a substantial increase in tourist numbers. Private tourist vehicles reached similar totals when compared to Easter for both days, with 138 for Tuesday and 106 for Wednesday. Many more tourists used taxis for transport with a total of 356 vehicles for both days and a day record of 204 vehicles on Wednesday 16th. Coaches again maintained their steady numbers for the weekdays with a total of 98 vehicles with a trend developing for the use of these vehicles during the mornings and early afternoons. Despite this, a few coaches were counted much later in the afternoon, possibly as a result of late arrivals of tours at the coach park.

Weekend numbers of local vehicles maintained themselves at a total of 181 vehicles with 92 for Saturday and 89 for Sunday. Likewise, the motorcycle numbers remained low. The weekend figures for taxis did not reflect the high numbers encountered in the middle of the week, with a total of 131 for both days; 26 vehicles less than in the month of June. Coaches fared little better, with only 23 vehicles on the Saturday and 4 on Sunday.

AUGUST

Numbers of local vehicles for weekdays increased throughout this month with a total of 297 vehicles -up 44 on last month- and numbers were evenly distributed throughout the day. Motorcycles on the other hand maintained their numbers with a total of 48 for both days. A total of 172 private tourist vehicles for the two days represented a marked decline in this form of transport accessing the Upper Rock. This can be explained by the ban on tourist vehicles that is in force during the height of the summer until 15:00hrs, after which only 96 vehicles were counted. In contrast, a massive influx of tourists represented record daily totals of taxis for Tuesday with 209 vehicles and Wednesday with 217, with up to 28 taxis in a 30-minute period in the morning. Coaches fared just as well with 52 vehicles on Tuesday and a record 58 on Wednesday, mainly operating throughout the morning and early afternoon.

Weekend numbers of local vehicles were fairly stable with a total of 210 for both days, spread out through the day. Similarly, the pattern for motorcycles had not changed throughout the hot summer period and a total of 67 were counted for both days. A total of 242 pri-

vate tourist vehicles represented the highest weekend total for the year with daily totals of 116 on Saturday and 126 on Sunday. Greatest vehicle density was found throughout the late morning and early afternoon, with a lot of vehicles taking advantage of the cooler late afternoon and entering just as the ticket office closed. Taxis and coaches did well on Saturday with 103 and 37 vehicles respectively, but on Sunday the taxis could only muster tourists for 48 vehicles and coaches did little better with only 7 vehicles to show for their efforts.

SEPTEMBER

Local vehicles continued along their summer trend with a consistent figure for the summer months of 142 vehicles for Tuesday and 133 for Wednesday, distributed fairly evenly throughout the day. There were a total 50 motorcycles for the two days, again consistent with recent monthly weekdays survey totals. Private tourist vehicle numbers decreased substantially with 106 on the Tuesday and only 34 on the Wednesday. This last figure could be as a result of the survey being carried out toward the end of the month by which time tourist numbers are well down. Low numbers were also influenced by wet weather throughout the morning and a total ban of traffic between 16:00hrs and 17:00hrs when a small fire broke out in the vicinity of Apes' Den. Taxi numbers were down on August figures with 150 vehicles on Tuesday and 161 on the Wednesday, but were still within a healthy margin, totalling 311 vehicles, a figure that fell between June and July's weekday totals. Density was distributed fairly evenly throughout the day, but toward the end of the month the majority of vehicles were counted in the morning and early afternoon. Surprisingly, coach figures were extremely high for this month, even surpassing the main holiday period of August. A total of 77 vehicles were recorded on the Tuesday and a record 85 on the Wednesday. This coincided with the arrival of the Queen Elizabeth II, for between 09:30hrs and 10:00hrs on the 16th, 14 vehicles were recorded contributing to the largest influx of visitors recorded within a short space of time, creating traffic jams at the bottlenecks of Jews' Gate and St. Michael's Cave.

Numbers of local vehicles increased to the highest total during the weekend of the summer months to 295, with 133 on Saturday and 162 on Sunday. This reflects the end of the bathing season and more importantly the start of the school term. Motorcycle figures continued the high numbers recorded in August with a total of 65 vehicles but private tourist vehicles dropped to 92 on Saturday and 81 on Sunday demonstrating the end of the holiday season. However the month of September heralded the arrival of 27 cruise ships with a potential of 21,000 passengers, which maintained a healthy tourist trade for both the taxi and coach tour operator. Taxis had their best weekend all year with 92 vehicles on the Saturday and 127 on the Sunday mainly during the morning and early afternoon. Coaches did likewise with 38 vehicles on Saturday and a record 66 on Sunday.

OCTOBER

Local vehicle numbers had begun to establish themselves back to the winter trend with a total of 154 vehicles on Tuesday and 139 on the Wednesday. The density again saw a slight rise in the middle of the afternoon. Motorcycle figures totalled 42 vehicles. Numbers of private tourist vehicles were similar to the previous month with the Tuesday total (98) greater than the Wednesday total (67), maintaining the trend seen during the earlier part of the year. The weekday total for taxis, at 362 vehicles, was an improvement on the previous month, with the Tuesday total of 214 vehicles surpassing that of Wednesday. Coach tours fared just as well, with 44 vehicles on the Tuesday and 88 vehicles on the Wednesday. After 15:00hrs very few coaches were counted.

The winter trend for local vehicles was now establishing itself with 202 on Saturday and 181 on Sunday, with large peaks of vehicles now obvious during the afternoon after 15:00hrs. In contrast, motorcycle numbers were down to 28 and 9 vehicles on the two days. Private tourist vehicles were much in evidence during the weekend with 80 vehicles on the Saturday and a large total of 145 on the Sunday. Tourist numbers were still healthy. This was reflected in the high numbers achieved by taxis, which managed 90 vehicles on the Saturday and only 59 vehicles on Sunday. Again, this was obviously due to cruise ships boosting numbers with a total of 27 ships and a potential capacity of 30,000 passengers for the month. The trend shows peaks in mid-morning on Saturday, correlating with the earlier arrival of the cruise ship Sundream with a potential capacity of 1146 passengers. Coaches reflected this trend with 40 on Saturday but only 13 on the Sunday.

NOVEMBER

By now, local vehicles maintained their autumn/winter numbers on weekdays with a total of 281 vehicles compared to last month's total of 293, the density again showing the characteristic afternoon peak. Likewise, motorcycles numbers reflected the exact same numbers as the previous month with 42 vehicles. Private tourist vehicle numbers were slowly dropping with 77 on the Tuesday and 47 on Wednesday, and this was reflected in tourists conveyed in taxis, which had also decreased substantially to 132 vehicles on Tuesday and 107

on Wednesday. Coach tour operators managed to muster a total of 108 vehicles for the two days. Most of this traffic was concentrated in the mornings.

Weekend local vehicle traffic remained similar to the previous month with a total of 386 vehicles compared to the total of 383 the previous month, again concentrated in the afternoons. However, motorcycle numbers were well down. Numbers of private tourist vehicles were much the same as the weekday total with only 119 counted. Similarly, figures for taxis for the weekend were much the same as the previous month with a total of 158 vehicles reflecting the customary figure of this sector during the autumn and winter months. This pattern was reflected in coach numbers with a comparable total to last month of 50 vehicles for the two days.

DECEMBER

The survey for this month included three of the days during the Christmas holiday period; namely Tuesday 23rd, Saturday 27th and the last day of the year, Wednesday the 31st. The authors expected a low turn out during this period, but the results were surprising. On the Tuesday the authors counted 169 local vehicles. This was a little above that days' total for the last few months, but on the Wednesday 208 local vehicles were recorded with the majority counted during the afternoon, when employers released their workers and granted the afternoon off. Coincidentally the weather on that day was marvellous for the time of the year and the locals took the opportunity for a ride around Gibraltar, producing a similar result as on Sundays. Motorcycles also had their best on Wednesday with 37 vehicles up the Rock. Likewise, private tourist vehicle numbers were average on Tuesday with 98 vehicles, but on the Wednesday 141 vehicles decided to visit the Upper Rock. The improved dry weather on the 31st also benefited the tour operators with taxi numbers up from November to a total of 198 for the two days. Likewise coach numbers did well on Wednesday with 40 vehicles but only managed 19 vehicles on the Tuesday.

The figures for local vehicles on Saturday totalled 171, but on Sunday a record number of vehicles were counted with 307, mainly during the afternoon reaching an incredible rate of 43 per half hour between 15:30hrs and 16:30 hrs. Tourist capacity during December must have increased, producing totals of 121 and 131 vehicles on both days surveyed, and taxi numbers for the Saturday were up from the last three months to 105 vehicles, and a respectable 92 on the Sunday. The coach tour operators did not fare as well with only a total of 27 vehicles for the two days, of which only two accessed the Nature Reserve on Sunday.

*

The summary above reflects the monthly trends throughout the year, but as can be appreciated in the summary, there are striking differences between the weekday and weekend traffic. To establish a clearer picture of the movements of all sectors of vehicles throughout the year, estimated monthly weekend & weekday means have been used to plot graphs (Figs. 4 & 5) that show the density of each sector of vehicle.

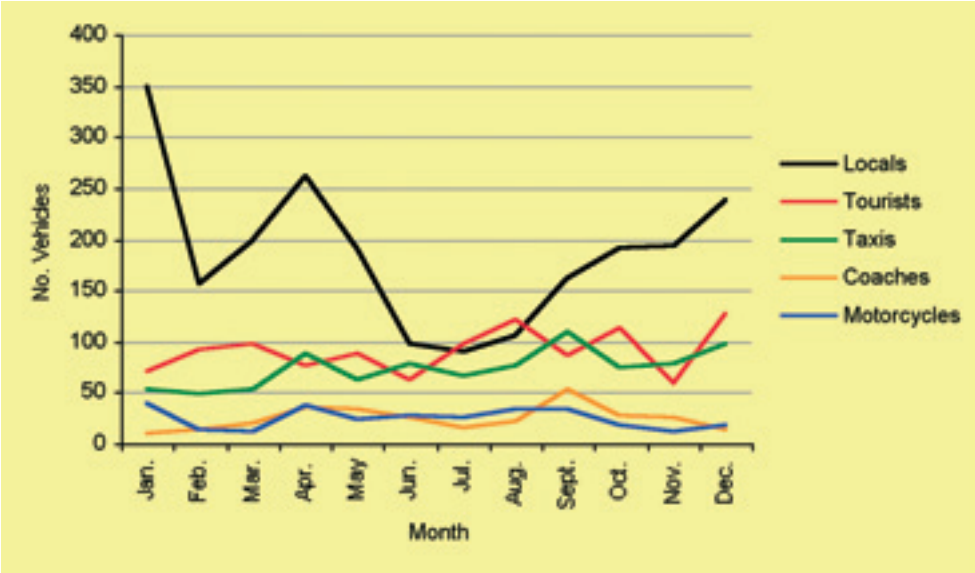

Figure 4. Estimated weekend mean for all months, for all sectors of vehicles surveyed in 2003.

Local vehicles are by far the most dominant sector on the Upper Rock during weekends. The largest figures are found during the winter months, after which a steady decrease is noted with a marked increase during the Easter period. Between mid May and mid September numbers drop considerably as the local population spends more leisure time at the beaches, avoiding the hot Upper Rock roads. Towards the end of September the winter trend resumes as can be seen in the graph, as the locals make more recreational use of the Nature Reserve, if only for a drive.

Private tourist vehicles and taxis are the next most frequent sectors but they almost never reach the numbers of local vehicles, except for private tourists during the summer months (especially the peak holiday season between the end of July and August, when locals are at an all time low). Even then numbers rarely exceed 150 vehicles for both categories.

Weekends are particularly slow for coaches, as most cruise ship arrivals take place during weekdays, and weekends are the time for arrivals and departures of the tourist element in the Costa del Sol. Therefore there is little activity in the way of organised tours to Gibraltar during this period of the week. Even then it is interesting to note the similarity in the peaks and troughs that this sector shares with taxis. This shows the year-through fluctuations in tourism at Gibraltar, especially in Easter and late summer. Motorcycle numbers are extremely low, only displaying a slight increase during the Easter period.

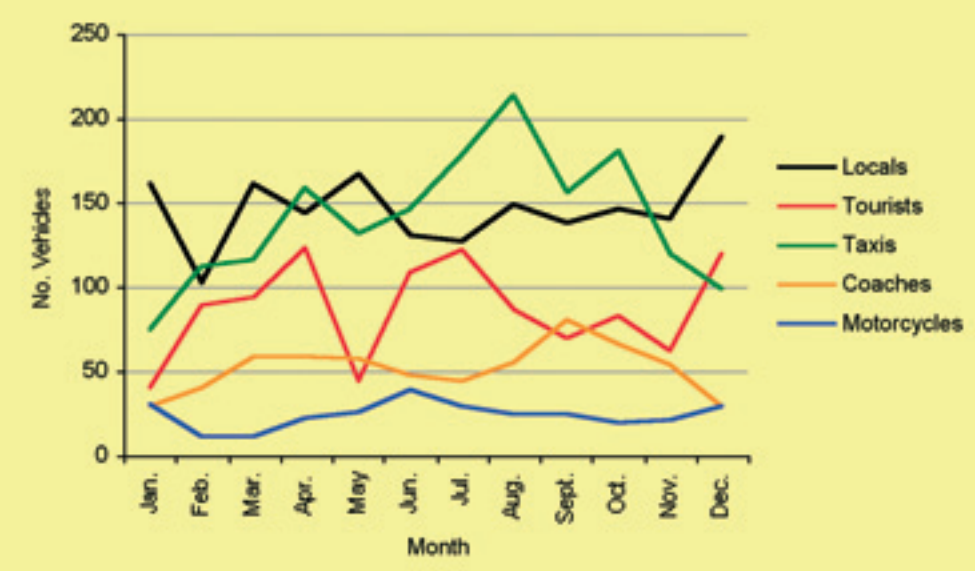

Figure 5. Estimated weekday mean for all months, for all sectors of vehicles surveyed in 2003.

Fig. 5 displays the estimated weekday mean for each month. Here, there is a noticeable difference in the vehicle densities observed in the estimated weekend mean. The two sectors that dominate the density of vehicles throughout the year are local vehicles and taxis. Local vehicles do not show a trend and numbers fluctuate irregularly, with only a slight decrease during the summer months and increases throughout December and January. This contrasts sharply with the taxis, which show very evident peaks. These are attributable to the increase of tourism to the Rock, with peaks at Easter, the summer months and early autumn when the arrival of cruise ships increased trade. Private tourist vehicles reflect the fluctuations of the taxis and mirrors the increases in the density of the arrival of tourists to Gibraltar. Coaches show a similar pattern. Although numbers never reach the high figures of the other three sectors, coaches convey more visitors. Again, motorcycle numbers are extremely low.

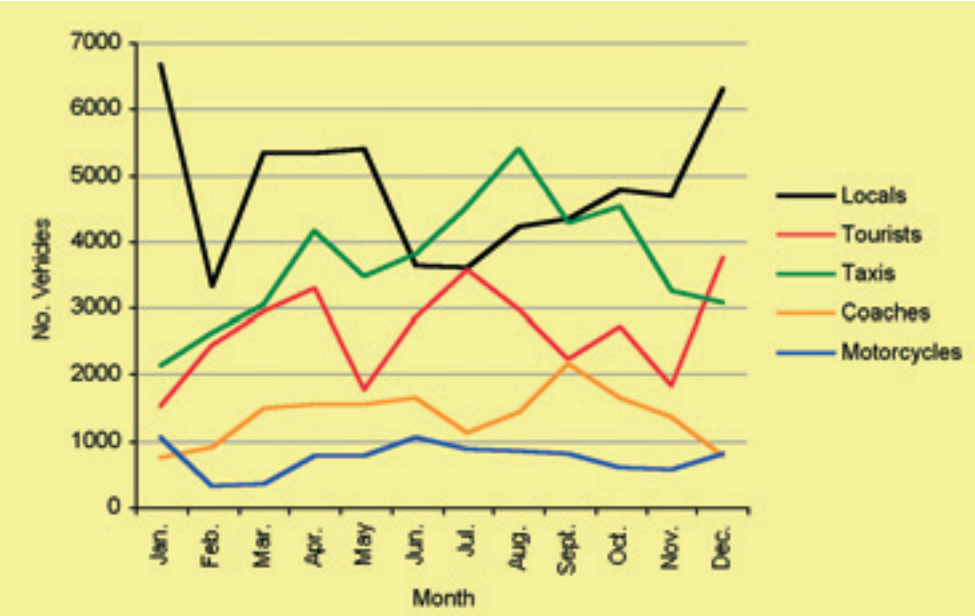

Figure 6. Estimated monthly totals for all vehicles entering the Upper Rock Nature Reserve during 2003.

