



Department of the Environment,
Heritage and Climate Change

HM Government of Gibraltar

Gibraltar Nature Reserve Management Plan



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Front cover: South view towards the Strait from Rock Gun, Upper rock

Above: View of the Mediterranean Sea from the Middle Ridge, Upper Rock

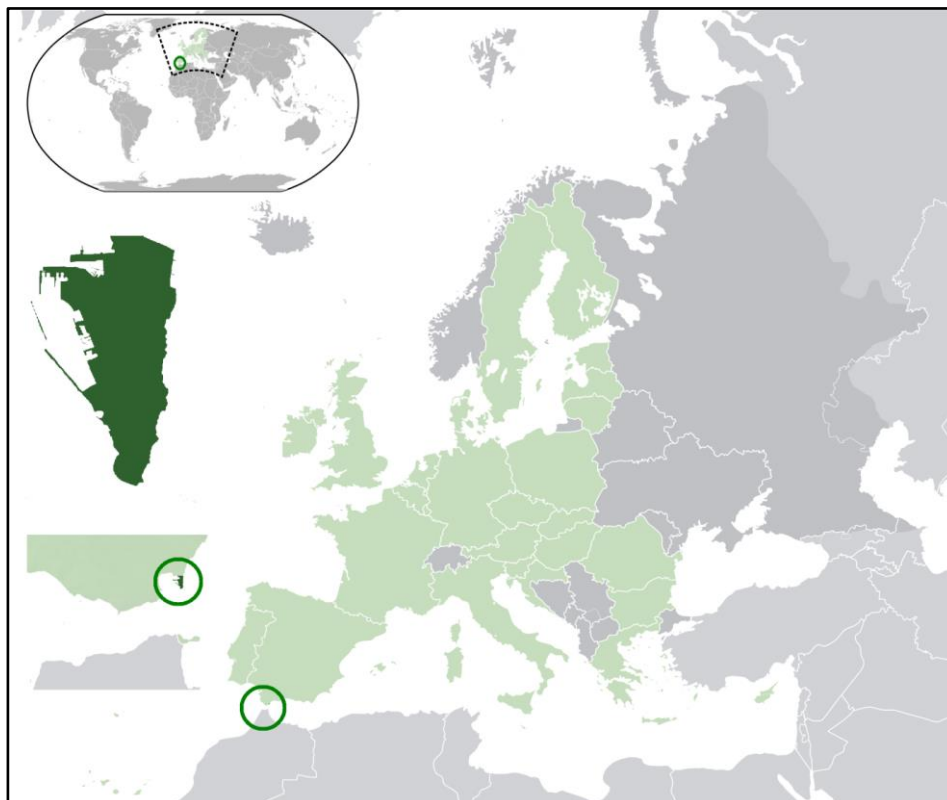
Back Cover: Jacob’s Ladder

Introduction

Gibraltar is an Overseas Territory of the United Kingdom situated at the entrance to the Mediterranean, overlooking the Strait of Gibraltar. Its strategic location and prominence have attracted the attention of many civilisations, past and present, giving rise to the rich history and popularity of 'The Rock'. In addition to its geographical importance, Gibraltar is just as impressive from a naturalist's perspective. It boasts many terrestrial and marine species, most of which are protected under the Nature Protection Act 1991, Gibraltar's pioneering nature conservation legislation.

Gibraltar's climate is Mediterranean, with mild, sometimes wet winters and warm, dry summers. Its terrain includes a narrow coastal lowland to the west, bordering the 426 metre high Rock of Gibraltar. With a terrestrial area of 6.53 km² and territorial waters extending up to three nautical miles to the east and south and up to the median line in the Bay of Gibraltar, it is of no surprise that Gibraltar's biological resources are inevitably limited. Yet despite its small extent, Gibraltar's biological diversity is well known for its variety and richness. It includes rare species of flora and fauna some of which are endemic and some which are found nowhere else in mainland Europe such as the Gibraltar Campion (*Silene tomentosa*), the Barbary Macaque (*Macaca sylvanus*) and the Barbary Partridge (*Alectoris barbara*). Moreover, Gibraltar's importance as a migratory bottleneck for birds, insects and marine species such as cetaceans and marine reptiles make it and the wider area of the Strait of Gibraltar an extremely important conservation area, as recognised by leading scientific institutions and non-governmental organisations such as the International Union for the Conservation of Nature and Birdlife International which designated two Important Bird Areas (IBAs) in Gibraltar.

Figure 1. Geographical location of Gibraltar.



Gibraltar's terrestrial environment has nevertheless changed considerably over the years. Historically, it is likely that the original vegetation found throughout the Upper Rock was woodland and this was destroyed over the centuries by tree felling and extensive goat grazing. Following the removal of goats during the 19th century, maquis or matorral became the dominant habitat type on the Upper Rock. This consists largely of species such as the Wild Olive (*Olea europea*), Lentisc (*Pistacia lentiscus*), Sandalwood (*Osyris lanceolata*) and Mediterranean Buckthorn (*Rhamnus alaternus*). A rich flora is particularly evident in open areas, firebreaks and the inaccessible cliffs and ledges on the Upper Rock.

The Gibraltar Nature Reserve has evolved and developed significantly since the Upper Rock was officially designated as a Reserve in 1993. As part of the continued effort to further protect biodiversity and natural habitats in Gibraltar, the then Upper Rock Nature Reserve was re-branded and its size extended in 2013 to include new areas that would further help protect important habitats and species. The Gibraltar Nature Reserve now encompasses 2.33km² which is approximately 36% of Gibraltar's terrestrial area. It includes many distinct habitats, some of which support endemic and rare species of flora and fauna and some typical plant associations. The habitats are legally demarcated under the Nature Conservation (Designation of Gibraltar Nature Reserve) Order 2013 (figure 2).

Providing specific habitats with legal protection carries additional responsibilities. It requires a robust management framework together with an action plan to ensure that conservation objectives are met. This was first recognised by Cortes (1977) when he developed the first environmental management plan for Gibraltar followed by Perez & Bensusan (2005) in their *Upper Rock Nature Reserve: A management and action plan* which was formally adopted by Her Majesty's Government of Gibraltar in 2012. A year after the publication of the plan, Perez (2006) assessed the wider requirements of conserving biodiversity in different terrestrial and marine habitats in Gibraltar as part of his wider management plan known as the *Gibraltar Biodiversity Action Plan: Planning for Nature*. Both of these plans have played a fundamental role in the development of the new Gibraltar Nature Reserve Management Plan; they are heralded as the cornerstone of conservation management in Gibraltar. The revised management plan therefore builds on these texts and the recommendations made therein, whilst neatly amalgamating all the relevant action points into one easily comprehensible and updated plan.

The Gibraltar Nature Reserve Management plan also brings with it a range of new and additional measures that will undoubtedly help improve the ecology of the Reserve as well as increase its value as a renowned tourist product. Achieving the delicate balance between conservation and tourism is by no means an easy task. It must, at the very minimum, be guided by an adherence to the principles of sustainable development. The new plan seeks to apply these principles by considering the environmental aspects of the Reserve as well as the social and economic dimensions or 'pillars'. To achieve this, the plan must be considered as a dynamic document that can be regularly updated in response to changing pressures and management requirements. Crucially, the plan should also be read in conjunction with the Gibraltar Development plan and the specific planning policies therein regarding the different components (e.g. zone 9 – Upper Rock, the Mount zone 8) The Gibraltar Development plan can be read at: <https://www.gibraltar.gov.gi/new/gibraltar-development-plan-2009>.

The Rock of Gibraltar: An EU protected site with International obligations

In addition to its local designation as a Reserve, a large proportion of the Gibraltar Nature Reserve is protected under European Union (EU) law. The Rock of Gibraltar is included in the list of EU protected sites as both a Special Area of Conservation (SAC) and a Special Protection Area (SPA) under the Habitats and Wild Birds Directives respectively. These are some of the highest levels of protection that can be afforded to a nature reserve in the EU and both SACs and SPAs are collectively known as NATURA 2000 sites. Gibraltar has more recently taken an active role in the development of EU policy in this field by regularly participating in EU Working Groups and high level meetings associated with the Mediterranean NATURA 2000 Protected Areas Network; a milestone achievement and high-level management measure in its own right. Being part of the wider EU framework also has its own obligations such as the requirement to have management plans and conservation objectives for each protected area. This management plan will serve to fulfil these requirements for the Rock of Gibraltar SAC/SPA, whose high-level conservation objectives were succinctly summarised as being:

‘Ensuring that the status of all European and locally protected features achieve or maintain favourable conservation status allowing for natural change’

More specific and measurable conservation objectives have been developed for EU habitats and species as part of the revised plan to ensure that tangible progress is made in safeguarding their protection. These are available from <https://www.gibraltar.gov.gi/new/publications>.