In Fig. 6, estimated monthly totals have been calculated for the year. The largest elements here are local cars, which peak at over 6000 per month during the winter. This sector is only surpassed during the summer months by the taxis. Coaches reflect the same trend as taxis and tourist vehicles, with more visitors using this mode of transport than the other two. From the point of view of impact, although coach numbers are less than half that of taxis, they probably pollute as much as several taxis together. Thankfully, daily local vehicle density and the rest of the other sectors do not usually coincide. The majority of the taxis, coaches, and private tourist vehicles arrive at the Nature Reserve during the morning and early afternoon, whereas the largest densities of local vehicles and motorcycles are registered during mid to late afternoons.

Obviously, the weekday and weekend mean and estimated monthly totals are based on just one weekend and two weekdays in the month. In order to quantify this error margin, the authors have calculated the 'standard deviation' for each figure given. Tables 3, 4 and 5 at the end of Appendix 3 contains all the data available that were used to plot the graphs in Figs. 4 to 7 and includes the weekday and weekend mean and weekday and weekend standard deviation, and also the daily mean, estimated monthly and annual total and monthly and annual standard deviation of each sector of vehicle surveyed.

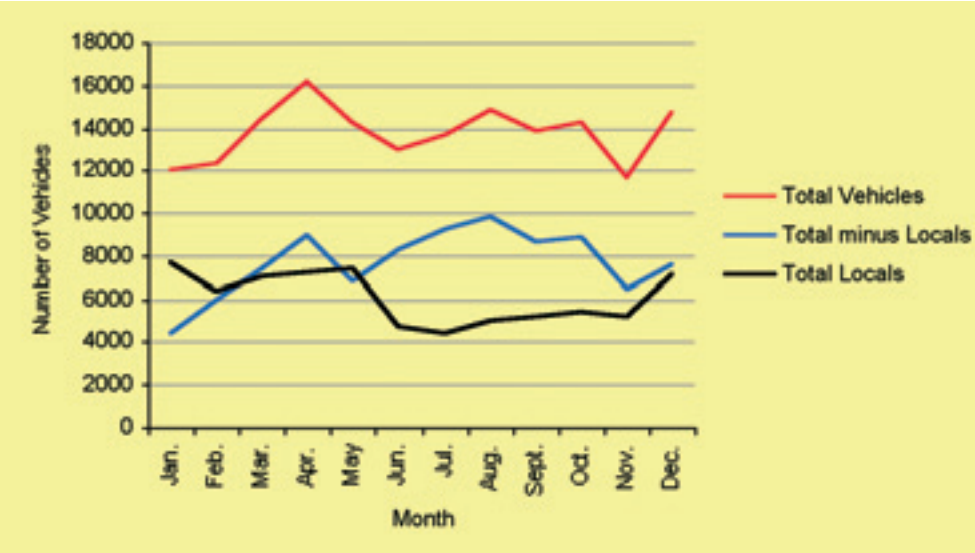

Figure 7. Comparisons between local vehicles, other vehicles and total number of vehicles in 2003.

The graph in Fig. 7 shows the total estimated number of vehicles using the Upper Rock Nature Reserve. The density numbers between 12000 vehicles in the winter months to a

maximum of 16000 vehicles in the Easter period and slightly smaller numbers during the summer period. When eliminating the local vehicles from this equation we can see that the peaks and troughs of the tourist sector match those for all vehicles significantly, showing that the increases and decreases are determined not by the local vehicles but by significant increases and decreases in the tourist trade. When the local vehicles, including motorcycles, are plotted on the graph the graph does not mirror the tourist sector or the vehicle total and shows a significant decrease during the summer months where the local population reverts to the beaches, returning to the Nature Reserve in numbers only during the mild weather periods of the other three seasons. Although we see in the weekday and weekend mean that local vehicles are a dominant feature of the Upper Rock roads, when we take into account the tourist trade as a whole, i.e. taxis, coaches and private tourist vehicles, we find that it is the tourist sector and not the local sector that has a greater bearing on traffic with all the detrimental effects this has with regard to atmospheric and noise pollution, road wear and tear and traffic conglomeration in the Nature Reserve. Local vehicles mainly drive through the Upper Rock without stopping, and therefore cause very little in the way of traffic jams. Local vehicles especially avoid the St. Michael's cave area, since it is well known to residents that there are usually large concentrations of tour operator and private tourist vehicles and very little parking available. It can be said, therefore, that eliminating local vehicles would do little to alleviate traffic problems.

Clearly though, locals have a considerable interest in the Upper Rock and should be considered when improvements are being planned. Facilities should therefore be improved and made available at times when locals use the Upper Rock.

21.8 The Proposed Funicular Project

The Funicular project is being led by a consortium of United Kingdom businessmen from Knightsbridge Investment Trust Limited, who are represented locally by Mr. Leslie Ratcliffe and the Swiss company 'Paul Glassey SA'. They are registered under the company name '21st Century Rock Ltd.' and have engaged the services of local architect Mr. Michael Azzopardi and Chartered Surveyors 'Brian Francis and Associates'.

Mr. Ratcliffe contacted GONHS' General Secretary in the summer of 2002 to discuss the funicular project and gauge GONHS' views with regards to the environment and the possibilities of carrying out an environmental impact assessment. The view of GONHS was that this project was detrimental to the objectives of the Society and would have a negative impact in several of the key issues and objectives which GONHS had identified and were being investigated as part of the Upper Rock Nature Reserve management plan. The General Secretary categorically told Mr. Ratcliffe that GONHS was opposed to such a project and that this venture would not receive their support at any stage.

Subsequently a meeting was held at the Europort Offices of the Department of Trade and Industry hosted by Mr. Richard Garcia of the Gibraltar Tourist Board and Mr. Paul Origo, the Town Planner. GONHS' General Secretary John Cortes was present as were Prof. Clive Finlayson and Mr. Carl Viagas of the Heritage and Planning Division and Mr. Joe Desoiza of the Heritage Trust. After lengthy discussions the three aforementioned bodies clearly stated that they did not support the project. These discussions did not mean that the project had been rejected by the Development and Planning Division, but all three bodies expected, and were under the impression that the project would be withdrawn.

It came as quite a surprise then that after several months a second report, 'Feasibility Report 2' dated 31st July 2003 (Glassey 2003) was released in November 2003. This report played on the many reservations that the three bodies had brought up in their discussions, and proceeded to attempt to address the issues. The main differences with the initial report were the relocation of the track to a more direct route to the top and diminishing the visual impact by locating the rail track on the ground as opposed to an elevated rail (this having a greater direct impact on the vegetation). The project also envisaged a 230m tunnel taking the rail from the Northern Defences and emerging at a location close to Princess Caroline's Battery

Late in 2003 the matter was raised at the Development and Planning Commission where the Town Planner recommended that the project would require an environmental impact assessment. The developers then engaged the services of 'Environmental Gain Ltd.' to carry out this assessment. This company's representative, Ms. Nikki Wood, met with representatives of GONHS and had frank discussions over the issues and problems relating to the funicular. The discussions were obviously related to environmental and ecological perspectives, and Ms Wood also held meetings with the other concerned bodies to gauge their opinions in the lead up to the preparation of the Scoping Report (Wood 2004) which was submitted on 3rd March 2004 to the Development and Planning Commission in the lead up to the final environmental impact assessment.

The Funicular project is a different means of proposed transport that intends to operate within the Upper Rock Nature Reserve. Will this solve any of the Nature Reserves problems? To begin with, this is not an alternative means of transport that will alleviate the traffic congestion on the Upper Rock Nature Reserve. This project is initially, solely aimed at targeting pedestrian tourists in the Casemates area, but will eventually also tap the cruise ship and trans-frontier visitors. It does not, however, provide an alternative to those tours offered by taxis and coaches, for reasons explained below. Therefore, like the Cable Car some decades before, it will not lessen to any degree the vehicular impact on the Upper Rock roads.

Will the funicular convey visitors to the existing tourist sites thereby alleviating pressure from vehicular traffic to reach these sites? The answer is no. The funicular will exploit a completely new area with a proposed top terminal station south of Rock Gun. This also envisages a walkway around the whole of the Rock Gun area. The whole area is still in MOD hands, and will be up to 2005. Despite numerous meetings with the MOD, whenever the funicular project has been raised, much to our surprise we have been met with blank faces, and kept very much in the dark. At no time had the MOD mentioned that the Middle Hill and Rock Gun area would be handed to the Gibraltar Government, neither has the Gibraltar Government hinted in that direction either. Nevertheless we believe that the consortium of businessmen would not have embarked on such a project if the appropriate guarantees and commitment to this had not been granted by both the Gibraltar Government and the MOD.

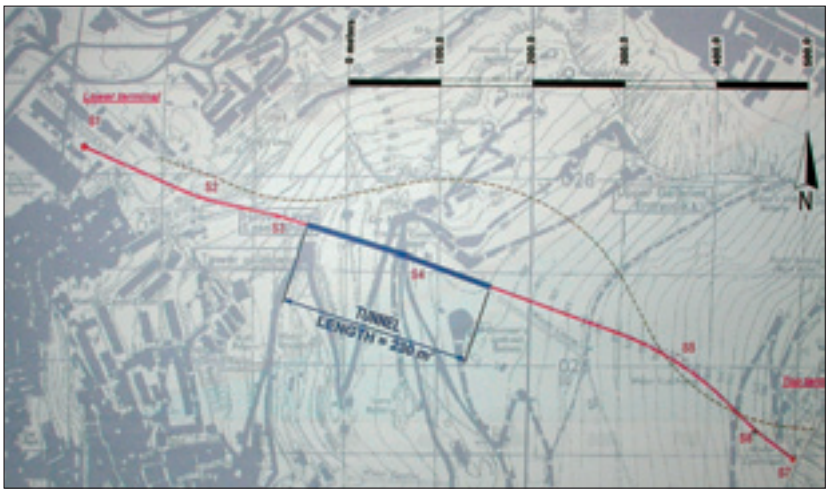

Figure 8. Second more direct proposed funicular route. (taken from Glassey (2003)).

The Funicular Project intends to cut through the Northern Defences close to the Moorish Castle walls, and then continue through a tunnel exiting close to Princess Caroline's Battery where the funicular would continue its ascent, dissecting the old water catchments to terminate south of Rock Gun. The construction and implementation would have grave repercussions on the environment, with the construction of the track at ground level, sectioning this scenic part of the Nature Reserve in two. Visually, the track will be seen from the town area to the north, and although the developers have implied that they can hide this by planting trees along the length of the track, given the soil depth, and the steep incline of the slope, this is virtually impossible. The best that can be achieved are olive bushes and these will take many years to even begin to obscure any construction. However, even this measure will obscure the characteristic white face of the area below Rock Gun, which can be seen in many brochures and most postcards in town.

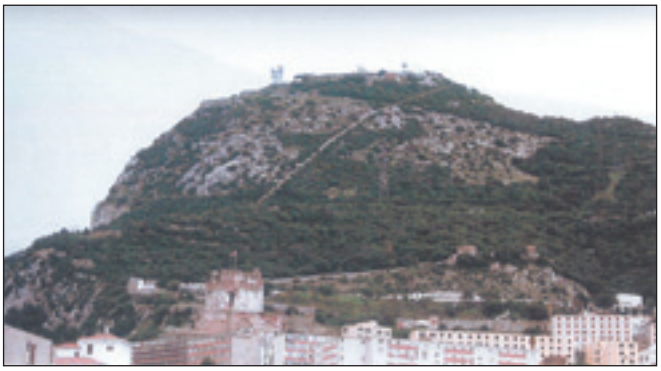

Figure 9. Second proposed route. View from the City. (taken from Glassey (2003).

Ecologically this is a key area of vital importance to most of the Gibraltar endemic and endangered plants. It also holds the 'wild' group of macaques that has served and continues to serve as research material for numerous university students worldwide, and is the authors' proposed biological reserve as the only area within the Nature Reserve where man has little impact (and now we want to let everybody loose in the area?).

A Funicular type of transport would be more appropriate if it was an *alternative* to alleviate the existing traffic and transport problem, if it utilised or was located adjacent to existing roadways and also if it served to convey visitors to existing sites. The location of a funicular alongside or on existing roadways would reduce the environmental impact since visually it would follow and merge with existing roadways. More importantly it would not section or fragment any part of the Nature Reserve more than the roads themselves do at the moment, and

the construction and operation of the funicular would be aided by the communicating roadways. This has to be visualised with a drastic reduction in traffic, thereby opening up the roadways to residents, essential and emergency vehicles and more importantly to pedestrians, now that the roadways would significantly be practically traffic free.

In any alternative transport system, consultation, agreement and direct involvement of the existing tour operators are paramount. The Taxi Association and coach tour operators are ultimately responsible for conveying most of the visitors to the Nature reserve at present. A system that undermines this arrangement, leading to a substantial loss in their takings, would, the authors believe, not be appropriate morally or legally, as these sectors have acquired rights. In this respect any alternative should include a direct involvement of these sectors and should not affect their economic benefits.

21.9 Recommendations

1) In the authors' opinion, the difficult problem of transport and traffic congestion is by far the most difficult of subjects for which to find suitable answers and alternatives. We understand that the Gibraltar Government makes a large profit from the Nature Reserve and wishes to continue to do so. Similarly the taxis, and coach tour operators want to see a continuation of their healthy trade. But realistically the increasing problems that continue to plague the Upper Rock Nature Reserve, which all the aforementioned sectors recognise, are a combination of the mistakes of all three. None of them contribute anything to improve the situation within the Upper Rock Nature Reserve, considering the substantial economic benefits they all obtain. Only M. H. Bland, managers of the Cable Car, have contributed by providing a computerised interpretation facility. The authorities simply apply necessary and cosmetic arrangements to conform to statutory obligations and appease public criticisms, i.e. firebreak maintenance or road cleaning, and the other two sectors reproach the Government for not carrying out improvements. If we are to see a drastic change in the Upper Rock Nature Reserve, we must expect commitments and sacrifices on the part of all three. To begin with, we need substantial economic contributions to the Nature Reserve on the part of the Gibraltar Government, tied in with relevant and meaningful negotiations with the taxi and coach tour operators, which will result in a constructive approach to the transport and traffic problem and substantial improvements to the Nature Reserve.

2) Traffic flow coming down through the Upper Town area from the Upper Rock should be redirected through the tunnel system that includes the Great North Road. This would avoid traffic congestion in what is an awkward sector of the town for tourist drivers. In addition, it would also give tourists an insight to the WWII tunnels and their history. Also, adequate control of traffic coming down through the Upper Town could relieve this area of the traffic problems that currently affect it (P. Origo, *pers. comm.*).

3) Promotion of an environmentally friendly mode of transport as an alternative to the present system of coaches and taxis. Ideally a hop on hop off loop-system with regular stops at all sites would solve many of the traffic problems. This could be a tramway or funicular system, or even a mini van shuttle, located at the Lathbury Barracks, which would pick up the tourists from taxis and coaches. They would then be conveyed to all the sites travelling then back through the Great North Road and dismounting at the Casino exit from where they would walk through the Alameda Gardens and down to the pick up point at Grand Parade.

4) All tour operators should operate their vehicles on Biodiesel. This is currently being investigated by M.H. Bland Ltd.

5) Any alternative transport modality for the Upper Rock Nature Reserve must not impact negatively on the natural assets of the area, and at the same time be in the interest of the present tour operators and should involve consultation, approval and ultimately direct involvement and a share in the new enterprise.

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22. Opportunities

22. Opportunities

Gibraltar has the chance to improve its environmental profile at international and national levels by applying a set of strict rules and objectives that will ensure the protection and conservation of its flora and fauna, that will create awareness of environmental issues among the local population, promote sustainable tourism projects and ensure a rich, sound and healthy environment for future generations. This set of strict rules and objectives is arranged in a document known as an 'Environmental Charter'. The Charter is composed in a way that will suit the needs of the area to which it is applied, and is formulated by experts in the field to cover all environmental issues and their sustainable development, rural economic development and educational needs. In fact, environmental charters vary very little indeed from area to area or country to country, because the requirements of the natural environment and sustainable development are broadly similar everywhere, with very little variation. These Charters are applied by city councils, boroughs, municipalities and provinces in the United Kingdom and the rest of Europe and the World, and also by NGO's in Natural Parks, Nature Reserves and protected areas.

Two of these charters, the 'Environment Charter for the UK Overseas Territories' and the 'Europarc Charter' could form the basis of Gibraltar's Environmental Charter. In view of this, we have reproduced their main objectives and supplied some background information on these.

22.1 Overseas Territories Environment Programme

The Programme Memorandum for the Overseas Territories Programme was published in September 2003. It consists of a joint programme from the Department for International Development and the Foreign and Commonwealth Office to support the implementation of the Environmental Charters, and environmental management more generally, in the UK Overseas Territories.

This programme provides a source of funding for an action plan to implement the Environmental Charter that was signed jointly with HMG in September 2001. Gibraltar and the British Antarctic Territory did not participate as signatories in this Charter. This came at a time when the FCO was considering the joint sovereignty proposals, and the Chief Minister opted out as he wanted to make the point that Gibraltar is internally self-governing with regard to the environment. Even if the Gibraltar Government did not want to accept a 'mandate' from the UK, the principles of the Charter are sound and can still form part of the Gibraltar Government's own Environmental Charter (a manifesto commitment in the 2004 General Elections). We have therefore transcribed the Environmental Charter for the UK Overseas Territories into this document to provide the authorities with the opportunity to use these guiding principles as a way forward in our efforts to unite Gibraltar with sound environmental practices. This does not exclude Gibraltar from requesting funds, but it does put the onus on the Gibraltar Government to apply a sound and credible environmental policy across the whole of its territory.

ENVIRONMENT CHARTER FOR THE UK OVERSEAS TERRITORIES:

Guiding Principles

For the UK Government, the Government of Gibraltar and for the people of Gibraltar.

1) To recognise that all people need a healthy environment for their well-being and livelihoods and that all can help to conserve and sustain it.

2) To use our natural resources wisely, being fair to present and future generations.

3) To identify environmental opportunities, costs and risks in all policies and strategies.

4) To seek expert advice and to consult openly with interested parties on decisions affecting the environment.

5) To aim for solutions which benefit both the environment and development.

6) To contribute towards the protection and improvement of the global environment.

7) To safeguard and restore native species, habitats and landscape features, and control or eradicate invasive species.

8) To encourage activities and technologies that benefit the environment.

9) To control pollution, with the polluter paying for prevention or remedies.

10) To study and celebrate our environmental heritage as a treasure to share with our children.

Commitments

The Government of the UK will:

1) Help build capacity to support and implement integrated environmental management, which is consistent with Gibraltar's own plans for sustainable development.

2) Assist Gibraltar in reviewing and updating environmental legislation.

3) Facilitate the extension of the UK's ratification of Multilateral Environmental Agreements to benefit Gibraltar and which Gibraltar has the capacity to implement.

4) Keep Gibraltar informed regarding new developments in relevant Multilateral Environmental Agreements and invite Gibraltar to participate where appropriate in the UK's delegation to international environmental negotiations and conferences.

5) Help Gibraltar to ensure it has the legislation, institutional capacity and mechanisms it needs to meet international obligations.

6) Promote better cooperation and the sharing of experience and expertise between Gibraltar, other Overseas Territories and small island states and communities, which face similar environmental problems.

7) Use UK, regional and local expertise to give advice and improve knowledge of technical and scientific issues. This includes regular consultation with interested non-governmental organisations and networks.

8) Use the existing Environment Fund for Overseas Territories (now superseded by the joint FCO/DFID UK Overseas Territories Environment Programme), and promote access to other sources of public funding, for projects of lasting benefit to Gibraltar's environment.

9) Help Gibraltar identify further funding partners for environmental projects, such as donors, the private sector and non-governmental organisations.

10) Recognise the diversity of the challenges facing the Overseas Territories in very different socio-economic and geographical situations.

11) Abide by the principles set out in the Rio Declaration on the environment and development and work towards meeting the International Development Targets (superseded by the Millennium Development Goals) on the environment.

The Government of Gibraltar will:

1) Bring together Government departments, representatives of local industry and commerce, environment and heritage organisations, the Governor's office, individual environment champions and other community representatives in a forum to formulate a detailed strategy for action.

2) Ensure the restoration and protection of key habitats, species and landscape features through legislation and appropriate management structures and mechanisms, including a protected areas policy, and attempt the control and eradication of invasive species.

3) Ensure that environmental considerations are integrated within social and economic planning processes; promote sustainable patterns of production and consumption within the territory.

4) Undertake environmental impact assessments before approving major projects and while developing our growth management strategy.

5) Commit to open and consultative decision-making on developments and plans which may affect the environment; ensure that environmental impact assessments include consul-

tation with stakeholders.

6) Implement effectively obligations under Multilateral Environmental Agreements already extended to Gibraltar and work to the extension of other relevant agreements.

7) Review the range, quality and availability of baseline data for natural recourses and biodiversity.

8) Ensure that legislation and policies reflect the principle that the polluter should pay for prevention or remedies; establish effective monitoring and enforcement mechanisms.

9) Encourage teaching within schools to promote the value of our local environment (natural and built) and to explain its role within the regional and global environment.

10) Promote publications that spread awareness of the special features of the environment in Gibraltar; promote within the territory the guiding principles set out above.

11) Abide by the principles set out in the Rio Declaration on the environment and development and work towards meeting international development Targets (now superseded by the Millennium Development Goals) on the environment.

Many of these goals have been achieved through GONHS' own initiative. Some have been realised in collaboration with the Gibraltar Government, but GONHS, although clearly committed to the environment, has not got the resources or funding to continue to produce, support, advise or address environmental developments at the rate these developments arise. They are certainly not ignored, but are processed as and when they crop up, all within the limitations of the Society, which handles all these matters on a voluntary basis. The Gibraltar Government, although aware of the important contribution GONHS makes on environmental matters, should recognise the limitations and provide the necessary funding and resources, especially for the role played in advising, providing and assessing developments in the environmental field where the Gibraltar Government depends entirely on the expertise and knowledge base of the members of GONHS.

22.2 The EUROPARC Federation

The condition of the Upper Rock as a Nature Reserve and a nature protection area needs to be established as such. One European body that can help stimulate the authorities in attaining and sustaining a reasonable level that will help enhance, expand and improve the tourist product in relation to the natural environment within a sustainable environmental level is the Europarc Federation.

This opportunity is especially aimed at the Tourism Agency, since one of the key elements of the Europarc Federation has been the development of 'The European Charter for Sustainable Tourism in Protected Areas'. We should adopt this document and become candidate members of Europarc, and in the process learn from other Charter members about their problems, concerns and achievements from which we can further understand the meaning and practical use of the term 'sustainable tourism.'

This is not a question of making more money; we probably make more than most, if not all of the European Parks, Nature Reserves and protected areas. It is a question of values; our natural values, the quality of the environment and heritage, and the sustainable use and development of the same, in order to ensure that future generations of Gibraltarians will be able to enjoy and reap the benefits from Gibraltar's Upper Rock Nature Reserve and unique environment.

22.2.1 Europarc

The EUROPARC Federation was founded in 1973 and brings together a wide range of organisations and individuals involved in the policy and practice of managing parks and protected areas across Europe. Europarc believes that parks and protected areas can play a key role in conserving and enhancing the continent's natural and cultural heritage and in charting the path towards more environmentally sustainable lifestyles and approaches to development in society as a whole.

Their aims are to:

- *Facilitate the establishment of new parks and protected areas.*
- *Promote good practice in the management of such areas.*
- *Raise their profile as a vital means of safeguarding many of the continent's most valuable natural heritage assets and thereby increasing support for their future protection.*

• Influence the future development of public policies and programmes, at the international level, to the benefit of their objectives.

Membership of the Europarc Federation brings with it useful benefits. The Federation has access to information about parks and other protected areas and their management throughout Europe, which can be consulted and applied to the Upper Rock Nature Reserve. There is also the opportunity for a range of services for the exchange of experience and staff, enabling them to increase expertise and knowledge for daily work in protected areas. They facilitate the exchange of information on protected area management and natural heritage conservation between European and Worldwide organisations.

An interesting aspect of Europarc is the relationship of trans-border cooperation in conservation management. In certain parts of Europe some protected areas extend their boundaries into other countries and Europarc facilitates the protocols taken in conservation management across the entire area. In Gibraltar we do not have this problem, for the Nature Reserve falls entirely within the territorys' boundary. However, with the proposed 'Natural Park of the Straits', which is to include Northern Morocco and Southern Spain, and could also include Gibraltar, there might be a logical case for a non-political entity such as Europarc to assist in any future discussions of an environmental nature.

Europarc has identified a series of objectives, which we now copy for the benefit of the readers of this chapter.

1) to facilitate the exchange of expertise on management skills and management planning among protected area staff in Europe, through the organisation of workshops, seminars, study visits and staff exchanges.

2) to develop and implement a strategy for supporting trans-frontier protected areas across Europe.

3) to develop and implement a strategy for supporting protected areas in their management of tourism through the European Charter for Sustainable Tourism in Protected Areas.

4) to demonstrate and apply the wealth of experience of the EUROPARC membership in the management of sensitive landscapes to the management of Natura 2000 sites.

5) to influence the future of rural development policy in the EU to reflect the experience of the membership in reconciling nature conservation with socio-economic objectives.

6) to maintain a system of publications, reviewed periodically to assess its effectiveness. This shall include regular information bulletins / newsletters (3-4 per year), topical reports and conference / seminar reports.

7) to develop a network of EUROPARC websites, with benefit (if possible) of commercial sponsorship.

8) to organise an Annual General Assembly and Conference.

9) to promote active cooperation and partnership between protected areas within Europe and also, where appropriate, with counterparts in other continents.

10) to set up and maintain a database of members and protected area experts.

11) to disseminate specialised information on protected area management through a suite of topic networks.

Although many of these objectives do not apply to Gibraltar (as in the case of the rural development policy) it would be of great benefit if the management of the Nature Reserve formed part of this network of European parks, protected areas and Nature Reserves, and more importantly adopted 'The European Charter for Sustainable Tourism in Protected Areas'. Here, again, we have taken the liberty to detail the background, statute and aims of the Charter.

22.2.2 The Charter's framework

The European Charter for Sustainable Tourism in Protected Areas reflects worldwide and European priorities, as expressed in the recommendations of Agenda 21 adopted at the Earth Summit in Rio in 1992, and by the European Union in its 6th Environment Action Programme and Strategy for Sustainable Development. The Charter belongs to the

EUROPARC Federation, the umbrella organisation of protected areas in Europe. It was developed by a European group representing protected areas, the tourism industry and their partners, under the EUROPARC umbrella, and builds on the recommendations of EUROPARC Federation (2001). The Charter was one of the priorities defined in the World Conservation Union's action programme for protected areas in Europe, "Parks for Life" (1994). The growing importance of sustainable tourism development as an area of international concern has been underlined by the recent elaboration of "International Guidelines for Sustainable Tourism" under the Convention on Biological Diversity. The European Charter directly addresses key principles of these International Guidelines, and represents a practical tool for their implementation at the regional level of protected areas.

22.2.3 Implementing the concept of sustainable development

This Charter promotes implementation of the concept of sustainable development, i.e. "development that meets the needs of present generations, without compromising the capacity of future generations to meet their needs" (Bruntdland Report). This form of development involves the preservation of resources for future generations, viable economic development and equitable social development.

The European Charter for Sustainable Tourism in Protected Areas is a valuable and practical tool for ensuring that tourism development in Europe's protected areas is sustainable. In becoming members of the Charter, protected areas demonstrate that they are cooperating to a high level with local stakeholders and tourism partners to address strategic tourism issues, and receive official recognition for their achievements in this field. At the same time, in joining the Charter they are making a 5-year commitment to further that cooperation, to implement agreed joint actions with their partners, and to continue striving for excellence in the management of tourism in their regions. The European Charter is thus neither a conventional quality label, nor a conventional partnership agreement, but combines elements of both to encourage and support a truly sustainable development of tourism in Europe's protected areas.

22.3 The Charter

Developing tourism in protected areas according to the principles of sustainable development

The underlying aims of the European Charter for Sustainable Tourism are:

• To increase awareness of, and support for, Europe's protected areas as a fundamental part of our heritage, that should be preserved for and enjoyed by current and future generations.
• To improve the sustainable development and management of tourism in protected areas, which takes account of the needs of the environment, local residents, local businesses and visitors.

A small Charter, you might think, with one statute and two aims that can easily be achieved by Gibraltar. However, the realisation of this charter comes at a price, and the price to pay is the implementation of, not only all the key goals and objectives in our management plan, but the execution of the key tourism objectives listed below as required by the Charter.

1. To protect and enhance the area's natural and cultural heritage, for and through tourism, and to protect it from excessive tourism development, by:

- *monitoring impact on flora and fauna and controlling tourism in sensitive locations.*
- *encouraging activities, including tourism uses, which support the maintenance of historic heritage, culture and traditions.*
- *controlling and reducing activities, including tourism impacts, which: adversely affect the quality of landscapes, air and water; use non-renewable energy; and create unnecessary waste and noise.*
- *encouraging visitors and the tourism industry to contribute to conservation.*

2. To provide all visitors with a high quality experience in all aspects of their visit, by:

- *researching the expectations and satisfaction of existing and potential visitors.*
- *meeting the special needs of disadvantaged visitors.*
- *supporting initiatives to check and improve the quality of facilities and services.*

3. To communicate effectively to visitors about the special qualities of the area, by:

- *ensuring that the promotion of the area is based on authentic images, and is sensitive to needs and capacity at different times and in different locations.*
- *providing readily available and good quality visitor information in and around the area, and assisting tourism enterprises to do so.*
- *providing educational facilities and services that interpret the area's environment and heritage to visitors and local people, including groups and schools.*

4. To encourage specific tourism products which enable discovery and understanding of the area, by:

- *providing and supporting activities, events and packages involving the interpretation of nature and heritage.*

5. To increase knowledge of the protected area and sustainability issues amongst all those involved in tourism, by:

- *providing or supporting training programmes for staff of the protected area, other organizations and tourism enterprises, based on assessing training needs.*

6. To ensure that tourism supports and does not reduce the quality of life of local residents, by:

- *involving local communities in the planning of tourism in the area.*
- *ensuring good communication between the protected area, local people and visitors.*
- *identifying and seeking to reduce any conflicts that may arise.*

7. To increase benefits from tourism to the local economy, by:

- *promoting the purchase of local products (food, crafts, local services) by visitors and local tourism businesses.*
- *encouraging the employment of local people in tourism.*

8. To monitor and influence visitor flows to reduce negative impacts, by:

- *keeping a record of visitor numbers over time and space, including feedback from local tourism enterprises.*
- *creating and implementing a visitor management plan.*
- *promoting use of public transport, cycling and walking as an alternative to private cars.*
- *controlling the siting and style of any new tourism development.*

22.4 Recommendations

It is our opinion that the implementation of the key issues set above, as part of the requirements of the Charter, can only serve to improve and benefit the state of play of the Upper Rock Nature Reserve. At the present moment these objectives are not achievable. Only through a conscientious and programmatic approach of the implementation of the Management Plan will the Upper Rock Nature Reserve be in a position to embark upon the objectives set out, specifically aimed at a sustainable tourism product.

Government will have to reconfigure their tourism strategy for the Upper Rock once the management plan is in operation. Amongst some of the key issues we have identified are:

- Quality of the product.
- Value for money.
- Consideration for the environment.
- Regulation of visitors.
- Regulation of vehicles.
- Pollution control.
- Transport policy.
- Credible infrastructure for environmental management and conservation issues.
- Interpretation centres for nature and heritage.
- Publications, specific or otherwise.
- Educational needs.
- Improved sanitary conditions.

When the management plan has been in operation for a few years and the major issues of the Upper Rock Nature Reserve and other environmental issues around Gibraltar have been addressed, then the authorities will be in a position to be able to adopt an Environmental Charter. Once this is in operation, the management of the Nature Reserve should apply for candidate membership of the Europarc Federation and adopt their charter for sustainable tourism. All this will result in the application of a sound environmental strategy throughout the territory of Gibraltar, and provide future generations with opportunity to enjoy the benefits of a clean, healthy and sound environment.

References

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- **EUROPARC-Spain (2002)** *Action Plan for the Protected Natural Areas of the Spanish State.* Madrid, Spain: Fundación Fernando Gonzàlez Bernàldez. 168pp.
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23. Management Plan

23. Management Plan

Gibraltar is unique in that about 40% of its surface area is designated a Nature Reserve. The unique topography and the Barbary macaques are without doubt the prime attractions enticing vast numbers of tourists to the Rock. This has created an economic source for the Government of Gibraltar that is of great benefit to the community as a whole. This must clearly continue. Yet we must not forget the unique environment that provides us with these benefits. The environmental integrity of the Upper Rock is not without its threats and challenges, and this could, and is, seriously affecting the stability of the Nature Reserve. It is our opinion that the way forward is a Management Plan that adopts a pragmatic approach, enabling the Nature Reserve to develop in a sustainable manner by combining economic interests together with the clear environmental requirements. This plan and its supporting chapters encompass the first step towards a self sustainable Nature Reserve that should benefit future generations of the people of Gibraltar for years to come.

23.1 Structure

To enable us to clearly understand the requirements necessary for the creation of a suitable structure in the development of the management plan for the Upper Rock Nature Reserve, several documents were consulted. Some of these, like the 'Environmental Management Plan for Seychelles' (2000), and the 'Falklands Conservation Five Year Plan 1999-2004' (1999), encompass whole territories composed of several islands, and include thematic areas in marine resources, agriculture, energy etc. These areas have no bearing on our Reserve. However, other thematic areas have similar environmental pressures and problems, e.g., invasive species, environmental sustainability, biodiversity, land use, etc. Other plans, like the 'Nature Conservation Management Plan for Predannack Airfield' (1999), are of a smaller nature but with similar problems that are addressed in a comparable fashion. Some include tourist development programmes whereas others have military constraints within their location and these were chosen because of the similarities in environmental, ecological, and touristic pressures, and other aspects of use that these areas have with Gibraltar.