Meeting EU and International biodiversity targets is yet another challenge associated with being part of the NATURA 2000 network. The EU has adopted an ambitious strategy to halt the loss of biodiversity and ecosystem services by 2020 as part of the United Nations Decade of Biodiversity. This follows global commitments made in Nagoya in October 2010 under the framework of the Convention on Biological Diversity. These commitments need to be translated into strong actions at the local level and the new management plan provides the ideal platform to demonstrate Gibraltar’s aspiration to better protect the environment and halt biodiversity loss.



Convention on
Biological Diversity



Figure 2. Extent of the Gibraltar Nature Reserve.



Legend

 Gibraltar Nature Reserve

Overview of the Management Plan

This plan looks at each of the different components that make up the Gibraltar Nature Reserve which are mapped out (figure 3) and include:

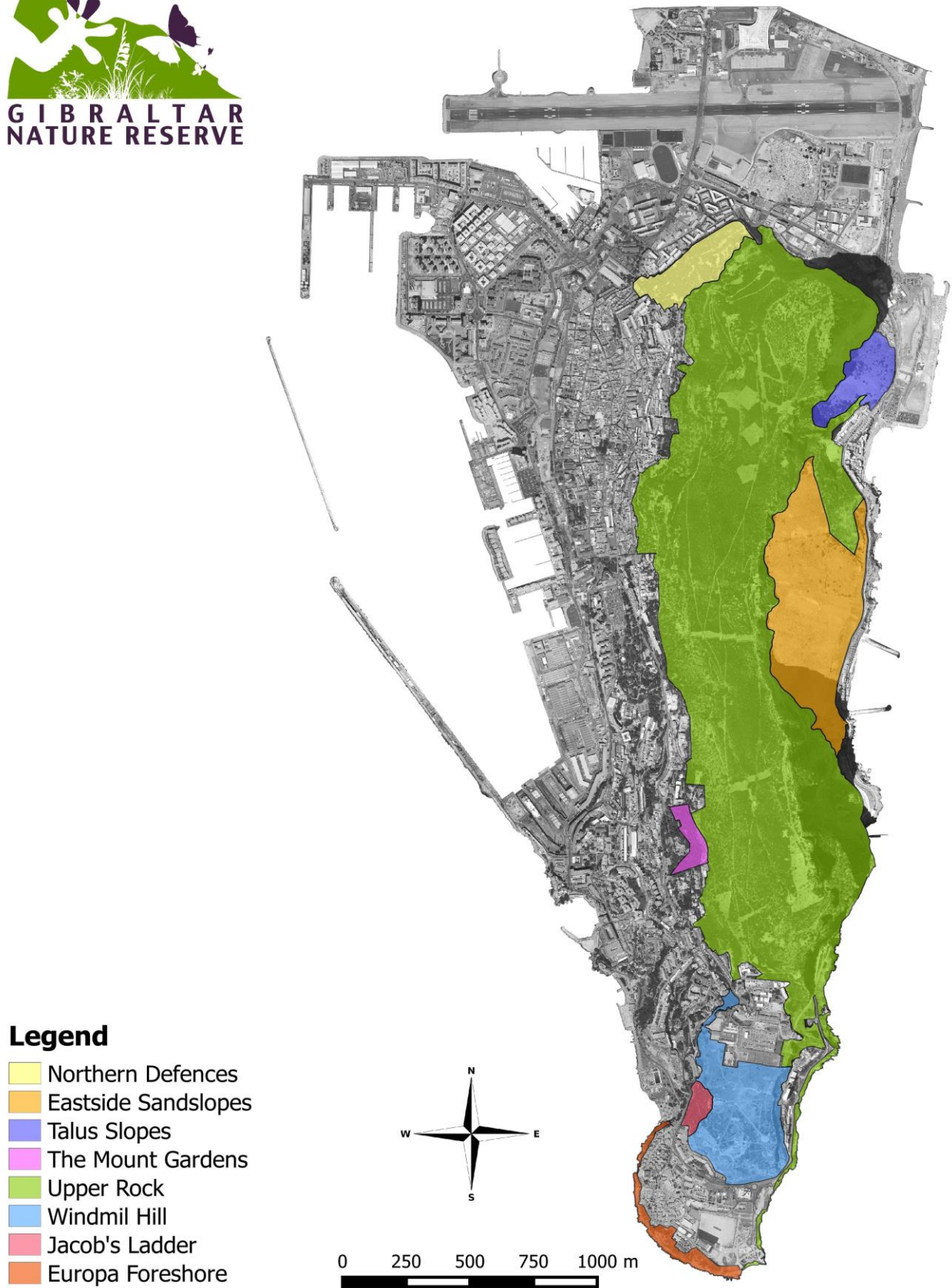
- The Upper Rock
- Northern Defences
- The Great Eastside Sand Slopes
- The Talus Slopes
- Parts of the grounds of the Mount
- Windmill Hill Flats
- Jacob's Ladder
- Europa foreshore

The plan provides an overview of the status of the different components whilst considering some of the habitats and species found in each component, including caves. Current factors affecting the different parts of the Reserve are assessed and this is followed by a comprehensive set of action points to help improve the ecological condition, recreational and heritage value as well as the tourism potential of the different Reserve components where relevant.

Biodiversity on the Rock: *Top left* – Swallowtail Butterfly. *Centre*: Griffon Vulture being released by Vincent Robba after being rehabilitated by the GONHS Raptor Unit. *Right*: Andalusian wall lizard. *Bottom left* – Barbary macaque. *Centre*: Hummingbird Hawk Moth. *Right*: Schreiber's Bent-winged Bat.



Figure 3. Components of the Gibraltar Nature Reserve.

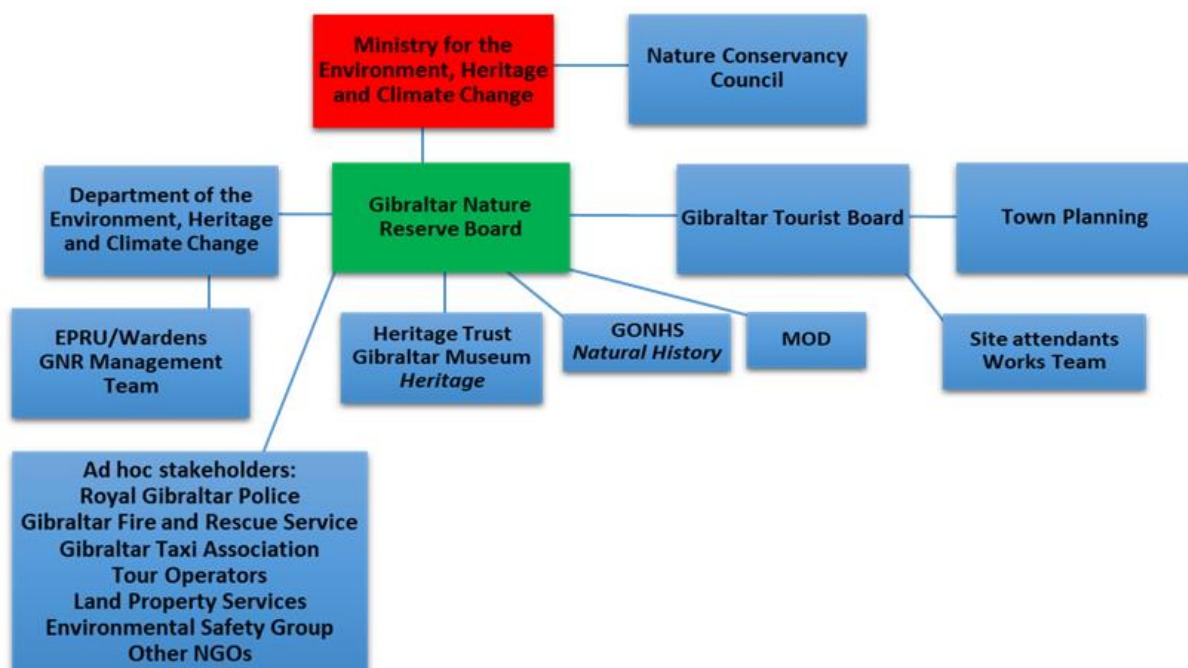


Management Structure

Implementing a hierarchical, coordinated and effective management structure will play a critical part in ensuring that all sites, habitats and species within the Reserve are protected. The unique wildlife and sites found within the Reserve continue to attract a large number of tourists to the Rock and this is an economic resource of immense importance to Gibraltar and its people, but it must be managed sustainably. The overall responsibility for the Upper Rock component of the Gibraltar Nature Reserve comes under the Ministry for the Environment, Energy and Climate Change. In order to synergise the existing management of the Reserve, a new Management Board will be created and regularly convened. The Gibraltar Nature Reserve Management Board will report to the Ministry for the Environment, Energy and Climate Change as the competent authority for protected areas and wildlife in Gibraltar. The composition of the Board is outlined below (figure 4).

The Department of the Environment and Climate Change will continue to play a critical role in the management of the Reserve, as well as the numerous stakeholders whose advice and recommendations are invaluable. These consist of the Gibraltar Ornithological & Natural History Society, the Gibraltar Botanic Gardens, the Heritage Trust, the Gibraltar Museum and the Ministry of Defence. A wider range of stakeholders who also have a vitally important role to play in the management of the Reserve will be consulted on an *ad hoc* basis, as relevant management issues arise. These include, but are not limited to, the Gibraltar Taxi Association, Tour Operators, the Gibraltar Fire and Rescue Service, Royal Gibraltar Police, cleaning contractors, Land Property Services, Gibraltar Electrical Authority, Aquagib, Environment Safety Group and other support services.

Figure 4: New management structure for the Gibraltar Nature Reserve.

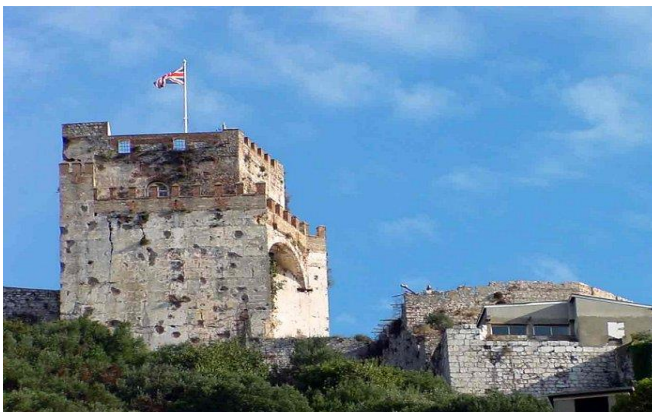


Gibraltar Nature Reserve: Upper Rock

A brief history of the Upper Rock and its management

The Upper Rock is not only rich in wildlife, but also in natural and human history. The presence of early man is confirmed in archaeological remains in caves, being partly the reason why some components of the reserve have recently been designated as a World Heritage Site by the United Nations Educational, Scientific and Cultural Organisation (UNESCO). The Moors were the first civilization to reside permanently on the Rock. Although named Mons Calpe by the Romans, it was later alleged to have been given the name Jebel Tarik, or mountain of Tarik. This name refers to the Umayyad General Tariq Ibn-Ziyad who led the Muslim conquest of Spain in 711 AD at the head of an army of Berbers, Syrians and Yemenis. Another possibility is that it was named Jebel Tarr, or bird mountain, in reference to the impressive passage of soaring birds often seen over the Rock.

Left: The Tower of Homage. Right: 16th century portrait of the Muslim Berber General Tariq ibn Ziyad who led the Islamic conquest of Visigothic Hispania through Gibraltar in 711 A.D.



Few Moorish structures are still present and clearly visible in Gibraltar today. Undoubtedly the most prominent is the Tower of Homage, part of the Moorish Castle complex which borders the Upper Rock. This castle was built in 1068 AD by the Arab governor of Algeciras. The Moors were present in Gibraltar until 1462, when the Rock was taken by the forces of Queen Isabella and King Ferdinand of Spain. It was after 1540, when Barbary Corsairs raided the town, that Charles V of Spain ordered the construction of a new defensive wall to protect the town from any attack from the South. This wall was later extended towards the ridge of the Rock and is now known as Charles V Wall.

In 1704, joint British and Dutch forces captured Gibraltar during the War of Spanish Succession, and in 1713 the Treaty of Utrecht was signed, granting Gibraltar to the British Crown. In order to protect the town against a counter-offensive, fortifications in Gibraltar were reinforced by the British garrison. Additional batteries were also constructed at the northern end of the Rock, overlooking the Spanish lines, which are still evident to this day. In 1782, renewed Spanish military activity prompted the Governor of Gibraltar at the time, General George Elliott, to find new ways to counter the Spanish effort to re-gain Gibraltar. One idea arose from Warrant Officer Ince, who suggested mounting a gun battery on the notch, a ledge that sits half way up the North face of the Upper Rock. Tunnelling towards the notch commenced and after blasting

some fifteen metres, an opening or aperture had to be constructed to provide ventilation. It was then realised that such apertures would make for excellent gun emplacements. Tunnelling therefore continued during the 18th Century, giving rise to the many gun emplacements that are seen on the Northern cliff face of the Upper Rock. Some of the most impressive military tunnels built during this time can still be accessed today, such as the Great Siege Tunnels. This is one of the Nature Reserve's prime tourist attractions.

The British Garrison has historically maintained a strong presence on the Upper Rock, and before WWII, it began constructing defensive batteries on most promontories on the Rock for the protection of 'Fortress Gibraltar'. In 1938, the then Governor of Gibraltar, Sir Edmund Ironside strengthened the Rock's defences against the possibility of a land attack, particularly those facing North. Defensive guns can still be seen at Princess Caroline's and Princess Amelia's Batteries. Large 9.2 inch guns were also placed at the southern end of the Rock to defend the Strait of Gibraltar. These still stand at O'Hara's and Lord Airey's Batteries. Numerous anti-aircraft batteries and searchlight emplacements were also built during this time and these can still be found in different parts of the Nature Reserve, particularly the Upper Rock and the Northern Defences.

On the advent of WWII, the Upper Rock became a total exclusion zone to the resident population. It was demarcated by an 'unclimbable fence'. Soon after the war, the Upper Rock was again opened to the public, but only during daylight hours. The area was controlled by the Gibraltar Security Police and regular firebreak and vegetation clearance works were carried out by the Ministry of Defence (MOD).

Mk X gun facing north at Breakneck Battery, Upper Rock, in January 1942.



In the mid to late 1960's most of the Upper Rock was passed into the care of the Gibraltar Government with the MOD retaining control of Middle Hill, Rock Gun and Spyglass Battery, together with the management of the Barbary macaques. St. Michael's Cave and the Upper Galleries were the first two sites to be developed for tourism but the macaques quickly became, and remain, the most important attraction that entices tourists to Gibraltar.

The Government of Gibraltar recognised that it had to take strong action to conserve Gibraltar's natural habitats and species early on in the 1990s, and in doing so, published the Gibraltar Nature Protection Act on the 9th May 1991. The Upper Rock itself was designated as a Nature Reserve shortly after, in 1993. The establishment by the GONHS of the Jews' Gate (Upper Rock) Field Study Centre in 1990 played a pivotal role in raising awareness on the need to protect the riches of the Upper Rock. The Field Centre also helped place the Reserve on the global map and set the foundations for the Gibraltar Ringing Group - the only ringing group operating under the British Trust for Ornithology outside the United Kingdom. Over the years, the Field Centre has enabled hundreds of researchers to visit and carry out scientific research on birds, flora, mammals, insects and reptiles within the Upper Rock. Bird migration, for example, has regularly been monitored from Jews' Gate for over 45 years. All of this has helped situate the Upper Rock as a unique monitoring station within the wider region of the Strait of Gibraltar.

Current Status

The passage of time and historic events have resulted in the Upper Rock's environment undergoing several transformations. Habitats have ranged from a once wooded landscape to a totally denuded slope and, more recently, a succession of habitats comprising pseudo steppe, garrigue and dense maquis. The Gibraltar Ornithological & Natural History Society (GONHS) has been instrumental in researching, documenting and studying the habitats and species found on the Upper Rock, whilst providing sound management recommendations as exemplified in the *Upper Rock Nature Reserve: Management and Action Plan* (Perez & Bensusan 2005) and the *Gibraltar Biodiversity Action Plan* (Perez 2006).