At a local level, the 'Biodiversity Initiative: Gibraltar. A Case for Maintaining Biodiversity' by GONHS (1994) was consulted. This provided us with a background to the structure of the environmental aspects of the management plan. Finally the 'Upper Rock Nature Reserve. An Environmental Impact Assessment Report 2002' by C.E. Perez (2002), highlighted details and provided suggestions for the improvement of the Upper Rock Nature Reserve. This proved fundamental in the composition of the programmed approach to much of the management plan.

23.2 Proposed Plan Implementation

23.2.1 Institutional Arrangements and Composition

The Upper Rock Nature Reserve requires the input of several different Government departments, institutional bodies, businesses and entities (i.e., stakeholders), all of which have either vested interests or participate in one way or another in the use, repairs, maintenance and general condition of the area. These are:

- Gibraltar Tourist Board: currently responsible for the sites and the whole of the Nature Reserve
- Ministry for the Environment: should be responsible for the Nature Reserve other than the sites, ticket sales, etc.
- MOD: still own and control a large portion of the Upper Rock, until these are passed over to the Gibraltar Government
- GONHS: acts as consultant on environmental matters, and actively participates in research on all environmental aspects of the Reserve, including macaques, bats in caves, etc. Also responsible for the feeding and management of the macaques
- Heritage Trust: historical heritage found within the Reserve
- Gibraltar Museum: archaeological and historical heritage found within the Reserve
- M.H. Bland: the Cable car and Bland and Calypso tour buses
- Taxi Association: taxis and Persian Rose tour buses
- City Fire Brigade: fire hazards and maintenance of water tanks, fire hydrants, ancillary equipment, etc.
- Royal Gibraltar Police: security, wildlife liaison officer and enforcement of Nature Protection Ordinance
- Support Services: highways repairs, maintenance and sewerage

and to a lesser extent,

- Land Property Services: as the management company for the Upper Rock residents
- Housing Department: representing the residents at Poca Roca
- GONHS Caving and Climbing section: activities within the Reserve and additional backing for cave digs and rescues
- Gibtelecom: telephone lines, aerials, etc.
- Aquagib: water supply and pipelines
- Environmental Agency Ltd.: pest control
- Gibraltar Scout Association and Gibraltar Girl Guide Association: camps located within Reserve
- and of course, the general public.

23.3 Proposal 1

1) Based on our findings and the situation at present, the authors believe that the best management system for the Upper Rock Nature Reserve is one that must work independently from any governmental constraints, but in keeping with governmental policy and programme of works, where the contractors would be paid a percentage of the takings to allow the economic means to provide the maintenance, repairs, improvements, stability and well-being of the rest of the Nature Reserve.

2) Management policy and works programmes for the Upper Rock Nature Reserve should be developed by a newly constituted Board of Management made up of the main stakeholders, who would have direct input on decision making and formulation of policy, dealing with subjects other than that related to the tourist sites (where these have no direct bearing on the Nature Reserve).

3) This would release the Gibraltar Tourist Board to concentrate and diversify on the Upper Rock sites and other aspects of tourism that would complement the efforts made by the management company for the Upper Rock Nature Reserve, thereby increasing the overall potential and benefits for the community as a whole.

4) Responsibility for policy on tourism and transport on the Upper Rock and including the sites would fall under the Ministry for Tourism and Transport and the Gibraltar Tourist Board, whereas responsibility for policy on the environment and other matters relating to the Upper Rock Nature Reserve would fall under the Ministry for the Environment.

5) There should be close and regular liaison between the Tourist Board and the Upper Rock Board of Management.

23.4 Proposal 2

1) The Government of Gibraltar to maintain overall responsibility for the administration and management of the Upper Rock Nature Reserve, under the management structure proposed below.

2) The Government, within the Ministry for the Environment, to set up a 'Board of Management' of the Upper Rock Nature reserve, to be constituted from the departments, organisations, institutional bodies, etc., as listed in the 'Institutional Arrangements and Composition' paragraph (23.21). Not all of these need representation, for many have only but a small role, but should be consulted whenever necessary.

3) The Board to formulate policy, provide advice and guidance and act as arbitrators in cases of conflicts or disagreements regarding implementation, funding or programme proposals and/or formulation.

4) The Board of Management to liase with both the Ministry for the Environment and the Gibraltar Tourist Board, both of which would have representation on the board. These two departments, working together, should provide the 'Secretariat', as they are ideally suited to providing the logistical and secretarial support to the Board. This to involve administrative support in monitoring, co-ordination, reviews and implementation of policy decisions.

5) The Board of Management to employ a Manager that would organise and implement the policy decisions, works programmes and recommendations arrived at by the Board.

In both Proposal 1 and 2, the Government, may decide to engage, though its Board of Management, a Management Body, a competent firm or organisation to carry out the latter's policies and to act as the Executive of the Board in management, etc. This role would be roughly equivalent to that carried out by the "Director Conservador" of an Andalusian 'Parque

Natural'. It would involve generating ideas for the Board to consider, keeping up to date with Directives and other international initiatives, and implementing the policies.

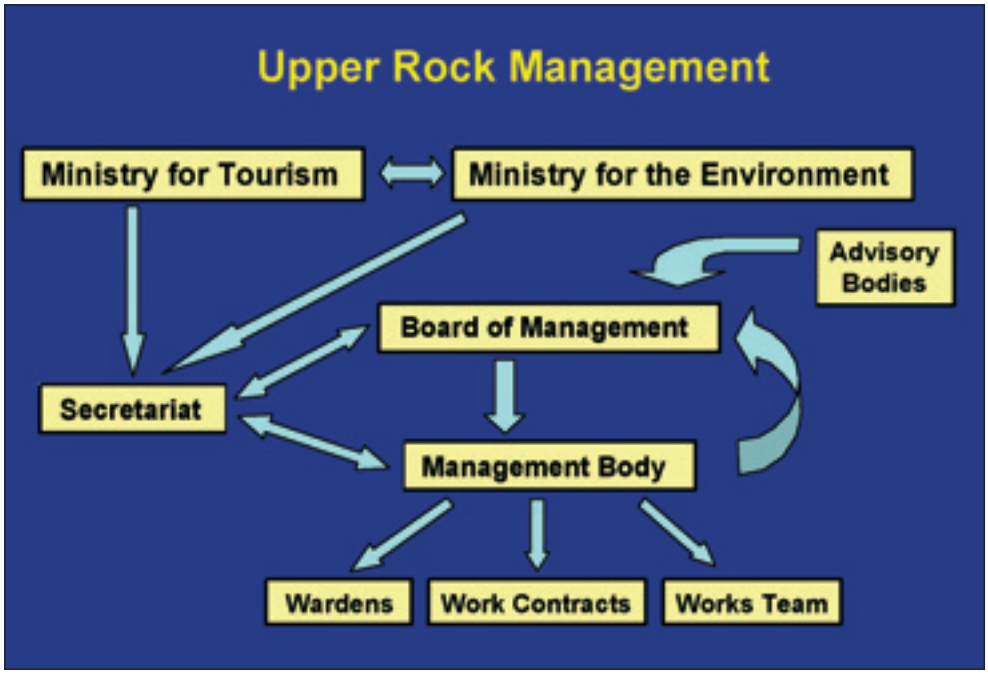

Figure 1. Management structure for Proposal 2.

23.5 Division of Responsibility

In our scheme, the Ministry of Tourism and Transport would be the Agency with responsibility for all existing and future tourist sites. This should include the ticket offices at entry to the Reserve and the control of traffic at Jews Gate and St. Michael's cave and any other points thereafter including security on the Rock, especially after hours at the Moorish Castle entry point. The Ministry has adequate experience dealing with these sites in the past, and is therefore ideally suited to maintaining the product from a tourism perspective.

Similarly, the Ministry of the Environment would be the Agency with responsibility for all environmental matters within the Upper Rock Nature Reserve, including the Barbary macaques. This should include heritage, highways, cleaning and other related subjects. The environment and heritage on the Upper Rock has long been neglected and this Ministry's remit is adequate in incorporating and addressing those needs whilst allowing the Ministry for Tourism to tackle the tourist product, and consulting the Ministry for Heritage where necessary. It is wise that this Ministry should have taken over the Barbary macaques as one of its responsibilities since, although directly related with the tourism, the requirements for the management and feeding of these animals, as well as the interaction and impact they have on their surroundings, falls better under an environmental department rather than a tourism directed one.

The monies collected for entry into the Upper Rock Nature Reserve and the sites should be administered by the Board of Management of the Nature Reserve. An 'Annual & Recurrent Works Programme' including a financial breakdown of recurrent expenditure would be submitted by the Ministry for the Environment, re environmental management, etc, and the Ministry for Tourism re management of sites, security etc. The Management Body would manage this through the Management Board.

23.6 Implementation Methods

23.6.1 Implementation

The Board should establish an 'Annual Works Programme' elaborated by the management body based on the programmes presented in the Management Plan. Financing and implementation agreements would form the basis of the implementation.

23.6.2 Workforce

The workforce of the Upper Rock Nature Reserve to be composed of a habitat and environmental management workforce of 10-12 persons and a contingent of 6 wardens.

23.6.3 Management

The Board of Management would employ a Manager who would organise and implement

the policy decisions, works programmes and recommendations arrived at by the Board. He would have, under his authority, the Habitat Management work force and the Wardens contingent. The Manager would monitor progress of all works programmes, and report back to the Board on a regular basis.

23.6.4 Monitoring and Review

The structure of the Management Plan dictates that it is reviewed annually so that the elaboration, implementation and revision of the programmes can take place. The Secretariat should work with the Management Body that would submit new programmes for the Management Plan. These programmes are to be reviewed by the Board. Continuous monitoring is of critical importance for the success of the Plan and would be the mandate of the Secretariat.

23.6.5 Reporting

Implementing Agencies to supply aspects of the development of programmes and implementation to the Secretariat on a regular basis, which in turn would report to the Board of Management.

23.6.6 Public Relations & Perception

The Secretariat to hold briefing sessions with other interested organisations and public bodies to invite participation and suggestions to the Plan in the form of new programmes and initiatives. It is recommended that information on the development of programmes is made available to the public on a regular basis, namely through press releases, media coverage or even in the form of a newsletter.

23.6.7 Financing

The costs for the annual maintenance, repairs and improvements and the development of the Nature Reserve, including staff costs, should be provided by the entrance fees. Capital and emergency expenditure for large projects, e.g., road widening, installation of sanitation facilities and infrastructure, etc., should be borne in full by the Gibraltar Government as part of the improvements to the Nature Reserve under the ''Gibraltar Development Plan' (1991), subject to approval by the Development & Planning Commission, after an environmental impact assessment has been carried out.

Chapter 24, 'Action Plan', includes a specific breakdown of the costs required as part of the Management Plan, and includes recurrent expenditure. Financial details are approximate and based on current rates at the time of the publication of this document.

23.6.8 Future Improvement

To ensure the success of the Management Plan it is crucial that the Secretariat implement a training and facilitation programme for sectors needing this type of improvement, expertise and skills. In this respect it is important to build partnerships with organisations, especially GONHS, the Heritage Trust and the Gibraltar Museum who have the knowledge and skills, in their respective fields that are capable of supporting and improving the programmes in the Management Plan.

23.7 Principles

The strategy that has to be pursued should integrate the following core principles:

• Integration of factors

The realisation that social, economic and natural systems are really part of the greater environment as a whole.

• Ecological Integrity

The productivity, health and diversity of the ecosystems of the Upper Rock have to be restored.

• Continual Improvement

The need for a constructive approach towards evaluating and improving the product from a tourism, historical and environmental perspective.

• Focus

Adopting a programmatic approach to facilitate an ongoing continual improvement around sustainable management.

• The Precautionary Principle

The recognition that the environment is complex and extremely diverse requires a conservative approach to developments with unknown consequences.

• Future Development

Strategies to encourage the sustainable development and interests of environmental, historical and touristic programmes.

23.8 Goals and Objectives

A number of important goals have been identified and these are supported below by a series of objectives (in italics) that will help implement and achieve these aims. Some of these goals are already in the implementation stage and only require continual monitoring, whereas others can only be achieved through specific training and education to meet the necessary skills to accomplish these targets. A number of programmes have been devised to run on a continual basis with constant revision and monitoring. As the implementation of the programmes and objectives develop, new goals will be identified and so the process of managing the Upper Rock Nature Reserve will be achieved through mutual collaboration between the secretariat and implementing agencies, and the continual renewal and appraisal by the Board of Management.

1) Establish and maintain the biodiversity and ecological integrity of the Upper Rock Nature Reserve and ensure the sustainable capacity of core life support systems.

1.1 Programme to establish the biodiversity of the flora and fauna of the Nature Reserve in keeping with the mandate of the 'Biodiversity Convention'[1]. Once there is a better understanding of the ecosystem, a strategy can be developed to protect specific areas and implement environmental impact assessment procedures and laws. This report goes some way towards achieving this aim.

1.2 Programmes to facilitate the rehabilitation of ecosystems that have been damaged as a result of human activity.

2) Build active partnerships and sound public involvement between the Gibraltar Government, the private sector and society in general in order to foster co-responsibility for the environmental management of the Reserve and the environment of Gibraltar.

2.1 Programme for involving all sectors of society (NGO's, Government, private sector, schools) to participate and co-operate in the environmental management and use the resources more effectively.

2.2 Programme to facilitate and encourage the participation of the Gibraltar Government, NGO's, businesses and the general public to sponsor biodiversity projects and actively foster conservation.

3) To fulfil and implement international directives and responsibilities as part of the Member State, the UK, in recognition of the fact that Gibraltar, at the crossroads of two continents and two seas plays a vital role in the conservation of ecosystems in the region.

3.1 Ensure that Natura 2000, the Biodiversity Convention, the Bonn Convention, the World Heritage Convention, Eurobat, the EC Birds Directive and the EC Habitats Directive are implemented with the designation of the sites.

3.2 Establish the requirements of all Directives and prepare the groundwork for the implementation of the same including special areas of conservation (SACs).

3.3 Prepare the financial budget to solicit community-funding sources (i.e. LIFE, Structural funds, Leader) for the implementation of the said Directives.

3.4 Ensure that Gibraltar is consulted when relevant Directives and other international instruments are being drafted or revised.

4) Develop programmes to effectively establish sustainable measures in the area of environmental management.

4.1 The establishment of an environmental management unit of 10-12 persons to effectively tackle habitat succession, pathways, firebreaks, and invasive species.

4.2 Programme for the training and management of personnel employed in key areas of environmental habitat management.

5) Establish the control and eradication of invasive species.

*5.1 Programme for the identification, and location of key invasive species and a strategy of eradication using environmentally friendly means and devices (*see *Chapter 8).*

5.2 A public perception programme on the damage invasive species can and do cause, especially aimed at the residents of the Reserve.

6) Develop a re-introduction programme of fauna and flora beneficial to the Nature reserve.

6.1 Establish a programme of co-operation with local and international NGO's and other

[1] 'The Gibraltar Biodiversity Project' launched in Jan. 2004 by GONHS.

bodies to grow all endemic and near endemic plants and indigenous tree species of Gibraltar, with a view to replanting and re-introducing these.

6.2 A programme to introduce the Spanish ibex, Barbary sheep and roe deer with 1) the view of enhancing the tourist product, and more importantly 2) as a means of controlling the vegetation in specific areas, with these grazing and browsing animals.

7) Develop a conservation action plan for the MOD land within the reserve.

7.1 A conservation action plan for MOD areas was published in 2003 by GONHS (Bensusan & Perez 2003).

7.2 Monitor the implementation of the suggestions in the MOD action plan, even once current MOD sites pass into Government custody, and revise and review where appropriate.

8) Continuously reconfigure and develop the strategies for the population control of the yellow-legged gull and control and management of the Barbary macaque, based on recent research.

8.1 Analyse past gull-control strategies and reconfigure to incorporate recent trends and population distribution.

8.2 Develop a population control strategy for Barbary macaques based on recent research, but also on the requirements of the Reserve in keeping with sound environmental practices.

8.3 Take into consideration all the recommendations and suggestions that were discussed at the 2003 conference 'The Barbary Macaque: Comparative and Evolutionary Perspectives'.

9) Establish and implement guidelines for a sustainable management policy for the Barbary macaques.

9.1 Continuously reassess adequate group size and numbers to enable efficient management strategy.

9.2 Establish interpretation centres at key locations to inform and educate the general public and promote the Barbary macaques.

9.3 Establish a sound and practical working relationship with the veterinary authorities to ensure the welfare of the macaques.

10) Establish a cave management and conservation programme.

10.1 Constitute the establishment of a cave management plan with suggestions and recommendations from, and through the involvement of, organisations and bodies with a legitimate interest in caves.