Flora

The Upper Rock hosts a wide variety of species, some of which are only found in Gibraltar and the Strait region. The Gibraltar Candytuft (*Iberis gibraltatica*) is perhaps the most distinctive and attractive of these plants. Large tufts of these very pretty, pink to lilac flowers colour the cliffs and ledges of the Nature Reserve in the spring. This species also grows across the Strait, where it is rare, and Gibraltar is its only European station. The white Gibraltar Chickweed (*Cerastium gibraltarium*), which is found only in Gibraltar, grows, like many of Gibraltar's special plants, along cliff habitats. Often found alongside this species is the Gibraltar Saxifrage (*Saxifraga globulifera gibraltatica*), a variety that is also endemic to the Rock. Stands of these plants hug the sides of cliffs and walls, and are characterised by their tiny white flowers and often red, lobed and hairy leaves. The aromatic Gibraltar Thyme (*Thymus wildenowii*) is more common than the previous two species and is fairly widespread within the Nature Reserve.

Perhaps the most special plant found on the Upper Rock is the Gibraltar Campion (*Silene tomentosa*), a very rare species that is found only on the Rock of Gibraltar. After being seen for the last time in 1985, this plant was thought to have become extinct. However, it was rediscovered nine years later close to the site where it had last been observed. The Gibraltar Campion is a very attractive perennial. Each plant produces a number of white to pink flowers

which emit a sweet scent during the evening and at night.

Although the Upper Rock currently holds diverse flora, with approximately 363 species recorded by Linares (2003), its vegetation is largely dominated by Mediterranean shrub habitat known as maquis. The maquis species composition found in Gibraltar today is unique in the region, largely due to the Rock's alkaline soils influenced by the limestone which forms the bulk of the ground rock (Cortes, in Heath & Evans 2000). Some of the key species that make up the maquis are listed in table 1.

Table 1. Key species found in the Upper Rock's maquis habitat.

Wild Olive (*Olea europea*)
Sandalwood (*Osyris lanceolata*)
Dwarf Fan Palm (*Chamaerops humilis*)
Lentisc (*Pistacia lentiscus*)
Turpentine tree (*Pistacia terebinthus*)
Mediterranean Buckthorn (*Rhamnus alaternus*)
Mediterranean Jasmine (*Jasminum fruticans*)
Honeysuckle (*Lonicera implexa*)
Common Wild Madder (*Rubia peregrina*)
Spineless Butcher's Broom (*Ruscus hypophyllum*)
Spiny Broom (*Calicotome villosa*)
Shrubby Scorpion Vetch (*Coronilla valentina*)
Mediterranean Broom (*Genista linifolia*)

Dense maquis is made impenetrable in places by climbing plants such as the Common Smilax (*Smilax aspera*), Dutchman's Pipe (*Aristolochia baetica*), Black Byrny (*Tamus communis*) and *Clematis cirrhosa*. In addition, scattered individuals of Sweet Bay (*Laurus nobilis*), Black Hawthorn (*Rhamnus lycioides*), Virgin's bower (*Clematis flammula*), Kerme's Oak (*Quercus coccifera*), Nettle Tree (*Celtis australis*), Bean trefoil (*Anagyris foetida*), Carob Tree (*Ceratonia siliqua*), Common Hawthorn (*Crataegus monogyna*) and *Phillyrea latifolia* also occur in the Upper Rock (Linares 1994).

The firebreaks that break up the maquis harbour a very large variety of flowering plants; more so than the maquis, where light can scarcely penetrate through the canopy, making growth of annual plants extremely difficult. These areas hold a total of 213 plant species; some 37% of the Rock's entire flora, and include some species that grow only on the firebreaks. These areas look very colourful during the winter and spring, when plants such as the Paper-white Narcissus (*Narcissus papyraceus*), Common Asphodel (*Asphodelus ramosus*), Giant Tangier Fennel (*Ferula tingitana*), Wild Gladiolus (*Gladiolus communis*), Galactites (*Galactites tomentosus*) and Mallowleaved Bindweed (*Convolvulus althaeoides*), as well as rarer species such as the Shrubby Sideritis (*Sideritis arborescens*) and Yellow Bartsia (*Parentucellia viscosa*) add much character to the landscape.



Giant Tangier Fennel



Several habitat types, other than maquis, are also found in the Upper Rock, such as a garrigue habitat which was first characterised and surveyed by Cortes in 1979. Garrigue is a low scrub habitat dominated by annuals and aromatic herbs. Plants that grow in this habitat include Wild Rosemary (*Rosmarinus officinalis*), Esparto Grass (*Macrochloa tenacissima*), White Asparagus (*Asparagus albus*), Toothed and Cut-leaved Lavender (*Lavandula dentata* & *L. multifida*), Mediterranean Broom (*Genista linifolia*), Prasium (*Prasium majus*), Shrubby Scorpion Vetch (*Coronilla valentina*) and the Germanders (*Teucrium fruticans* & *T. lusitanicum*). Many beautiful flowers typically occur between these shrubs, such as the large, blue Giant Squill (*Scilla peruviana*), a small iris known as the Barbary Nut (*Moraea sisyrinchium*), Narrow-leaved Purple Iris (*Iris filifolia*), Wild Gladiolus, Purple Jerusalem Sage (*Phlomis purpurea*) and Star of Bethlehem (*Ornithogalum baeticum*).

As part of the *Upper Rock Nature Reserve Management Plan* (Perez & Bensusan, 2005), a second habitat survey was carried out in 2002, although no surveys have been carried out since using tools such as Geographical Information Systems (GIS). This would greatly assist the management of specific habitats in the Upper Rock and wider Reserve network and is therefore included as a priority measure of the plan.

EU habitat types

The current composition of some of the habitats found within the Upper Rock and the wider Gibraltar Nature Reserve can also be classified into specific habitat types of European importance. These are listed under Annex I of *Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, otherwise known as the Habitats Directive.

EU habitat types found in the wider Reserve include:

- **Mediterranean Sclerophyllous Forests (*Olea* and *Ceratonia*)** – *Olea europea* is one of the main shrubs/trees found within the Reserve, particularly the western slope, whereas the Carob Tree (*Ceratonia siliquais*) is slowly re-establishing itself in the lower reaches of the Reserve. Both the Gibraltar funnel web spider (*Macrothele calpeiana*) and the Horseshoe whip-snake (*Coluber hippocrepis*) occur in this habitat type. These species are also listed under the Habitats Directive.
- **Vegetated sea-cliffs of the Mediterranean coast with endemic *Limonium* spp.** - Limestone sea cliffs harbouring perennial plant communities including the Gibraltar Sea-lavender (*Limonium emarginatum*) are found throughout the Reserve.
- **Thermo-Mediterranean and Pre-steppe Brush with low formations of *Euphorbia* close to cliffs** - Found on parts of the western slopes of the Rock and especially Mediterranean Steps. This habitat is extremely important for breeding Barbary Partridge (*Alectoris barbara*) and as a stop-over site for migratory birds.
- **Mediterranean arborescent matorral including matorral with Sweet Laurel (*Laurus nobilis*)** - This is representative of Mediterranean matorral covering most of the western slopes of the Nature Reserve, dominated by Wild Olive (*Olea europea*), *Osyris lanceolata*, Mediterranean Buckthorn (*Rhamnus alaternus*) and Lentisc (*Pistacia lentiscus*), with individual stands of Sweet Laurel (*Laurus nobilis*) and Nettle Tree (*Celtis australis*) scattered within. The laurel-containing matorral is mainly found on the south-western slopes. The presence of this species makes it a Priority Habitat. This habitat is important as a stopover site for migratory birds and also holds populations of the

Gibraltar Funnel-web Spider (*Macrothele calpeiana*) and the Horseshoe Whip-snake (*Coluber hippocrepis*).

- **Chasmophytic Vegetation on Rocky Slopes of calcareous sub-types** - Found on the northern and eastern cliffs of the Rock, including the outcrops of the cliffs along the western side. Plants of particular interest found within this habitat type include Gibraltar Saxifrage (*Saxifraga globulifera gibraltarica*), Gibraltar Chickweed (*Cerastium gibraltaricum*), Gibraltar Thyme (*Thymus wildenowii*), Wall Helichrysum (*Helichrysum rupestre*) and the Gibraltar Candytuft (*Iberis gibraltarica*). The endemic Gibraltar Campion (*Silene tomentosa*), once thought extinct (Cortes & Linares, 1993), has also been found in this habitat. The chasmophytic vegetation of the Rock of Gibraltar is representative of areas of limestone in the Mediterranean but has added global importance due to the presence of taxa which are either endemic or with affinities to North Africa.
- **Dunes with *Euphorbia terracina* and *Malcolmietalia* dune grassland** – Found on the Sand Slope component of the Reserve. Typical species found in these habitats include the White Asphodel (*Asphodelus albus*), Joint Pine (*Ephedra fragilis*), False Caper (*Euphorbia terracina*), Silver Sea Stock (*Malcolmia littorea*), Gibraltar Restharrow (*Ononis natrix ramosissima ramosissima*), *Elaeoselinum foetidum*, Giant Tangier fennel (*Ferula tingitana*), Smilo Grass (*Piptatherum miliaceum*), Red Dock (*Rumex bucephalophorus*), Sticky Catchfly (*Silene nicaeensis*), Giant Mullein (*Verbascum giganteum*), Iberian Scorpion (*Buthus cf. ibericus*), Bedriaga's Skink (*Chalcides bedriagai*), Three-toed Skink (*Chalcides chalcides striatus*), Yellow-legged Gull (*Larus michahellis*) and the Barbary Partridge (*Alectoris barbara*).
- **Caves not open to the public** – Found throughout the Reserve network, particularly within the Upper Rock and the Great Sand Slope components. These support populations of bats including Schreiber's Bent-wing Bat (*Miniopterus schreibersi*) and European Free-tailed Bat (*Tadarida teniotis*).

Birds

The Upper Rock is a place of special importance for birds. Thousands upon thousands of migrating birds concentrate at the Strait of Gibraltar in the autumn on their way South to their wintering grounds in Africa. The Northward migration in the spring is just as impressive when birds return to their European breeding grounds. It is the migration of soaring birds, and in particular the birds of prey, that captures the imagination of most people. These movements can be spectacular, and it is not uncommon for several thousand birds belonging to a number of species to be seen in one day. Black Kites (*Milvus migrans*) and Honey Buzzards (*Pernis apivorus*) are most plentiful. About 90,000 individuals of each species cross the Strait during the southward migration. Also frequent are Booted Eagles (*Aquila pennata*), Short-toed Eagles (*Circaetus gallicus*), Montagu's Harrier (*Circus pygargus*) and Marsh Harriers (*Circus aeruginosus*), Egyptian Vultures (*Neophron percnopterus*), Griffon Vultures (*Gys fulvus*), Common Buzzards (*Buteo buteo*), Sparrowhawks (*Accipiter nisus*), White Storks (*Ciconia ciconia*) and Black Storks (*Ciconia nigra*). During the spring, migrating raptors are best observed from Jews' Gate Field Station when the wind blows from the west, as it is during these times that the stream of birds is pushed towards Gibraltar. However, during the autumn, soaring bird migration is best observed from the top of the Rock.





Short-toed Eagle

Migration of smaller birds, or passerines and near-passerines, can also be quite noticeable at times. Those that migrate during daylight hours, such as hirundines and European bee-eaters (*Merops Apiaster*) are perhaps most noticeable. However, during adverse weather conditions, nocturnal migrants are often grounded on the Upper Rock in some numbers. Warblers, thrushes and chats can often be seen searching for food in order to replenish their energy and continue their arduous journey. In addition, the unwary walker may sometimes startle larger birds such as nightjars and Hoopoes (*Upupa epops*). As well as hosting an abundance of migratory birds, the Upper Rock also harbours some interesting and even unique resident species. The Barbary Partridge (*Alectoris Barbara*), a bird that is not uncommon within the Reserve, is found nowhere else on mainland Europe. Like the Macaque (*Macaca sylvanus*), this bird was introduced to Gibraltar from North Africa. Some interesting birds of prey are also to be found within the Upper Rock. The cliffs around the Upper Rock hold up to six nesting pairs of Peregrine Falcon (*Falco peregrinus*), a very high number for such a small area. There is enough food for this density to be maintained as the falcons frequently hunt dayflying migrants. Watching a pair of Peregrines stooping after flocks of Swallows over the crest of the Rock is a spectacular and unforgettable sight. Two species of Kestrel also breed on the cliffs of the Upper Rock. These are the Common Kestrel (*Falco tinnunculus*) and the beautiful, globally endangered Lesser Kestrel (*Falco naumanni*). Nocturnal raptors such as the magnificent Eagle Owl (*Bubo bubo*) and also the Little Owl (*Athene noctua*) nest on the cliffs in and around the Upper Rock, whereas Tawny (*Strix aluco*) and Scops Owls (*Otus scops*) are regularly seen during the winter and migration periods.



European Robin

Reptiles

Twelve species of reptile occur within the Upper Rock, twice the number of species that occur within the whole of the UK. The reptiles most likely to be seen are the Andalusian Wall lizard (*Podarcis vaucheri*) and the Moorish Gecko (*Tarentola mauritanica*). The largest European lizard, the Ocellated lizard (*Timon lepidus*), was found in the Upper Rock but is now considered locally extinct. Other species found include the Algerian sand-racer (*Psammotriton algirus*) and the legless Amphisbaenian, which is found under rocks and in the soil.

The most common snake is the Horseshoe Whip Snake (*Hemorrhois hippocrepis*), which is long and thin with a horseshoe pattern on its back and a bright orange underside. Other snakes found in the Upper Rock are the Ladder Snake (*Zamenis scalaris*), Southern Smooth Snake (*Coronella girondica*), False Smooth Snake (*Macropododon mauritanicus*) and the Grey Montpellier Snake (*Malpolon monspessulanus*). Of these, the False Smooth Snake (*Macropododon mauritanicus*) and the Montpellier Snake (*Malpolon monspessulanus*) are venomous.

Mammals

The most famous of the Rock's mammals are of course the Barbary Macaques (*Macaca sylvanus*). Little is known about their origin, although they were probably introduced to

Gibraltar by the British. The story of how Winston Churchill intervened to save the macaques during the second world war, when their numbers had reduced considerably, is a well known chapter of British military folklore. The macaques are just as emblematic today as they were back then and perhaps more importantly, they are one of Gibraltar's major tourist attractions.

Apart from the Macaques, few mammals are found on the Upper Rock and most are difficult to see. A small population of Wild Rabbits (*Oryctolagus cuniculus*) occurs, as do the Greater White-toothed Shrew (*Crocidura russula*) and Black Rat (*Rattus rattus alexandrinus*), which in Gibraltar is actually brown with a white belly. The Red Fox (*Vulpes vulpes*) was found on the Upper Rock until the early 1980s. These gradually became extinct, although a reintroduction programme is being proposed as part of the plan.

A number of bat species are found on the Upper Rock. The European Free-tailed Bat (*Tadarida teniotis*), one of the largest bats in Europe, makes its home within crags on the cliffs that surround the Upper Rock. Some of the caves and tunnels provide roosting and breeding sites for bats; the Greater Mouse-eared Bat (*Myotis myotis*) and the rare Schreiber's Bent-wing Bat (*Miniopterus schreibersi*) were formerly found at some of these sites in great numbers, but these have since undergone a sharp reduction, caused in part by human disturbance. Pipistrelle species are also common and can frequently be seen in the town area and the Gibraltar Botanic Gardens. More recently, species such as the Isabelline Serotine (*Eptesicus isabellinus*) have also been recorded in the Reserve and there is growing evidence that larger species such as *Nyctalus* bat species are found on the Upper Rock.



Invertebrates

A diverse range of insects and other invertebrates can be observed on the Upper Rock. These are sometimes large and colourful and spring is the season when insects are most plentiful. However, some species such as the praying mantises and dragonflies are a feature of the late summer months, with the migration of dragonflies across the Strait being particularly noticeable.

Approximately 33 species of butterfly can be seen on the Upper Rock. They include species such as the Cleopatra (*Gonypteryx cleopatra*), Clouded Yellow (*Colias croceus*), Spanish Festoon (*Zerynthia rumina*), Red Admiral (*Vanessa atalanta*) and Painted Lady (*Vanessa cardui*). The Large Swallowtail (*Papilio machaon*) and the Two-tailed Pasha (*Charaxes jasius*) are perhaps some of the more emblematic species of the Reserve, given their large and colourful appearance. Moths are also plentiful and early spring is the best time to see caterpillars of the Pine Processionary Moth (*Traumatocampa pityocampa*), which create silken nests on pine trees.



These caterpillars, whose hairs are extremely irritant and should be avoided, form long processions and are usually seen along the roads and paths of the Upper Rock in March and April. Other interesting species of insects include the Hummingbird Hawkmoth (*Macroglossum stellatarum*) as well as the Striped Hawkmoth (*Hyles livornica*) and Cream-spot Tiger moth (*Epicallia villica*).

The Cicada (*Cicada orni*) is yet another common insect found on the Upper Rock and characteristic of the Gibraltarian summer. The males of this large, fly-like creature churr away persistently during the summer months. It is at this time of the year that clusters of the Mediterranean Coastal Snail (*Theba pisana*) can be seen on the tops of stalks and poles as they shut off for the season in order to survive the hot and dry summer period experienced on the Upper Rock. Towards the end of the summer, adult praying mantises (*Mantis religosa* & *Sphodromantis viridis*) can be seen in open areas on and around the Upper Rock. Their prey include large insects and even small lizards.