10.2 Establish the biodiversity of cave habitats and initiate programmes to research and conserve our cave ecology.

10.3 Establish guidelines for non-environmentally intrusive archaeological digs in caves, and insist on environmental impact assessments before the same may proceed.

10.4 Increase public awareness and understanding of the value of our caves and promote these concepts through publications, lectures and school curricula.

11) Develop a conservation strategy and management programme for all historical constructions and heritage on the Upper Rock.

*11.1 Programme to identify all the historical sites, together with a management plan for the same (*see *Chapter 7).*

11.2 Programme to develop key historical sites with tourism in mind, including improvements to existing ones.

11.3 Ensure the co-operation of implementing agencies with the environmental lobby to guarantee that the conservation strategy and management plan for heritage, encompasses an environmental impact assessment.

12) Reconfigure and develop new strategies for the tourist product.

12.1 Programme for the enhancement of existing and development of new tourist sites on the Upper Rock.

12.2 Programme to incorporate new technological advances to improve the tourist product, re: sound, vision and robotics.

12.3 Restructuring of the façade of all tourist sites using environmentally friendly material and methods.

13) Establish commercial concessions at the tourist sites with the vision of re-investing a percentage back into the Nature Reserve.

13.1 The development of commercial concessions at key sites should form part of the sustainable development plan for the Nature Reserve.
13.2 Encourage articles and publications of a historical and environmental nature appertaining to the site, to be the key elements on sale.

14) Establish adequate informative plaques and signs at key tourist sites and at strategic locations around the Nature Reserve.

14.1 Installation of plaques with suitable graphical information appertaining to the site in question, preferably in several languages, or utilising self-explanatory graphic symbols.
14.2 Installation of plaques with suitable graphical information at either end of pathways indicating the route, average time of the walk and specific features of natural and historical heritage the walker may encounter.

15) Establish ways to develop and promote Eco-tourism, in keeping with the natural environment.

15.1 Programme for the development of an eco-tourism pathway network and management resource.
15.2 The establishment of interpretation centres at key points, i.e., Apes' Den, Mediterranean Steps, Princess Caroline's Battery, etc.
15.3 The marketing and promotion of the products of the Nature Reserve focusing on the sustainable management of the same.

16) Establish proper environmental research facilities and promote the use of our resources efficiently.

16.1 Programme to build on the promotional efforts by GONHS and existing infrastructure, and establish and equip present and future research facilities with increase in demand.
16.2 Programme to encourage the use of research facilities for local educational needs.
16.3 The establishment of lines of communication and a common forum between research and management bodies.

17) Develop and augment more effective environmental public information and education.

17.1 Build on the increasing environmental information that would be available through the many programmes that will be pursued in this plan and develop the same through press releases, frequent publications and with environmental education curricula in mind.

18) Develop a competent transport system, capable of adequately conveying large numbers of people, quickly, silently and with a minimal impact to the environment.

18.1 Encourage the participation of all tour operators i.e., (Gibraltar Taxi Association, Persian Rose, Parodytur, M.H. Bland Ltd) in discussions to find an amicable solution to the traffic and transport problems encountered in the Nature Reserve.
18.2 Programme for the development of an environmentally friendly system of transport to be used efficiently taking into consideration the economic interests of <u>all</u> tour operators.

19) Limit the emission of greenhouse gases and other air pollutants in the Nature Reserve.

19.1 A programme to encourage and if possible enforce the use of 'Bio diesel' or similar non-polluting fuel, for public service vehicles.

20) Minimise the adverse impact of highways infrastructure on the environment.

20.1 Encourage a programme of road maintenance and resurfacing, at a suitable time of the day and year, which will cause minimum impact to the environment and to users and residents of the Nature Reserve.
20.2 Establish objective communications with appropriate agencies for an environmental impact assessment before works are approved. This to include works commissioned by the Gibraltar Government.
20.3 Encourage the use of low maintenance road surfaces, which will allow unimpeded traffic flow.
20.4 Establishment of a programme for the replacement of road railings using environ-

mentally friendly materials, and/or those materials with an aesthetic appeal in a Nature Reserve.

20.5 Encourage the implementing agency to review their highways strategy in the Nature Reserve on an annual basis.

21) Ensure that proper sanitation facilities are constructed at key locations and guarantee that wastewater disposal and infrastructure is effectively and discretely located.

21.1 Identify those key locations and assess the environmental impact that these constructions will have.

21.2 Ensure constructions are built with and utilise environmentally friendly materials and blend in with their surroundings.

21.3 Ensure that wastewater disposal and related infrastructure is located effectively and discretely and safeguard the environment from the possibility of pipeline bursts.

21.4 Insist on the usage of potable water in sanitation facilities, as this will have a minimal impact in case of pipeline burst or water seepage.

22) Establish a proper refuse collection strategy to include peripheral areas, pathways and picnic sites.

22.1 Provide key tourist and picnic sites with adequate refuse bins that are aesthetically and environmentally suited in a Nature Reserve.

22.2 Provide key Barbary macaque sites with monkey proof refuse bins that are aesthetically and environmentally suited to a Nature Reserve.

22.3 Establish a unit to clean peripheral areas, slopes, pathways, caves and picnic sites, with environmental sensitivity in mind.[2]

22.4 Encourage training and environmental management skills of unit personnel to achieve the aims of 21.3.

23) Encourage the establishment of an 'Upper Rock Disaster Exercise', with the corresponding agencies, to effectively assess the 'Upper Rock Disaster Plan' and test accessibility, suitable fire prevention infrastructure, evacuation measures and back up.

23.1 Establish with the relevant agencies an adequate network of fire hydrants, water tanks and related equipment on the Upper Rock.

23.2 Emphasise the use of potable water to extinguish fires within the Nature Reserve.

23.3 Insist on the establishment of an annual firebreak maintenance programme, which could operate in conjunction and collaborate with the proposed environmental maintenance and habitat management bodies.

23.4 Seek the cooperation and services of the 'INFOCA' fire-fighting hydroplanes from the 'Agencia de Medio Ambiente de Cádiz' in the event of a catastrophic fire.

24) Seek the establishment of a permanent police presence, e.g., Wildlife Liaison Officer, patrols and Warden facilities to monitor and establish the enforcement of the 'Nature Protection Ordinance, 1991'.

24.1 Implementation of the post of 'Warden' as stipulated in the 'Nature Protection Ordinance, 1991' (L/N 11).

24.2 Establishment of a permanent police presence on the Nature Reserve, together with regular patrols both day and night.

24.3 Active participation from the law enforcement authorities, Wardens, implementing agencies, environmental organisations, tour operators and members of the public to foster good environmental behaviour and ensure the nature protection laws are upheld.

25) The establishment of a Biological Reserve in the enclosed area known as Rock Gun and Middle Hill.

25.1 Establish the Biological Reserve, as an area restricted to the public, where the development of scientific research will not be tainted by visitor pressure or interaction.

25.2 Establish an administrative body of scientists to manage the Biological Reserve for the purpose of research into Gibraltar's fauna and flora and for containing and maintaining populations of Gibraltar's endangered species of wildlife, with the intention of re-introduction to other areas of the Upper Rock Nature Reserve.

25.3 Promote local and international scholars to participate in the research of the fauna and flora within the Biological Reserve and continue to encourage primate researchers with their on-going studies into the macaques.

25.4 Establish the proposed introduction programme of Spanish ibex and/or Barbary sheep, and roe deer within the Biological Reserve, as discussed in 6.2.

[2] A unit from 'Master Services' commenced removal of refuse from cliffs in the summer of 2003.

25.5 Authorise small, guided groups of visitors to the Biological Reserve only under strict supervision, preferably by the Warden who would be able to inform on the work being carried out there.

25.6 Continue the collaboration of researchers with GONHS, and the use of GONHS' Research facilities at Bruce's Farm.

Courtesy Gibraltar Tourist Board

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24. Action Plan

24. Action Plan

The Upper Rock Nature Reserve has largely been allowed to fall into a state of neglect. Since the actions required to improve the Reserve and raise this to the level of most Western European Nature Reserves and Tourist Sites are numerous and expensive, we have divided actions into three main categories according to their level of priority. These are given below.

Red = High Priority
Blue = Medium Priority
Green = Low Priority

The cost of carrying out all of the actions costed below is an estimated £363,755, plus £250,000 *per annum* (based on approximate estimates for 2004). It would be unrealistic (but nevertheless highly desirable) to carry out all of these actions in a year, from the point of view of both financial and workforce constraints. Therefore, those given a high priority should be acted upon first. Actions with a lower level of priority should not be neglected, but tackled as soon as high priority actions have been carried out.

1. Legislation

This section includes some proposed amendments to the 'Nature Conservation Area (Upper Rock) Designation Order'. The legal draftsman involved in making these amendments should work in close consultation with the GONHS to ensure that the resulting legislation is satisfactory.

Table 1.

Action	Requirement	Cost (£)
1.1.	The establishment of a team of a minimum of six Wardens	15000 p.a., p.p.
1.2.	Ongoing programme for the eradication of feral cats within the Nature Reserve	tackled by 1.1.
1.3.	Eradication of feral goats	subject to method
1.4.	Removal of chicken runs and poultry within the Nature Reserve	removed by owners

1.5. Legislation to be drafted to state that money generated through admission is to be spent on the Nature Reserve, and exactly how this money is to be spent on the Upper Rock. Some of these funds must go towards the conservation of the Reserve's natural history and heritage.

1.6. The management of the Nature Reserve to be the responsibility of the Ministry for the Environment. The Ministry for Tourism and Leisure to be responsible only for the management of the tourist sites, namely St. Michael's Cave, O'Hara's Battery, the Upper Galleries, Princess Caroline's Battery, the 'City Under Siege' exhibition and the Moorish Castle.

1.7. Amendment of the Designation Order to include a section or sub-section on obstruction of roads by cars, particularly taxis and coaches (at places such as St. Michael's Cave and Prince Phillip's Arch).

1.8. Proper enforcement of the law to reduce the excessive use of horns and loud music by vehicles.

1.9. Restriction of all traffic on upper roads (i.e., beyond St. Michael's Cave), unless the reason for use is consistent with wildlife conservation aims, Nature Reserve staff requirements or emergency and essential vehicular use.

1.10. Residents of the Upper Rock Nature Reserve to be issued with a disc that is to be displayed on windscreens, authorising access through Willis's Road after closing time.

1.11. Amendment of Designation Order to stipulate new closing and opening times, and set these at 07:00hrs and 22:00hrs during the change to summer time at GMT+2 and set at 07:00hrs and 20:00hrs during the change to wintertime at GMT +1. Opening and closing times to be known as the 'specified time'.

1.12. Barrier at the Moorish Castle to remain down after the specified time. Access to be granted only if the driver of the vehicle requesting entry is a resident with a valid Upper Rock Nature Reserve disk, or guest of the same and produces proof of permission or identity and specifies location or residence where he/she will be visiting. In this last case, visitors are only to be allowed to proceed after the Security Guard confirms destination via a phone call to the residence in question. In addition, persons may be granted permission if access is compatible with the needs/aims of the Nature Reserve. In this case, documentary evidence must be produced.

1.13. No person without permission to remain within the Nature Reserve after the specified time.

1.14. Gates at Engineer Road and Lathbury Barracks to be closed at the specified time.

1.15. Amendment of Designation order to stipulate that tour operators be held responsible for the actions of their clients in relation to macaques and litter.
1.16. No building or structure to be erected within the Upper Rock, without prior approval from the Board of Management, and then only for the purposes of the administration and conservation of the Nature Reserve, or the enhancement of existing and future tourist sites.
1.17. Section 6.(1) of the Designation Order to be amended to include the phrase, '…except with the prior written consent of the Authority, *in consultation with the Nature Conservancy Council*…'
1.18. Policies within 'The Gibraltar Development Plan' pertaining to the integrity of the Upper Rock as a Nature Reserve to be included within the 'Nature Conservation Area (Upper Rock) Designation Order'.
1.19. Designation Order to be amended to include a detailed account of the Wardens' authority.
1.20. Designation Order to be amended to replace the term 'Wild Life Warden' with 'Wildlife Warden'.
1.21. All sections or sub-sections of the Designation Order which do not already do so to be amended to include the words '…after consultation with the Nature Conservancy Council,' when a decision is to be made by the Governor.
1.22. Restriction on access to caves holding roosting and/or breeding bats. Access to be granted only by the Cave Management Committee.
1.23. Natural areas that are important as feeding sites for bats to be protected in accordance with Council Directive 92/43/EEC. This to include sites outside the Nature Reserve boundary.
1.24. Amendment of section 5.1 of the Designation Order to prohibit the feeding of exotic and/or introduced species within the Nature Reserve.
1.25. Amendment of the Designation Order, so that the term 'wild animal' be replaced by the terms 'indigenous fauna' and 'introduced fauna'.
1.26. Residents who keep pets within the Nature Reserve to apply and obtain a valid licence for these pets, in accordance with the Designation Order.
1.27. Designation Order to be amended to include a 'buffer zone' around the boundary of the Nature Reserve.
1.28. Legislation to be drafted to control what animals or plants are kept in peripheral areas to the Nature Reserve.
1.29. Designation Order to be amended to include the total prohibition on possession and/or use of pesticides, herbicides and fungicides within the Upper Rock Nature Reserve, unless under licence.

2. The Face of the Upper Rock Nature Reserve

Table 2.

Action	Requirement	Cost (£)
2.1.	Thorough enforcement of litter-control laws	tackled by police and 1.1.
2.2.	Contract for clearing of litter throughout areas of the Nature Reserve that are not currently cleared.	12000 p.a.
2.3.	Litter-control signs	1500
2.4.	CCTV cameras at frequently vandalised sites	30000
2.5.	Macaque-proof bins to replace current bins	10000
2.6.	Eradication of all graffiti, and consequent maintenance	tackled by 9.1.
2.7.	Annual clearing of roadsides, carried out as specified by GONHS.	tackled by 9.1.
2.8.	Disused pipes and ancillary equipment to be removed	tackled by 9.1.
2.9.	Signposts and information panels	some currently being developed using Management Plan budget, + 15000
2.10.	Clearing of boulders and rubble on paths	MOD community project
2.11.	Structural damage to paths and steps to be repaired	assessment by M.E.R.U.
2.12.	Erection and maintenance of handrails along more dangerous sections of paths and steps	assessment by M.E.R.U.
2.13.	Repair and maintenance of heritage sites along paths	assessment by GoG Conservation Officer

Action	Requirement	Cost (£)
2.14.	Clearing of vegetation along paths	tackled by 9.1.
2.15.	Removal of dead trees lying across paths	tackled by 9.1.
2.16.	Replacement of sewerage system along Martin's Path	assessment by M.E.R.U.
2.17.	Development and production of pamphlet or booklet for pedestrian use of the Nature Reserve, indicating routes of interest	being developed using Management Plan budget
2.18.	Relocation of kennel at Princess Caroline's Battery	provision of alternative site by GoG
2.19.	Military aerials, cables and pipelines to be removed by the MOD on release of land to Government of Gibraltar	to be borne by proprietors, i.e., MOD
2.20.	Relocation of existing cables that remain in use, to increase attractiveness of firebreaks and roadsides	to be borne by proprietors, i.e., MOD
2.21.	Railings along roadside to be replaced by more attractive railings	60000
2.22.	Garage at Jews' Gate to be relocated	provision of alternative site by GoG
2.23.	Replacement of monument at Jews' Gate. Pending recommendations	undetermined
2.24.	Fence that surrounds Scout camp at GLO to be replaced	2900
2.25.	Picnic sites to be created at Governor's Lookout and Princess Caroline's Battery. Benches, tables and monkey-proof bins to be installed, vegetation to be cleared, etc.	2500

3. Transport, Traffic & Tourism

Table 3.

Action	Requirement	Cost (£)
3.1.	Repair subsidence, Cave Branch Road, Signal Station Road and any other area where structural damage has occurred	assessment by M.E.R.U.
3.2.	Establishment of an annual road repairs and maintenance programme	no cost
3.3.	Straightening of bend on Engineer's Road	assessment by M.E.R.U.
3.4.	Provision of paved areas along roadways for pedestrians where possible	assessment by M.E.R.U.
3.5.	Improvement and addition of road and site signs	3000
3.6.	Increase concessionary rate to £4	no cost
3.7.	Reduce the private tourist rate to £6	no cost
3.8.	Redirection of traffic through Great North Road	assessment by M.E.R.U.
3.9.	Promotion of environmentally friendly mode of transport	2000
3.10.	All tour operators to operate their vehicles on Biodiesel	responsibility of GoG and tour operators

4. Introduced Flora

Table 4. Action is required to remove the following species.

Action	Species	Manpower	Duration (weeks)	Cost (£)
4.1.	*Senecio angulatus*	10	12	24000
4.2.	*Chasmanthe floribunda*	6	2	tackled by 9.1.
4.3.	*Lantana camara*	2	1	tackled by 9.1.
4.4.	*Opuntia ficus-indica*	3	24	14000
4.5.	*Carpobrotus acinaciformis x edulis*	2	1	tackled by 9.1.
4.6.	*Ailanthus altissima*	3	3	tackled by 9.1.
4.7.	*Agave americana*	3	1	tackled by 9.1.