In addition to insects, other invertebrates are also common. Several large spiders occur, the most notable of which are the Orb-weaving Spider (*Araneus pallidus*) and the Gibraltar Funnel-web Spider (*Macrothele calpeana*), a very large, hairy, black spider whose webs can be seen in many of the tree trunks and crevices of the Nature Reserve. Equally notable is the large centipede *Scolopendra cingulatus*, commonly found under rocks and bark of trees. These creatures are protected by law and can inflict a nasty bite. Rare snails can also be found in the reserve such as the endemic snail *Acricula norrisi*, found nowhere else but in Gibraltar, as well as *Oestophoroa calpeana* which is endemic to the Strait of Gibraltar region.

Former inhabitants

A number of species have been lost from the Upper Rock and the wider reserve over the years. Birds such as the Osprey (*Pandion haliaetus*) nested in Gibraltar until the 1930's and a pair of Bonelli's Eagles (*Aquila fasciata*) and another of Egyptian Vultures (*Neophron percnopterus*) were also present. Smaller birds such as the Black Wheatear (*Oenanthe leucura*) were also found, particularly in the Great Eastside Sand Slopes. Mammal species that have been lost include the Spanish Ibex (*Capra pyrenaica*), Red Fox (*Vulpes vulpes silicea*), Genet (*Genetta genetta*) and Wild Boar (*Sus scrofa baeticus*) amongst others. Reptiles such as the Ocellated Lizard (*Lacerta lepida*) and the Spiny-footed Lizard (*Acanthodactylus erythrurus*) were also found. This plan aims to reintroduce some of these animals to further increase the species richness and value of the reserve. More importantly, the plan will help ensure that the existing species found in the reserve are not lost.

Factors affecting the Upper Rock

Most factors affecting the habitats of the Upper Rock were originally addressed in Perez & Bensusan (2005). Most of these pressures remain significant issues in the management of the Upper Rock and are highlighted below:

- Visitor pressure and disturbance;
- Increased urban development and encroachment near the boundary of the Reserve;
- Limited green corridors especially between Windmill Hill and the Upper Rock;
- Cliff stabilisation measures and illegal climbing activities;
- Feral cats;

- The spread of alien and other invasive species;
- Excessive traffic and pollution;
- Habitat succession.

Existing measures in place

Numerous management measures are already well established in the functioning of the Gibraltar Nature Reserve, predominantly within the Upper Rock component, and these include:

- Annual clearing of roadside vegetation;
- Path maintenance;
- Gull control programme;
- Alien and invasive species control programme;
- High maquis clearance programme;
- Clearing of firebreaks;
- Habitat/sites surveillance programme.

The creation of the Upper Rock Team (URT) had a profound impact on the delivery of key management measures. The URT was previously tasked with the general upkeep of the Upper Rock in terms of roadside vegetation clearing and the maintenance of paths and structures. As part of the revised plan, the role of the team has been extended to tackle all areas of the Gibraltar Nature Reserve to ensure that the relevant management measures are implemented. In doing so the URT has been re-branded the Gibraltar Nature Reserve Management Team.

Gibraltar Nature Reserve Management Team. Left to Right (back): Reuben Senior, (Front) Matthew Dignam, Arthur Asquez, Christian Asquez and Jonathan Avellano.



Upper Rock conservation measures in practice. 1. Planting trials carried out with local schools. 2. High maquis clearance carried out by the Nature Reserve Management Team. 3. Installation of Nature Reserve demarcation signs.



Management measures

The implementation of the measures presented in Perez & Bensusan (2005), together with those identified by the Department of the Environment and Climate Change, will cater for the necessary requirements of the Upper Rock. The Gibraltar Nature Reserve Management Plan therefore seeks to reinforce current actions and introduces new measures to further secure and enrich biodiversity within the Upper Rock as well as increase its tourism and recreation value. The proposed measures are listed below.

Management and coordination

- Establishing a renewed Management Board for the Gibraltar Nature Reserve;
- Ensuring that there is harmonisation with (1) the Gorham's Cave Complex World Heritage Site Management Plan to safeguard the Outstanding Universal Value of the property and (2) the Barbary Macaque Action and Management Plan;
- Increasing resources for the Gibraltar Nature Reserve Management Team;
- Requiring prior approval from the Minister for the Environment and Climate Change for any proposed events or activities affecting the Upper Rock or the wider Gibraltar Nature Reserve.

Ecology and conservation

- Designating Rock Gun and Middle Hill as a Biological Reserve with restricted access;
- Determining more specific and measurable conservation objectives for all EU protected habitats and species within Rock of Gibraltar SPA/SAC and regularly reviewing these objectives;
- Improving facilities at the Jews' Gate, Bruce's Farm and Farrington Battery Field Centres;
- Carrying out regular habitat surveys of the Upper Rock and the wider Reserve using GIS and local/EU habitat classifications;
- Improved firebreak clearing programme, including the creation of new firebreaks;
- Requiring prior approval from the Department of the Environment and Climate Change for the clearing of roadsides. This shall be carried out in line with the guidelines developed by Linares (1997);
- Annual clearing of Bruce's Farm & Aerial Farm firebreaks;
- Creating re-population and re-introduction facilities within the Reserve;
- Re-populating and re-introducing species within the nature reserve such as the Barbary Partridge (*Alectoris barbara*), Wild Rabbit (*Oryctolagus cuniculus*), Red fox (*Vulpes vulpes*), Lesser Kestrel (*Falco naumani*) and others following established protocols;
- Exploring the re-introduction of Roe deer (*Capreolus capreolus*) and the Black wheatear (*Oenanthe locura*);
- Continuing to artificially propagate and re-introduce the Gibraltar Campion (*Silene tomentosa*);
- Creating and maintaining pond habitats;
- Implementation of the Barbary Macaque Action and Management Plans;
- Increased surveillance monitoring of cave habitats (see caves section);
- Systematic removal of invasive and alien species.



Orb-weaving Spider

Aesthetic improvements

- Removal of old signage and installation of new, uniform signage including Nature Reserve demarcation, fire hazard, traffic awareness and tourist information signs;
- Installing new balustrades;
- Removal of disused pipes and structures or where this is not possible reducing their visual impact;
- Increasing the frequency of graffiti removal works.

Environmental education

- Installing new habitat and wildlife interpretation panels;
- Increasing Nature Reserve awareness and education including the development of a Gibraltar Nature Reserve mobile application;
- Creating modern and interactive interpretation centres on the Upper Rock;
- Publishing an Upper Rock guide.



Security & litter removal

- Increasing security in the Upper Rock (e.g. CCTV and more regular environmental enforcement patrols);
- Increasing resources and wildlife training for the Department of the Environment and Climate Change's Environmental Protection and Research Unit;
- Providing recycling bins for plastic, paper and glass in all the main tourist sites;
- Increasing litter removal schedules and extending these to inaccessible areas, such as cliffs, using qualified abseiling staff.

Recreation

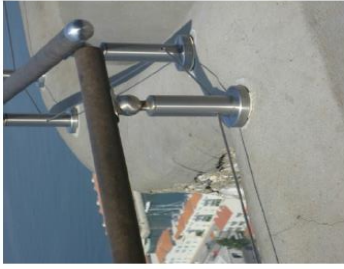
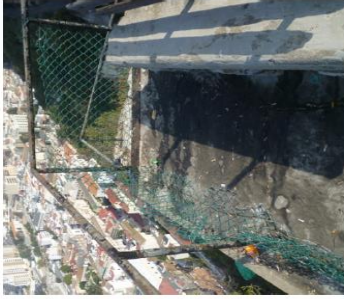
- Installing new picnic areas;
- Installing new telescopes in key viewpoints;
- Constructing a bird photography hide;
- Securing, restoring and facilitating public access to heritage assets, including WWII artefacts, within the Upper Rock;
- Installing drinking water fountains in selected locations of the Upper Rock;
- Improving scouting and girlguiding facilities;
- Improving disability access, where possible, within the Reserve;
- Providing facilities for astronomy enthusiasts at O'Hara's Battery;
- Designating a climbing area(s) for sports climbers;
- Maintaining existing paths.

Additional measures relevant to the Upper Rock are contained within the 'Thematic trails and general improvements' section of the plan.



General Improvements – Materials palette and standard details

Ensuring a standardization of materials, standard details and graphic styles to ensure a more coherent and uniform aesthetic throughout the Nature Reserve.



Existing:

- Mixture of various materials and details, often in very disparate state of repair from each other
- Piecemeal refurbishments and interventions, each with a different language; poor legibility and lack of cohesion that detracts from the visitor experience



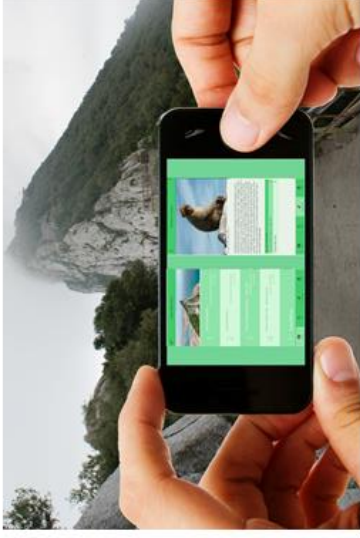
Ongoing:

- Standardized palette of materials and typical details to be employed throughout, developing a consistent look to be used for all works in the Nature Reserve
- Utilizing an aesthetic that is sensitive to the historic and natural setting, avoiding pastiche and 'sanitised' looks that detract from the real attractions of the Upper Rock



General Improvements – Signage and visitor information

Improved and more uniform way-finding and interpretational signage, as well as interactive mobile phone app.



Ongoing intervention:

- Simple and legible way-finding signage, including maps, directional signs and informative interpretation signs. Unified graphical look, typeface and colour scheme, readily recognizable in different locations throughout the Upper Rock
- Clearly identified pedestrian routes and sites, linking the Upper Rock Nature Reserve to the urban context
- Interactive app with content for visitors with smartphones, including aspects such as way-finding assistance, additional interpretative information, etc. To be further developed with elements such as augmented reality, interactive games, etc.



Transport and Traffic

The total number of annual visitors to Gibraltar regularly exceeds 11 million people. Visitors arrive by air, sea, car and coach, or as pedestrians through the land border. A very high proportion of visitors are day trippers and most of these visit the Upper Rock component of the Gibraltar Nature Reserve. Tour operators provide dedicated tours by minibus to tourist sites within the Reserve and this is complemented by a taxi service which also provides personalised tours. The Gibraltar Tourist Board issues guide licences to individuals trained to conduct tours by bus, taxi or the ever popular walking tours.

Table 2. Number of visitors to Gibraltar, including the Gibraltar Nature Reserve: Upper Rock from 2015-2018.

| Year | Land Frontier | Coaches | Private Motor Vehicles | By Air | Cruise Liner | Upper Rock |
|------|---------------|---------|------------------------|---------|--------------|------------|
| 2015 | 9,625,700 | 6,461 | 2,428,000 | 218,720 | 488,789 | 858,573 |
| 2016 | 9,463,700 | 6,931 | 2,620,100 | 270,067 | 570,564 | 959,105 |
| 2017 | 9,876,600 | 7,111 | 2,602,900 | 277,784 | 572,491 | 1,033,024 |
| 2018 | 10,353,800 | 6,661 | 2,754,800 | 217,059 | 576,397 | 1,030,321 |

Transport and traffic during peak visitor times are possibly some of the most difficult issues to manage within the Upper Rock. This is particularly evident during the months of July, August and September when there is an increase in visitor numbers to Gibraltar and in turn the Upper Rock.



The increasing popularity of the Upper Rock as a tourist destination is inevitably having an impact on the amount of traffic and finding a silver bullet solution is no easy task; it will require significant commitments from all the different stakeholders combined with innovative transport solutions. Necessary transport measures include:

- Restricting vehicle access to the Upper Rock including after the closure of ticket booths with the exception of residents;
- Creating a new entrance station at Devil's Gap Battery for pedestrians;
- Continued development of pedestrian trails;
- Commissioning a report on the development of a transport system for the Upper Rock Nature Reserve in consultation, and for the benefit, of all key stakeholders. The system should cater for a 'Park and Ride' facility to detract private vehicles from entering the Reserve during opening hours;
- Restricting private vehicle access to Apes Den and Prince Phillip's Arch during peak visitor times;
- Creating fiscal incentives for hybrid vehicles e.g. reduced ticket fees or subsidies for tour operators;
- Restricting vehicle access to Princess Amelia's Battery with the exception of blue badge holders;
- Implementing a regular road repairs programme;
- Installing new road safety barriers where possible;
- Installing speed bumps in key areas of the Upper Rock;
- Introducing an air quality monitoring programme for the Upper Rock.

Gibraltar Nature Reserve: The Northern Defences

Brief history of the Northern Defences

The Northern Defences is one of the most heavily fortified areas within the Gibraltar Nature Reserve and forms part of the North Front defence line which extends from the tip of the Old Mole in the Bay rising to Rock Gun Battery at the very top of the North Face of the Rock. Gibraltar, as a result of its strategic position, has been contested historically by both European and North African powers, enduring fourteen sieges since the 11th century. The peninsula's occupants, Moors, Spaniards and British, have all built, modified and strengthened fortifications and defences that include walls, bastions, gun batteries, magazines, galleries and modern tunnels.

Aerial view of the Northern Defences component of the Gibraltar Nature Reserve.



Early fortifications overlooking the Isthmus and flanking the approach to the city, consisted of not only Musquet firing lines cut in the solid rock or along walls built up with masonry but also numerous cannon and mortar batteries. The Northern Defences has three main Lines, the King's Lines, built by the British after the capture of the Rock in 1704 upon pre-existing Spanish defences, Prince's Lines, excavated between 1704 and the siege of 1727, and the Queen's Lines, excavated during the Great Siege of 1779-83.

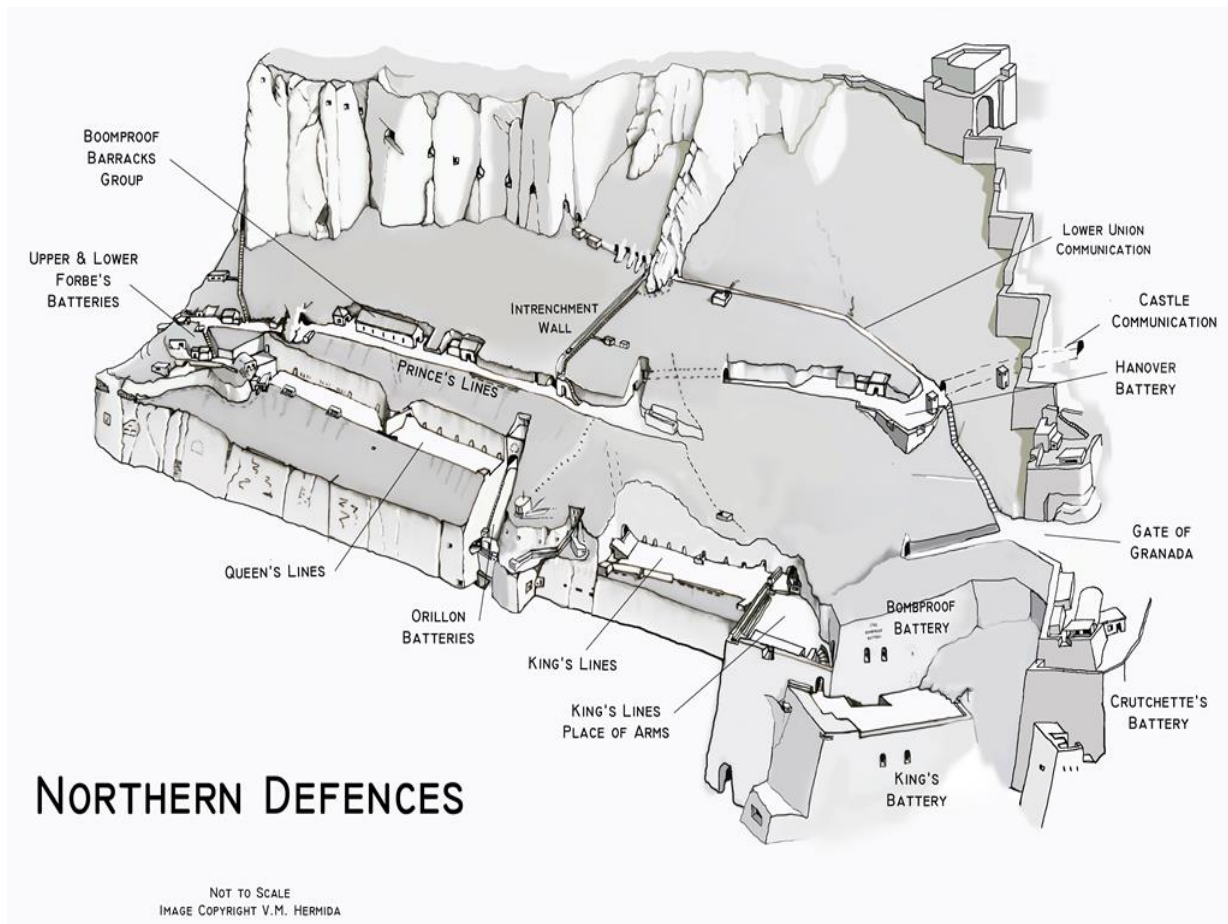
During the latter part of the 18th Century a series of Galleries were cut parallel to and communicating with both the King's and Queen's Lines. These Lower Galleries provided not only communication but also gun embrasures, shelter, storage, powder magazines, quarters and even a source of potable water.