4.8. Amendment of 'Nature Conservation Area (Upper Rock) Designation Order, 1993' (L/N 51 of 1993) to include a ban on the growing or keeping of the following plants by residents:

- *Pennisetum clandestinum* Chiov. ex. Hochst.
- *Senecio angulatus* de Candolle
- *Chasmanthe floribunda* (Salisbury) Brown
- *Ailanthus altissima* (Miller) Swingle
- *Carpobrotus acinaciformis* (L.) Bolus
- *Carpobrotus acinaciformis x edulis*
- *Carpobrotus edulis* (L.) N.E. Br.
- *Opuntia ficus-indica* (L.) Miller
- *Lantana camara* L.

…plus any other that are deemed to be potential invasives by the Nature Conservancy Council.

5. Fire & Firebreaks

Table 5.

Action	Requirement	Cost (£)
5.1.	Continuation of current clearing of firebreaks	no added cost
5.2.	Annual clearing of Bruce's Farm & Aerial Farm firebreaks	20000 p.a.
5.3.	New fire hazard signs to be erected	1500
5.4.	Damaged water tanks to be replaced by fibreglass tanks	assessment by City Fire Brigade
5.5.	Number of water hydrants to be increased	assessment by City Fire Brigade

6. Heritage

Table 6.

Action	Requirement	Cost (£)
6.1.	Vegetation around Moorish wall to be cleared, 30m on either side	tackled by 9.1.
6.2.	Historical graffiti at 'Moorish' wall to be protected with perspex sheet	300
6.3.	Restoration of Charles V Wall, particularly steps and railings	assessment by M.E.R.U.
6.4.	Removal of tall vegetation to the south of Charles V Wall	tackled by 9.1.
6.5.	Provision of sanitary facilities at Princess Caroline's Battery	assessment by G.T.B.
6.6.	Batteries, gun emplacements and other WWII structures to be refurbished	assessment by GoG Conservation Officer
6.7.	Information panel at disused water catchment on Engineer Road	1000

7. Mammals

Table 7.

Action	Requirement	Cost (£)
7.1.	Monitoring of bat populations	tackled by 1.1.
7.2.	Erection of grilles and fences to protect bat caves	4000
7.3.	Replenish depleting rabbit population using wild stock from Spain	no cost
7.4.	Reintroduction of red fox	no cost
7.5.	Introduction of Spanish ibex and/or Barbary sheep	2000
7.6.	Introduction of roe deer	being investigated

8. Birds

Table 8.

Action	Requirement	Cost (£)
8.1.	Control of feral pigeon	extension of GONHS Gull Cull licence
8.2.	Monitoring of lesser kestrel population	tackled by 1.1.
8.3.	Replenishing of lesser kestrel population	2000
8.4.	Reintroduction of black wheatear	no cost

9. Habitats

9.1. A team of 10-12 persons to be employed to tackle every aspect of habitat management within the Nature Reserve. This is to include habitat management, the clearing of roadsides and disused water catchments, the control and eradication of exotic flora and replanting programmes. This team can also tackle other aspects of Nature Reserve management, such as the clearing of pathways, clearing of rubbish in habitats (including caves), etc. The team is to be trained and supervised by GONHS personnel.

Cost: £13000 p.a., p.p.

Table 9.

Action	Requirement	Cost (£)
9.2.	Control of *Acanthus mollis*	tackled by 9.1.
9.3.	Removal of woody vegetation on Rock Gun water catchment	tackled by 9.1.
9.4.	Planting programme at woodland sites using Mediterranean tree species	tackled by 9.1.
9.5.	All cliffs surrounding the Nature Reserve to be included within revised boundary	no cost
9.6.	All cliffs to be included as SACs under the EU Habitats Directive	no cost
9.7.	Removal of woody shrubs in garigue habitats	tackled by 9.1.

10. Research and Monitoring

Table 10.

Action	Requirements	Cost (£)
10.1.	Designation of Rock Gun and Middle Hill as a Biological Reserve	no cost
10.2.	Establishment of a management body for the Biological Reserve	no cost
10.3.	Watering site to be established for introduced herbivores	5000
10.4.	Monitoring programme recommended in Chapter 17.10	tackled by 1.1.
10.4.	Establishment of Environmental education programmes for schools	see Chapter 17.10

11. Tourist Sites

Table 11.1. Jews' Gate

Action	Requirements	Cost (£)
11.1.	Bollards to be replaced with a visible barrier	300
11.2.	Water drinking fountain to be connected to the mains	200
11.3.	Water pressure for drinking fountain and toilets to be increased	to be investigated by G.T.B.
11.4.	Telescope to be replaced	4055

Table 11.2. St. Michael's Cave

Action	Requirements	Cost (£)
11.5.	Resurfacing of the road leading down to New St. Michael's Cave	assessment by M.E.R.U.
11.6.	Porta-cabin to be removed and ticket office to be extended	8000
11.7.	Implementation of Tour guides in the Cave	to be assessed by G.T.B.
11.8.	Regular, environmentally friendly vermin control	Environmental Agency, no additional cost

Table 11.3. Ape's Den

Action	Requirements	Cost (£)
11.9.	Adequate sign at the top of Lower Queen's Road indicating 'Ape's Den'	covered by 3.5.
11.10.	Complete refurbishment of this site	30000
11.11.	Provision of an interpretation centre	9000
11.12.	Establishment of a quality souvenir shop	to be negotiated

Table 11.4. Upper Galleries

Action	Requirements	Cost (£)
11.13.	Construction of large new terrace	assessment by M.E.R.U.
11.14.	Connect the Upper to the Middle Galleries via a lift or spiral staircase	assessment by G.T.B.

Table 11.5. City Under Siege

Action	Requirements	Cost (£)
11.15.	Parking facilities for the site at Waterworks entrance	assessment by M.E.R.U.
11.16.	Provision of path from parking facilities to the site	assessment by M.E.R.U.
11.17.	Enlargement of ticket office	9000
11.18.	Toilet facilities for this site to be located at the Waterworks entrance	assessment by G.T.B.
11.19.	Habitat management of the area around the site	tackled by 9.1.

Table 11.6. Moorish Castle

Action	Requirements	Cost (£)
11.20.	Parking facilities for the site at Waterworks entrance	see 11.16.
11.21.	Establishment of a quality souvenir shop for this site and the above	to be negotiated
11.22.	Habitat management and clearing of vegetation around the Castle walls	tackled by 9.1.

Table 11.7. Cable Car Top Station

Action	Requirements	Cost (£)
11.23.	Replacement of telescopes	borne by M.H. Bland Ltd.
11.24.	Information panels	borne by M.H. Bland Ltd.

Table 11.8. South of Cable Car Top Station

Action	Requirements	Cost (£)
11.25.	Complete refurbishment	20000
11.26.	Development into an exhibition of the WWII installations	30000
11.27.	Clearing of refuse on the east cliffs	to be tackled by Master Services

12. Pine Trees

Table 12.

Action	Requirements	Cost (£)
12.1.	Dead pine trees to be felled	tackled by 9.1.
12.2.	Dead pine trees to be replaced with live trees	500, tackled by 9.1.
12.3.	Additional pine trees to be planted in suitable areas	500, tackled by 9.1.
12.4.	*Pinus halepensis* to be favoured in any replanting programme	no cost

13. Geology and Caves

Table 13.

Action	Requirements	Cost (£)
13.1.	Cleaning of all refuse and debris in caves	tackled by 9.1.
13.2.	Restriction of access to Martin's Cave	tackled by 7.2.
13.3.	Information panels outside key caves	3000
13.4.	Removal of obsolete cables and ancillary equipment in caves	MOD community project
13.5.	Bray's cave to be made safe	borne by Gibraltar Museum
13.6.	Establishment of Cave Management Committee	no cost

14. The Lower Slopes

Table 14.

Action	Requirements	Cost (£)
14.1.	Inclusion of all orchid species under Schedule 3 of Nature Protection Ordinance	no cost
14.2.	Habitat management	tackled by 9.1.
14.3.	Extension of Nature Reserve boundary to include Lower Slopes	no cost

15. European Wildlife Directives

15.1. Designation of Upper Rock Nature Reserve as an SAC under the EU Habitats Directive.

15.2. Preparation of an action plan for the conservation of lesser kestrels in Gibraltar. Currently being prepared by GONHS.

Table 15.

15.3. - summary of cost of financing Habitats Directive requirements

Habitat	Action	Cost (£)
Vegetated Sea Cliffs	Site supervision	tackled by 1.1.
Matorral with Laurus	**Initial cost (non-recurring)**	
	Habitat/site restoration	none required
	Clearing of rubbish/debris	tackled by 9.1.
	Recurrent expenditure (p.a.)	
	Habitat management	none required
	Site supervision	tackled by 1.1.
Thermo-mediterranean and Presteppe Brush	**Initial cost (non-recurring)**	
	Habitat/site restoration, Rock Gun area	30000
	Recurrent expenditure (p.a.)	
	Habitat management	tackled by 9.1.
	Site supervision	tackled by 1.1.
Chasmophytic vegetation	**Initial cost (non-recurring)**	
	Surveying of site and remedial action	10000
	Recurrent expenditure (p.a.)	
	Habitat management	none
	Site supervision	tackled by 1.1.

CONTINUE>>

Habitat	Action	Cost (£)
Caves	**Initial cost (non-recurring)**	
	Habitat/site restoration	tackled by 13.1.
	Protection of caves	tackled by 7.2.
	Recurrent expenditure (p.a.)	
	Monitoring/Supervision/Conservation	tackled by 1.1.
Total	**Capital**	**Recurrent**
Annual	£40,000.00*	£0.00*
Grand Total		£40,000.00*

* Provided arrangements described in 1.1., 7.2., 9.1. & 13.1. have already been implemented.

16. Barbary macaques

Many of the actions required for Barbary macaques are covered in previous sections. This is the case, for example, with illegal feeding, maintenance and refurbishment of sites, restriction of access to at least one pack and traffic restrictions along the Upper Roads. In addition, those requirements that have not yet been covered are listed in table 16.

Table 16.

Action	Requirements	Cost (£)
16.1.	Importation of macaques from North Africa to replenish local genetic stock	10000
16.2.	Exportation of macaques to North Africa in order to replenish genetic stock of small populations and to repopulate sites where the species has disappeared	20000
16.3.	Exportation of macaques to Zoological parks to be favoured over culling	Cost depends on demand

17. Works Programme for 9.1.

Table 17. Works programme for the 9.1. team. Actions have been categorised according to the frequency with which works need to be carried out.

Action	Once	Every Year	Every 2 Years	Every 5 Years	Every 10 Years
2.6.		•			
2.7.		•			
2.8.	•				
2.14.			•		
2.15.	•				
4.2.	•				
4.3.	•				
4.5.	•				
4.6.	•				
4.7.	•				
6.1.				•	
6.4.				•	
9.2.		•			
9.3.					•
9.4.	•				
9.7.				•	
11.21.				•	
11.25.				•	
12.1.	•				
12.2.	•				
12.3.	•				
13.1.			•		
14.2.				•	
15.3.		•			

It is evident when looking through the action plan that the workload for the team of 10-12 individuals appointed under action 9.1. is considerable. However, whereas some of these jobs must be tackled on a regular basis, others require only one action. Table 16 shows the frequency with which each action must be addressed.

Some of the problems listed under 'Once' may recur. These should be tackled as and when required. New dead trees may occasionally fall across paths, and likewise, pines along roadsides may occasionally die. However, this is the exception rather than the norm, and the workforce will only have to tackle these small tasks as and when they occur (i.e., very rarely). The removal of exotic invasives will likewise require only one action. Obviously, if these species re-establish themselves within the Reserve, or if any new exotic invasives appear, then these problems will have to be tackled anew. However, this will only occur sporadically, and tackling a new invasive species is a simple task as long as the problem is identified and tackled promptly before the plant has had a chance to spread. Tree planting programmes are also listed under this column. Such a programme could be ongoing, but providing that enough healthy saplings take root, each area tackled will only have to be addressed once.

Actions that need to be addressed frequently include litter problems outside of the areas tackled by Master Services (specifically within caves and habitats) and graffiti. Unfortunately, these are problems that will surface year after year, and so permanent vigilance and action is required. It is significant to note that tighter enforcement of laws and the presence of wardens may reduce these problems considerably. This would therefore reduce the workload of the 9.1. team.

Some of the actions listed in table 17 require the clearing of vegetation, in particular woody vegetation. In open areas such as the disused water catchment at Rock Gun, the introduction of large herbivores would go some way towards controlling woody vegetation permanently. Such an action would therefore reduce the team's workload considerably. Large herbivores could also be introduced to some of the large firebreaks towards the Northern end of the Rock.

The problematic plant *Acanthus mollis* must be tackled annually. This does not mean that the whole of the Upper Rock must be denuded of this plant every single year. This would not be a feasible task. Rather, different areas could be tackled in different years, and some areas may require more attention than others. Such areas include firebreaks and paths, which will, in any case, be tackled regularly. When these areas are being cleared, special attention must be given to the removal of *Acanthus mollis*. The careful, licensed use of a paraquat herbicide such as 0.5% or 1% glyphosphate or Dalapon, could eliminate this plant from areas where it causes the gravest problems.

Appendix 1: Species Lists

2.1 Vascular Plants

The following plants are found within the Upper Rock and the Lower Slopes, and are listed alphabetically rather than taxonomically, as given by Linares (2003). Those highlighted with an * are not native.

Acanthus mollis
Achyranthes sicula
Aetheorhiza bulbosa
*Agave americana**
*Ailanthus altissima**
Ajuga iva
Allium ampeloprasum
Allium pallens pallens
Allium sphaerocephalon
Allium triquetrum
*Aloe arborescens**
Anacamptis pyramidalis
Anacyclus radiatus
Anagallis arvensis
Anagyris foetida
Andryala integrifolia
Anogramma leptophylla
Anthyllis tetraphylla
Antirrhinum majus
Arenaria leptoclados
Arisarum simorrhinum
Aristolochia baetica
Arum italicum
Asparagus albus
Asparagus aphyllus
Asphodelus aestivus
Asphodelus albus
Asphodelus fistulosus
Asplenium billotii
Asplenium onopteris
Asplenium trichomanes
Aster squamatus
Asteriscus acuaticus
Asteriscus maritimus
Astragalus baeticus
Astragalus hamosus
Atractylis cancellata
Atriplex halimus
Avena barbata
Avena sterilis
Avenula gervaisii
Bellardia trixago
Bellis sylvestris
Beta vulgaris
Biscutella megacarpaea
Biscutella sempervirens
Blackstonia perfoliata
Borago officinalis
Brachypodium distachyon
Brachypodium retusum
Briza maxima
Bromus diandrus
Bromus hordeaceus
Bromus madritensis
Bromus rigidus
Bupleurum fruticosum
Calamintha sylvatica
Calamintha arvensis
Calendula suffruticosa
Calicotome villosa
Campanula erinus
Campanula rapunculus
Campanula velutina
Cardamine hirsute
Carduus pycnocephalus
Carduus tenuiflorus
Carex hallerana
Carlina corymbosa
*Carpobrotus acinaciformis x edulis**
Carthamus arborescens
Carthamus lanatus
Celtis australis
Centaurea melitensis
Centaurea pullata
Centaurium erythraea
Centaurium pulchellum
Centranthus clacitrapae
Centranthus ruber
Cerastium gibraltaricum
Cerastium glomeratum
Ceratonia siliqua
Ceterach officinarum
Chaenorrhinum villosum
Chamaerops humilis
*Chasmanthe floribunda**
Cheilanthes vellea
Chenopodium album
Chenopodium ambrosioides
Chenopodium murale
Chrysanthemum coronarium
Cistus albidus
Cistus salvifolius
Clematis cirrhosa
Clematis flammula
Colchicum lusitanum
Convolvulus althaeoides
Convolvulus siculus
*Conyza albida**
*Conyza bonariensis**
Coronilla valentina
Crataegus monogyna
Crepis capillaries
Crepis vesicaria
Cuscuta planiflora
Cymbalaria muralis
Cynara humilis
Dactylis glomerata
Daphne gnidium
Daucus carota
Delphinium pentagynum
Desmazeria rigida
Dianthus carophyllus
Dittrichia viscosa
*Dracaena draco**
Ecballium elaterium
Echium boissieri
Echium creticum
Echium plantagineum
Elaeoselinum foetidum
Ephedra fragilis
Erodium chium
Erodium malacoides
Erodium moschatum
*Eucalyptus camaldulensis**
*Eucalyptus globulus**
Euphorbia characias
Euphorbia exigua
Euphorbia helioscopia
Euphorbia segetalis
Euphorbia squamigera
Fedia cornucopiae
Ferula tingitana
Ficus carica
Filago pyramidata
Foeniculum vulgare
*Freesia refracta**
Fumaria capreolata
Fumaria sepium
Galactites tomentosa
Galium murale
Galium verrucosum
Genista linifolia
Gennaria diphylla
Geranium molle
Geranium purpureum
Geranium rotundifolium
Gladiolus communis
Gynandriris sisyrinchium
Hedypnois arenaria
Hedypnois cretica
Helianthemum origanifolium
Helichrysum rupestre
Hippocrepis multisiliquosa
Hirschfeldia incana
Hordeum leporinum
Hyoseris radiata
Hyparrhenia hirta
Hypericum perforatum
Iberis gibraltarica
*Iris albicans**
Iris filifolia
Jasminum fruticans
Kundmannia sicula
Lactuca tenerrima
Lagurus ovatus
*Lantana camara**
Lathyrus amphicarpos
Lathyrus clymenum
Lathyrus setifolius
Laurus nobilis
Lavandula dentata
Lavandula multifida
Lavatera arborea
Lavatera cretica
Leontodon longirrostris
Leucojum autumnale
Linaria amethystea
Linaria tristis
Linum bienne
Linum strictum
Lobularia maritima
Logfia gallica
Lolium rigidum

Lonicera implexa
Lotus arenarius
Lotus collinus
Lotus edulis
Lotus ornithopodioides
Magydaris panacifolia
Malva hispanica
Medicago minima
Medicago orbicularis
Medicago polymorpha
Medicago tornata
Medicago truncatula
Melica arrecta
Melica magnolii
Melica minuta
Melilotus indica
Melilotus sulcata
Mercurialis annua
Micromeria graeca
Minuartia geniculata
Minuarta hybrida
Misopates orontium
Muscari comosum
Narcissus papyraceus
Nepeta tuberosa
*Nicotiana glauca**
Olea europea
Ononis pubescens
Ononis reclinata
Ononis viscosa
Ophrys apifera
Ophrys bombyliflora
Ophrys fusca
Ophrys lutea
Ophrys speculum
Ophrys tenthredinifera
*Opuntia ficus-indica**
*Opuntia vulgaris**
Ornithogalum orthophyllum
Orobanche amethystea
Orobanche crenata
Orobanche minor
Orobanche ramosa
Orobanche sanguinea
Osyris quadripartita
*Oxalis pes-caprae**
Pallenis spinosa
Parentucellia viscosa
Parietaria judaica
Parietaria lusitanica
Parietaria mauretanica
Paronychia argentea
*Pelargonium inquinans**
Peterorhagia nanteuilii
Petroselinum crispum
Phagnalon saxatile
Phalaris canariensis
Phillyrea latifolia
Phlomis purpurea
*Pinus halepensis**
*Pinus pinea**
Piptatherum caerulescens
Piptatherum miliaceum
Pistacia lentiscus
Pistacia terebinthus
Pisum sativum
*Plumbago auriculata**
Plantago afra
Plantago coronopus
Plantago lagopus
Poa infirma
Polycarpon tetraphyllum
Polygala rupestris
Polypodium cambricum
Prasium majus
Psoralea bituminosa
Pulicaria odora
Quercus coccifera
Ranunculus bullatus
Ranunculus paludosus
Raphanus raphanistrum
Rapistrum rugosum
Reichardia intermedia
Reseda alba
Rhamnus alaternus
Rhamnus lycioides
Romulea clusiana
Rosmarinus officinalis
Rostraria cristata
Rubia peregrina
Rumex intermedius
Ruscus hypophyllum
Ruta angustifolia
Sagina apetala
Sanguisorba minor
Saxifraga globulifera
Scabiosa atropurpurea
Scandix pectin-veneris
Scilla autumnalis
Scilla peruviana
Scorpiurus muricatus
Sedum album
Sedum rubens
Sedum sediforme
Selaginella denticulata
*Senecio angulatus**
Senecio vulgaris
Serapias parviflora
Sherardia arvensis
Sideritis arborescens
Silene colorata
Silene gallica
Silene latifolia
Silene nocturna
Silene tomentosa
Smilax aspera
Smyrnium olusatrum
Solanum alatum
*Solanum sodomeum**
Solanum villosum
Sonchus asper
Sonchus oleraceus
Sonchus tenerrimus
Spartium junceum
Spiranthes spiralis
Stachys circinata
Stellaria media
Stellaria pallida
Stipa tenacissima
Stipa capensis
Succowia balearica
Tamus communis
*Tecoma capensis**
Teucrium fruticans
Teucrium lusitanicum
Thapsia villosa
Theligonum cynocrambe
Thesium humile
Thymus willdenowii
Trifolium campestre
Trifolium glomeratum
Trifolium scabrum
Trifolium stellatum
Trifolium tomentosum
Trisetaria panicea
*Tropaeolum majus**
Umbilicus horizontalis
Umbilicus rupestris
Urguinea maritima
Urospermum picroides
Urtica membranacea
Valantia hispida
Valantia muralis
Verbascum sinuatum
Veronica arvensis
Veronica cymbalaria
Vicia benghalensis
Vicia lutea
Vicia sativa
Vicia villosa
Vinca difformis
Vulpia ciliata
Vulpia geniculata

Report on Rare and Special Plants: by Leslie Linares

Gibraltar chickweed *Cerastium gibraltaricum* Boiss.

This plant is believed endemic to Gibraltar, and used to be more common than at present. In the past it has been found in the Rock Gun /Green's Lodge Road area; along the ridge above and along Douglas Path; on and below the ridge from Signal Hill to the lookout at the start of Douglas Path; along Martin's Path; at the top of Mediterranean Steps. At present, the populations from Signal Hill to Douglas Path have disappeared. The reasons for this are not clear, but could be due to the increase in gull population altering the soil composition, and the increased activity of the monkeys in that area. The other populations are holding their own, though the ones along Martin's Path seem to be on the decline. One new population

was seen last year on the cliff face below Devil's Gap.

Gibraltar campion *Silene tomentosa* Otth. in DC.

This plant is endemic to Gibraltar and is extremely rare. It was believed extinct for over 100 years until a couple of plants were seen along Green's Lodge Road in 1979. The next sighting was in 1985, again along Green's Lodge Road and also at the entrance to the Galleries, when six plants were noted. The last sighting in the wild was of three plants in 1994, this time along Rock Gun Road. Plants have been successfully raised at the Alameda Gardens, from seeds collected from the last find, but attempts at re-introducing them to the wild have not met with great success. It is possible that plants may be growing on the more inaccessible parts of the Rock's northern and eastern cliffs.

Wild carnation *Dianthus caryophyllus* L.

This beautifully scented plant used to be quite common from the Rock Gun / Green's Lodge area, all along the upper ridge of the Rock, including from Signal Hill to Douglas Path, and also along Martin's Path. In the past 10 years or so, not a single plant has been seen growing anywhere along this route, though there may be some still growing in the restricted Rock Gun / Green's Lodge area. The disappearance of this species seems to go hand in hand with that of the Gibraltar Chickweed; these two species seemed to coincide in habitat.

Gibraltar saxifrage *Saxifraga globulifera* Desf. var. gibraltarica Ser.

This variety of *S. globulifera* is believed to be endemic to Gibraltar. It is a rare plant. Three populations have been observed: a small one at the top of Mediterranean Steps, another small one at the top of the road to the Galleries, and a larger one at Rock Gun. The plants at Med Steps and Rock Gun, seem to be faring reasonably well, but the ones near the Galleries are suffering the effects of the mindless scraping and clearing that the Upper Rock roadsides are subjected to. This population has dwindled from a healthy state to one of near extinction.

Gibraltar thyme *Thymus willdenowii* Boiss.

This species is believed to be a native of North Africa, but grows well in Gibraltar. It is quite widespread along the Upper Rock, growing from cracks on the limestone, and very commonly along roadsides and footpaths. Because of this, many plants are, again, being lost to the indiscriminate and over-enthusiastic clearing of roadsides. At present, this species is quite common, but its future could be in the balance.

Orchids

All species of the orchid family found in Gibraltar are rare. These species grow best on undisturbed soil, in unexposed clearings. On the Rock these conditions are met in rocky outcrops and clearings in the Maquis, on firebreaks, and along footpaths and roadsides. Clearings in the Maquis are few and far between; firebreaks are not being maintained regularly; and roadsides are continuously being disturbed. As a result of disturbance, and of loss and change of habitat, the number of orchids has suffered a serious decline over the last 15 years or so.

The most common species is the two-leaved Gennaria, *Gennaria diphylla* (Link) Parl.. This is quite common and widespread along footpaths and roadsides all along the Upper Rock. Next comes the autumn ladies tresses orchid, *Spiranthes spiralis* (L.) Chevall. This is also quite widespread, but not common. These are difficult to find, and usually grow in clearings and firebreaks. Then comes the small-flowered Serapias *Serapias parviflora* Parl.. This species is also quite widespread on the Upper Rock, but is rare. It grows best on clearings and along roadsides and footpaths. The brown bee orchid *Ophrys fusca* Link, and the yellow bee orchid *Ophrys lutea* (Gouan) Cav., are the two species of insect orchid which one is more likely to see on the Upper Rock, but their number has dropped so dramatically over the last 15 years or so, that only 5 or 6 of each are visible throughout the Upper Rock. In the past, the bulk of their number was to be found growing along most of the roadsides of the Reserve. Their decline can only be attributed to road clearing. The mirror orchid *Ophrys speculum* Link, has only been found on the lower slopes of the Upper Rock. Up to 40 plants were once counted in this area. At the last count, only 3 were seen. Here the problem is one of the once clear, open habitat (once kept clear by goats), now becoming more overgrown, and returning to Maquis. The bee orchid *Ophrys apifera* Hudson, is very rare, with only 2 or 3 plants seen. They have never been common; their numbers having dwindled from a maximum of around 10. They grow best in clearings and along footpaths. The bumblebee orchid *Ophrys bombyliflora* Link, used to be fairly common, though not widespread on the Upper Rock.

Today, not one has been seen for over 10 years or so. The same fate has befallen the sawfly orchid *Ophrys tenthredinifera* Willd.. This species was always rare, with only 5 or 6 having been seen in the past, mainly along footpaths. Lastly, the pyramidal orchid *Anacamptis pyramidalis* (L.) L.C.M.Richardson, which has not been seen for about 15 years. This species was found on Mediterranean Steps, where up to 5 were once noted. Their decline was probably due to an increase in the growth of surrounding vegetation.

2.2 Birds

All species of bird that have been recorded within or from the Upper Rock (198 species) are listed below:

Cory's shearwater *Calonectris diomedea*
Balearic shearwater *Puffinus mauretanicus*
yelkouan shearwater *Puffinus yelkouan*
great cormorant *Phalacrocorax carbo*
shag *Phalacrocorax aristotelis*
northern gannet *Morus bassanus*
little bittern *Ixobrychus minutus*
black-crowned night heron *Nycticorax nycticorax*
cattle egret *Bubulcus ibis*
little egret *Egretta garzetta*
grey heron *Ardea cinerea*
purple heron *Ardea purpurea*
black stork *Ciconia nigra*
white stork *Ciconia ciconia*
glossy ibis *Plegadis falcinellus*
European spoonbill *Platalea leucorodia*
greater flamingo *Phoenicopterus ruber*
European honey buzzard *Pernis apivorus*
black kite *Milvus migrans*
red kite *Milvus milvus*
black-shouldered kite *Elanus caeruleus*
Egyptian vulture *Neophron percnopterus*
Lammergeier *Gypaetus barbatus*
cinereous vulture *Aegypius monachus*
griffon vulture *Gyps fulvus*
marsh harrier *Circus aeruginosus*
hen harrier *Circus cyaneus*
Montagu's harrier *Circus pygargus*
pallid harrier *Circus macrourus*
northern goshawk *Accipiter gentilis*
Eurasian sparrowhawk *Accipiter nisus*
spotted eagle *Aquila clanga*
lesser spotted eagle *Aquila pomarina*
Spanish imperial eagle *Aquila adalberti*
golden eagle *Aquila chrysaetos*
booted eagle *Hieraaetus pennatus*
Bonelli's eagle *Hieraaetus fasciatus*
common buzzard *Buteo buteo*
long-legged buzzard *Buteo rufinus*
short-toed eagle *Circaetus gallicus*
osprey *Pandion haliaetus*
merlin *Falco columbarius*
lesser kestrel *Falco naumanni*
common kestrel *Falco tinnunculus*
European hobby *Falco subbuteo*
red-footed falcon *Falco vespertinus*
peregrine *Falco peregrinus*
lanner *Falco biarmicus*
Eleonora's falcon *Falco eleonorae*
Barbary partridge *Alectoris barbara*
common quail *Coturnix coturnix*
common crane *Grus grus*
stone curlew *Burhinus oedicnemus*
Eurasian avocet *Recurvirostra avoceta*
northern lapwing *Vanellus vanellus*
ringed plover *Charadrius hiaticula*
Eurasian woodcock *Scolopax rusticola*
whimbrel *Numenius phaeopus*
great skua *Cartharacta skua*
Arctic skua *Stercorarius parasiticus*
black-headed gull *Larus ridibundus*
Audouin's gull *Larus audouinii*
yellow-legged gull *Larus michahellis*
lesser black-backed gull *Larus fuscus*
common tern *Sterna hirundo*
Sandwich tern *Sterna sandvicensis*
black tern *Chlidonias niger*
pin-tailed sandgrouse *Pterocles alchata*
woodpigeon *Columba palumbus*
rock dove *Columba livia*
stock dove *Columba oenas*
collared dove *Streptopelia decaocto*
European turtle dove *Streptopelia turtur*
great-spotted cuckoo *Clamator glandarius*
common cuckoo *Cuculus canorus*
barn owl *Tyto alba*
Eurasian eagle owl *Bubo bubo*
European scops owl *Otus scops*
little owl *Athene noctua*
tawny owl *Strix aluco*
long-eared owl *Asio otus*
common nightjar *Caprimulgus europaeus*
red-necked nightjar *Caprimulgus ruficollis*
alpine swift *Tachymarptis melba*
common swift *Apus apus*
pallid swift *Apus pallidus*
river kingfisher *Alcedo atthis*
European bee-eater *Merops apiaster*
European roller *Coracias garrulus*
Eurasian hoopoe *Upupa epops*
great spotted woodpecker *Dendrocopos major*
green woodpecker *Picus viridis*
Eurasian wryneck *Jynx torquilla*
short-toed lark *Calandrella brachydactyla*
Eurasian skylark *Alauda arvensis*
crested lark *Galerida cristata*
thekla lark *Galerida theklae*
woodlark *Lullula arborea*
Eurasian sand martin *Riparia riparia*
crag martin *Ptyonoprogne rupestris*
red-rumped swallow *Hirundo daurica*
barn swallow *Hirundo rustica*
house martin *Delichon urbica*
tawny pipit *Anthus campestris*
tree pipit *Anthus trivialis*
meadow pipit *Anthus pratensis*
Richard's pipit *Anthus richardi*
yellow wagtail *Motacilla flava*
grey wagtail *Motacilla cinerea*
white wagtail *Motacilla alba*
winter wren *Troglodytes troglodytes*
hedge accentor *Prunella modularis*
alpine accentor *Prunella collaris*
rufous bush robin *Cercotrichas galactotes*

Eurasian robin *Erithacus rubecula*
common nightingale *Luscinia megarynchos*
bluethroat *Luscinia svecica*
black redstart *Phoenicurus ochruros*
common redstart *Phoenicurus phoenicurus*
stonechat *Saxicola torquata*
whinchat *Saxicola rubetra*
northern wheatear *Oenanthe oenanthe*
black-eared wheatear *Oenanthe hispanica*
red-tailed rock thrush *Monticola saxatilis*
blue rock thrush *Monticola solitarius*
ring ouzel *Turdus torquatus*
blackbird *Turdus merula*
song thrush *Turdus philomelos*
redwing *Turdus iliacus*
mistle thrush *Turdus viscivorus*
zitting cisticola *Cisticola juncidis*
common grasshopper warbler *Locustella naevia*
Savi's warbler *Locustella luscinoides*
sedge warbler *Acrocephalus schoenobaenus*
common reed warbler *Acrocephalus scirpaceus*
great reed warbler *Acrocephalus arundinaceus*
Blyth's reed warbler *Acrocephalus dumetorum*
Cetti's warbler *Cettia cetti*
western olivaceous warbler *Hippolais pallida*
melodious warbler *Hippolais polyglotta*
Icterine warbler *Hippolais icterina*
garden warbler *Sylvia borin*
Dartford warbler *Sylvia undata*
Marmora's warbler *Sylvia sarda*
subalpine warbler *Sylvia cantillans*
spectacled warbler *Sylvia conspicillata*
common whitethroat *Sylvia communis*
lesser whitethroat *Sylvia curruca*
Sardinian warbler *Sylvia melanocephala*
orphean warbler *Sylvia hortensis*
blackcap *Sylvia atricapilla*
common chiffchaff *Phylloscopus collybita*
Iberian chiffchaff *Phylloscopus ibericus*
mountain chiffchaff *Phylloscopus sindianus*
western Bonelli's warbler *Phylloscopus bonelli*
wood warbler *Phylloscopus sibilatrix*
willow warbler *Phylloscopus trochilus*
Pallas's warbler *Phylloscopus proregulus*
yellow-browed warbler *Phylloscopus inornatus*
firecrest *Regulus ignicapillus*
goldcrest *Regulus regulus*
spotted flycatcher *Muscicapa striata*
pied flycatcher *Ficedula hypoleuca*
long-tailed tit *Aegithalos caudatus*
crested tit *Parus cristatus*
coal tit *Parus ater*
blue tit *Parus caeruleus*
great tit *Parus major*
wallcreeper *Tichodroma muraria*
short-toed treecreeper *Certhia brachydactyla*
Eurasian golden oriole *Oriolus oriolus*
woodchat shrike *Lanius senator*
Southern grey shrike *Lanius meridionalis*
common magpie *Pica pica*
red-billed chough *Pyrrhocorax pyrrhocorax*
yellow-billed chough *Pyrrhocorax graculus*
western jackdaw *Corvus monedula*
northern raven *Corvus corax*
spotless starling *Sturnus unicolor*
common starling *Sturnus vulgaris*
house sparrow *Passer domesticus*
Spanish sparrow *Passer hispaniolensis*
common linnet *Carduelis cannabina*
common chaffinch *Fringilla coelebs*
brambling *Fringilla montifringilla*
Eurasian serin *Serinus serinus*
greenfinch *Carduelis chloris*
goldfinch *Carduelis carduelis*
siskin *Carduelis spinus*
hawfinch *Coccothraustes coccothraustes*
common crossbill *Loxia curvirostra*
bullfinch *Pyrrhula pyrrhula*
scarlet rosefinch *Carpodacus erythrinus*
indigo bunting *Passerina cyanea*
ortolan bunting *Emberiza hortulana*
cirl bunting *Emberiza cirlus*
rock bunting *Emberiza cia*
corn bunting *Miliaria calandra*

2.3 Mammals

The (non-human) mammals that are currently found within the Nature Reserve are listed below

greater white-toothed shrew *Crocidura russula*
greater mouse-eared bat *Myotis myotis*
Mediterranean pipistrelle *Pipistrellus mediterraneus*
Schreiber's bat *Miniopterus schreibersii*
European free-tailed bat *Tadarida teniotis*
Barbary macaque *Macaca sylvanus*
house mouse *Mus domesticus*
black rat *Rattus rattus*
common rabbit *Oryctolagus cuniculus*

2.4 Reptiles and Amphibians

The reptiles and amphibians that occur within the Upper Rock Nature Reserve are listed below:

common toad *Bufo bufo*
Perez' marsh frog *Rana perezi*
amphisbaenian *Blanus cinereus*
Turkish gecko *Hemidactylus turcicus*
Moorish gecko *Tarentola mauretanica*
ocellated lizard *Lacerta lepida*
Iberian wall lizard *Podarcis hispanica*
large psammodromus *Psammodromus algirus*
horseshoe whip-snake *Coluber hippocrepis*
Montpellier snake *Malopogon monspessulanus*
ladder snake *Elaphe scalaris*
southern smooth snake *Coronella girondica*
false smooth snake *Macroprotodon cucullatus*
grass snake *Natrix natrix*

The two amphibians (*Bufo bufo* and *Rana perezi*) have been introduced to areas were ponds have been constructed by man. All the reptiles are native to Gibraltar.

2.5 Beetles (Coleoptera)

The authors of this report are currently conducting a study of the beetle fauna of Gibraltar. Although a detailed picture of the beetles of the Upper Rock Nature Reserve cannot be provided, some interesting data have already arisen. Many different areas of Gibraltar have their own distinctive insect faunas due to the sharp differences in habitat that exist. Thus, species that are common in some areas may be rare or absent from others. For example, the tenebrionid *Akis acuminata*, probably the most well known beetle in Gibraltar (the typical 'escarabajo' people can remember), is very common and conspicuous in sandier areas such as those found on the eastern side, the isthmus and the gardens of the south district and yet this species seems to be absent from the Nature Reserve, whose rocky terrain dose not suit this beetle.

In addition, some interesting species have been identified. The carabid *Laemostenus (Ceuthostenes) mauretanicus* subsp. *polymephus* is a cave-dwelling taxon that has only been recorded from Gibraltar, San Roque and two caves in Cadiz and Málaga (Serrano 2003). Given this species' habits, it may well be that Gibraltar, with its numerous caves, is one of this beetle's strongholds. Similarly, the tenebrionid *Alphasida (Betasida) argentolimbata*, which has been recorded from the Upper Rock, is only found in nearby San Roque and Algeciras (J. de Ferrer, *pers. comm.*). The cerambicid beetle *Lucasianus levaillantii*, a mainly North African species, has also been recorded from the Upper Rock, where it probably feeds on the small population of *Cupressus sempervirens* that is found in the gardens of the Bruce's Farm residential area (Perez & Bensusan, *in prep.*). This beetle was first recorded in Iberia in 1987, where it is thought that it was introduced from North Africa (Vives 2000).

Another interesting find has been that of *Buprestis (Yamina) sanguinea*, a beetle belonging to the family Buprestidae that is a popular species amongst Spanish Coleopterists. This species was previously known only from a few locations in Madrid, Cataluña and Aragón, as well as a few records from North Africa that may correspond to a closely related species and not B. (Yamina) sanguinea itself (Cobos 1986). *B. (Yamina) sanguinea* feeds on plants that belong to the genus *Ephedra*. *Ephedra fragilis* is relatively common in Gibraltar, and it is on this plant that this beetle can be located. Although *B. (Yamina) sanguinea* has so far only been found on the southernmost slopes of the upper Rock Nature Reserve, it is likely that it has a more widespread distribution within Gibraltar. Since *Ephedra fragilis* is a very rare plant in the hinterland, the population of *B. (Yamina) sanguinea* that exists in Gibraltar is a very isolated one, and is thus of great value and importance.

2.6 Butterflies & Moths (Lepidoptera)

A list of butterflies:

swallowtail *Papilio machaon*
scarce swallowtail *Iphiclides podalirius feisthameli*
Spanish festoon *Zerynthia rumina*
large white *Pieris brassicae*
small white *Artogeia rapae*
Bath white *Pontia daplidice*
dappled white *Euchloe crameri*
Portuguese dappled white *Euchloe tagis*
green-striped white *Euchloe belemia*
desert orange tip *Colotis evagore nouna*
Morocco orange tip *Anthocharis belia euphenoides*
clouded yellow *Colias crocea*
brimstone *Gonopteryx rhamni*
Cleopatra *Gonopteryx cleopatra*
wood white *Leptidea sinapis*
Ilex hairstreak *Satyrium ilicis*
blue-spot hairstreak *Strymonidia spini*
small copper *Lycaenea phlaeas*
long-tailed blue *Lampides boeticus*
Lang's short-tailed blue *Leptotes pirithous*
geranium bronze *Carcyreus marshalii*
holly blue *Celastrina argiolus*
southern brown argus *Aricia cramera*
common blue *Polyommatus icarus*
two-tailed pasha *Charaxes jasius*
red admiral *Vanessa atalanta*
painted lady *Cynthia cardui*
striped grayling *Pseudotergumia fidia*
meadow brown *Maniola jurtina*
southern gatekeeper *Pyronia cecilia*
Spanish gatekeeper *Pyronia bathsheba*
speckled wood *Pararge aegeria*
wall brown *Lasiommata megera*
monarch *Danaus plexippus*
sage skipper *Muschampia proto*
mallow skipper *Carcharodus alceae*
red-underwing skipper *Spialia sertorius*
Lulworth skipper *Thymelicus action*

A provisional list of moths:

Nemophora raddella latrellella
Melasina ciliaris
Deuterohyalina albida
Reisserita chrysopterella
Tinea pellionella
Dialectica scalariella
Batia lunaris
Esperia sulphurella
Pleurota ericella
Agonopterix heracliana
Agonopterix scopariella
Depressaria pastinacella
Coleophora dianthi
Ethmia bipunctella
Pyroderces argyrogrammos
Epidola stigma
Mirificarma eburnella
Eurodachtha pallicornella
Pterolonche (Gomezbustillus) pulverulenta
Enolmis acanthella
Phtheochroa rugosana
Aethes rutilana
Aethes smeathmanniana
Cnephasia alticolana

Avaria hyerana
Cacoecimorpha pronubana
Clepsis consimilana
Epinotia thapsiana
Crocidosema plebejana
Cydia pomonella
Brachodes cassandrella
Paranthrene tabaniformis synagriformis
Choreutis pariana
Zygaena fausta gibraltarica
Zygaena hilaris
Alucita hexadactyla
Alucita desmodactyla
Galleria mellonella
Corcyra cephalonica
Lamoria jordanis
Pyralis obsoletalis
Pyralis farinalis
Orthopygia glaucinalis
Aglossa pinguinalis
Aglossa caprealis
Hypsopygia costalis
Ulotricha egregialis
Actenia brunnealis
Endotrichia flammealis
Bradyrrhoa cantenerella
Etiella zinckenella
Pempeliella ardosiella
Oxybia transversella
Apomyelois ceratoniae
Zophodia grossulariella
Homoeosoma sinuellum
Plodia interpunctella
Ephestia kuehniella
Ematheudes punctella
Agriphila geniculea
andalusiella
Ancylolomia tentaculella
Hellula undalis
Eudonia lineola
Nymphula stagnata
Evergestis limbata
Evergestis isatidalis
Pyrausta purpuralis
Pyrausta sanguinalis
Uresiphita limbalis
Udea numeralis
Udea ferrugalis
Mecyna asinalis
Nomophila noctuella
Dolicharthria punctalis
Dolicharthria bruguieralis
Duponchelia fovealis
Antigastra catalaunalis
Diasemiopsis ramburalis
Metasia suppandalis
Hydriris ornatalis
Palpita unionalis
Merrifieldia tridactyla
Emmelina monodactyla
Oidaematophorus lithodactylus
Crombrugghia distans
Crombrugghia tristis
Amblyptilia acanthodactyla
Stenoptilia stigmatodactyla
Stenoptilia zophodactyla
Agdistis frankeniae
Agdistis pseudocanariensis
Lantanophaga pusillidactylus
Zeuzera pyrina
Drepana binaria
Cilix glaucata
Abraxas pantaria
Stegania trimaculata
Rhoptria asperaria
Athroolopha pennigeraria
Menophra abruptaria
Menophra japygiaria
Peridobates rhomboidarius
Biston stratarius
Campaea honoraria
Crocallis dardoinaria
Petrophora narbonea
Gnophos (Dicrognophos) perspersatus
Gnophos (Euchrognophos) mucidarius mucidarius
Aspitates ochrearius
Onychroa agaritharia
Pseudoterpna coronillaria
Chlorissa etruscaria
Microloxia herbaria
Bustilloxia menadiara
Hemistola biliosata
Xenochlorodes olympiaria
Xenochlorodes beryllaria
Idaea mediaria
Idaea attenuaria
Idaea alyssumata
Idaea belemiata
Idaea elongaria
Idaea inquinata
Idaea seriata
Idaea camparia
Idaea cervantaria
Idaea eugeniata
Idaea degeneraria
Cyclophora puppillaria
Cyclophora porata
Timandra griseata
Scopula marginepunctata
Scopula imitaria
Rhodometra sacaria
Casilda consecraria
Orthonama obstipata
Xanthorhoe montanata
Xanthorhoe fluctuata
Nebula ibericata
Horisme scorteata
Eupithecia unedonata
Eupithecia centaureata
Eupithecia gratiosata
Eupithecia dodoneata
Eupithecia scopariata
Gymnoscelis rufifasciata
Chesias rufata
Lasiocampa trifolii
Malacosoma neustria
Streblote panda
Acherontia atropos
Polyptychus trisecta
Agrius convolvuli
Macroglossum stellatarum
Hyles livornica
Hyles celerio
Hyles euphorbiae
Thaumetopoea pityocampa
Orgyia trigotephras
Lymantria dispar
Lymantria atlantica
Eilema lurideola
Eilema complana
Eilema caniola
Coscinia cribaria
Phragmatobia fulignosa
Cymbalophora pudica
Epicallia villica villica
Utetheisa pulchella
Nodaria nodosalis
Pechipogo plumigeralis
Polypogon crinalis
Hypena obsitalis
Hypena lividalis
Catocala (Catocala) conjucta
Catocala (Catocala) elocata
Catocala (Catocala) nymphagoga
Catocala (Catocala) conversa
Catocala (Catocala) nymphaea
Ophiusa tirhaca
Dysgonia algira
Tyta luctuosa
Tathorynchus exsiccata
Catephia alchymista
Pandesma robusta
Eutelia adulatrix
Nola cicatricalis
Nola cristatula
Earias clorana
Earias insulana
Raphia hybris
Acronicta psi
Acronicta rumicis
Cryphia algae
Cryphia ravula
Cryphia raptricula
Cryphia muralis
Zeebeda falsalis
Acontia lucida
Eublemma ostrina
Eublemma parva
Eublemma pura
Metachrostis velox
Trichoplusia ni
Trichoplusia orichalcea
Ctenoplusia limberena
Chrysodeixis chalcites
Abrostola triplasia
Autographa gamma
Cucullia chamomillae
Calophasia platyptera
Heliothis peltigera
Helicoverpa armigera
Periphanes incarnata
Aegle vespertinalis
Synthymia fixa
Caradrina clavipalpis
Eremodrina oberthuri
Hoplodrina ambigua
Spodoptera exigua
Spodoptera littoralis
Sesamia nonagrioides
Anthracia ephialtes
Phlogophora meticulosa

Callopistria latreillei
Aporophyla nigra
Xylena vetusta
Xylocampa areola
Dichonioxa tenebrosa
Polymixis dubia
Blepharita spinosa
Dicestra trifolii
Diataraxia oleracea
Hecatera dysodea
Hecatera bicolorata
Hadena perplexa
Mythimna putrescens
Mythimna albipuncta
Mythimna vitellina
Mythimna l-album
Mythimna prominens
Mythimna (Morphopoliana) languida
Mythimna loreyi
Mythimna unipuncta
Panolis flammea
Ochopleura plecta
Ochopleura leucogaster
Diarsia dahlii
Noctua pronuba
Noctua fimbriata
Noctua comes
Noctua janthe
Xestia c-nigrum
Cerastis faceta
Peridroma saucia
Agrotis obesa
Agrotis crassa
Agrotis ipsilon
Agrotis segetum
Agrotis puta
Agrotis biconica

2.7 Dragonflies & Damselflies (Odonata)

Aeshna mixta
Hemianax ephippiger
Anax imperator
Anax parthenope
Sympetrum fonscolombei
Sympetrum striolatum

Other orders of insects have not been so well documented, and even those that are listed are by no means complete. However, amongst other insect and invertebrate taxa, there are some well-known species that can also be found within the Nature Reserve. These include the scorpion *Buthus occitanus*, the Gibraltar funnel-web spider *Macrothele calpeiana*, the centipede *Scolopendra cingulatus*, the violet carpenter bee *Xylocopa violacea* and the praying mantis *Mantis religiosa*. An intensive study of the entire biodiversity of the Upper Rock Nature Reserve, to include all invertebrates, would be highly desirable.

2.8 Isopods (by Jason Easter)

A provisional list of the Isopods of the Upper Rock is given next. Those recorded on the Lower Slopes have been included in this list.

Iberoniscus beruili
Armadillo officinalis
Armadillidium granulatum
Armadillidium vulgare
Porcellio flavocinctus
Porcellio scaber
Porcellionides pruinosus

2.9 Molluscs (by Alex Menez)

The area defined as the upper rock is based on Menez (1993). Nomenclature and order of the systematic list follows Ortiz de Zárate (1962); Kerney & Cameron (1979); Kerney *et al.* (1983); Vaught (1989); Giusti *et al.* (1995); Kerney (1999) and Falkner *et al.* (2002).

Acicula norrisi
Lauria cylindracea
Pyramidula rupestris
Chondrina calpica
Granopupa granum
Truncatellina cylindrica
Cecilioides acicula
Cecilioides jani
Cecilioides petitiana
Cecilioides connollyi
Ferussacia folliculus
Rumina decollata
Vitrea contracta
Oxychilus draparnaudi
Oxychilus hydatinus
Milax gagates
Limacus flavus
Deroceras ponsonbyi
Geomalacus malagensis
Caracollina lenticula
Oestophora calpeana
Trochoidea spp.
Candidula intersecta
Pseudotachea litturata
Otala lactea
Cornu aspersum
Iberus marmoratus

Cream spot tiger

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Appendix 2: Vandalism, Litter and Defacement

Photographs highlighting the extent of vandalisms, defacement and litter within the Upper Rock Nature Reserve are shown below.

Litter













Graffiti

Structures, Roads and Damage

Gibraltar Ornithological
and Natural History Society