Developments in military technology quickly made old defences obsolete and 20th Century construction in the form of new tunnels, machine gun posts, Gun and mortar positions as well as Defence Electric Lights can still be seen today.



These layers of belligerent history, from medieval Moorish to Cold War era, are all prevalent within the extent of the Northern Defences and a testament of military engineering. The area is not only an important ecological site within the Reserve, but also a prime heritage site of immense cultural, historical and touristic value.

Figure 6. Sites of historic importance within the Northern Defences.



Current Status

The Northern Defences are of importance to some of Gibraltar's endemic and endangered flora and fauna. A total of 144 plant species have been recorded in this area, with some important stands of the Gibraltar candytuft (*Iberis gibraltarica*) found on the cliffs. Other species found in the area are listed in table 3.

Along the upper reaches of the Northern Defences, the cliffs provide important nesting sites for breeding pairs of the Common Kestrel (*Falco tinnunculus*), Lesser kestrel (*Falco naumanni*), Little owl (*Athene noctua*) and the Blue rock thrush (*Monticola solitarius*).



Little Owl

Table 3. Some of the plant species found in the Northern Defences.

| Species | Common name | Comments |
|---|----------------------|---|
| <i>Arum italicum</i> | Italian Arum | Generally found as a 'weed' in gardens, but generally very scattered elsewhere. |
| <i>Filago pyramidata</i> | Broad-leaved Cudweed | Not a common plant. Usually found along trails and clearings. |
| <i>Gennaria diphylla</i> | Two-leaved Gennaria | The only member of the Orchid family recorded from the area. A protected species. Quite rare. |
| <i>Melilotus sulcatus</i> | Furrowed Melilot | A rare plant. Grows in scattered places, including the East Side. |
| <i>Petrorhagia nanteuillii</i> | Proliferous Pink | A very rare plant. Only found in this area. |
| <i>Petroselinum crispum</i> | Parsley | Schedule 3 plant. Growing on the cliff face above the area. The main stand for this species is the North Face of the Rock. |
| <i>Reseda luteola</i> | Dyer's Rocket | A rare plant. Found here and on Windmill Hill Flats. |
| <i>Saxifrage globulifera var. gibraltaria</i> | Gibraltar Saxifrage | Schedule 3 plant. A few plants growing on an old wall near the entrance to the area, and thus in danger of being cleared. Grows from Rock Gun down the North Face to the Galleries area. One other stand at the top of Mediterranean Steps. |
| <i>Scrophularia sambucifolia</i> | Elder-leaved Figwort | A very rare plant. Only found in the Northern Defences and one other location in the reserve. |
| <i>Succowia balearica</i> | Succowia | Schedule 3 plant. Quite common throughout Gibraltar. |
| <i>Thymus willdenowii</i> | Gibraltar Thyme | Schedule 3 plant. Widespread throughout the Rock. |
| <i>Verbascum sinuatum</i> | Wavy-leaved Mullein | Not a common plant. Found here, and in scattered places of the Upper Rock and North Front. |

In addition to the limestone cliff habitat, the Northern defences also provide an expanse of high maquis which is an important breeding and feeding site for resident and wintering birds such as the Blackcap (*Sylvia atricapilla*), Robin (*Erithacus rubecula*), Sardinian warbler (*Sylvia melanocephala*) and Wren (*Troglodytes hiemalis*). Ongoing research into bat populations and their movements within the Reserve suggest that the Northern Defences are also an important roosting and feeding site for bats. Both *Pipistrelle* spp. and the European free-tailed bat (*Tadarida teniotis*) have recently been recorded within this component of the Reserve.



Factors affecting the Northern Defences

The main factors currently affecting this component of the Reserve include:

- Vandalism;
- Litter;
- Neglected fortifications;
- Accessibility constraints.

Management measures

A careful balance needs to be achieved in order to retain the Northern Defence's rugged and natural environment whilst improving its heritage, recreational and ecological value. Increased surveillance monitoring forms a critical element of the Northern Defences future management considering that most of the ecological research carried out to date revolves around the breeding raptor species on the exposed cliff habitat. The Gibraltar Museum has in the past carried out some research into the site's heritage features with the Gibraltar Heritage Trust currently following up on this. The built Heritage found within the Northern Defences merit equal protection to that of the natural environment. The following measures are therefore proposed to help attain the conservation objectives of the Gibraltar Nature Reserve Management Plan:

- Restoration of defences, tunnels and paths and installing heritage information panels;
- Re-opened and improved connections to access the Northern Defences from Town;
- Increased surveillance monitoring of flora and fauna;
- Introduction of physical security and monitoring user safety;
- Introduction of proper maintenance and cleaning of all sites;
- Installing bat boxes and/or bat houses without requiring the closure of heritage locations;
- Installing heritage and wildlife interpretation panels in a heritage sensitive manner, at entrance only;
- Installing Nature Reserve demarcation and fire hazard signs;
- Improving visitor access within the Northern Defences;
- Creation of picnic sites and toilet facilities;
- Increased Environmental Enforcement patrols;
- Systematic removal of invasive and alien species.





POTENTIAL:

- Extensive level areas, readily accessible from the city centre and with privileged views out, but currently in a state of abandonment and disrepair.
- Possibility to create picnic areas, playgrounds and walking trails for use by local residents and visitors.
- Prevent vandalism and ensure maintenance to preserve the historic monuments and artefacts.



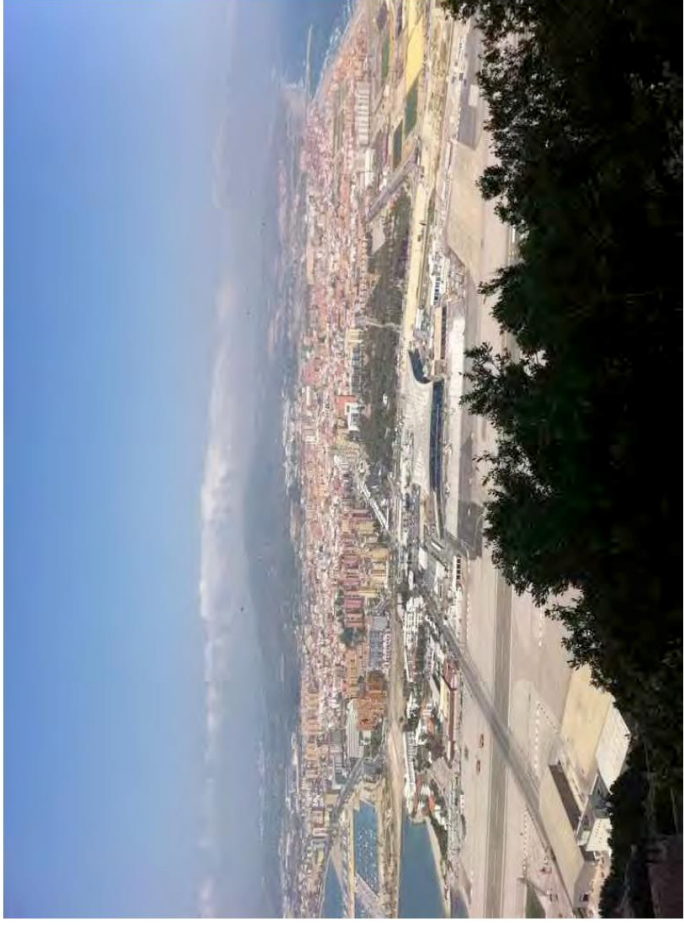
Patch repairs
Existing structures cleaned and patch repaired as necessary

Lighting
New light fixtures, ensuring area is kept well-lit and safe, encouraging public use



Interpretation
Directional and interpretational signage to help with way-finding and to highlight historical elements

Amenities
Recreational amenities to encourage public use

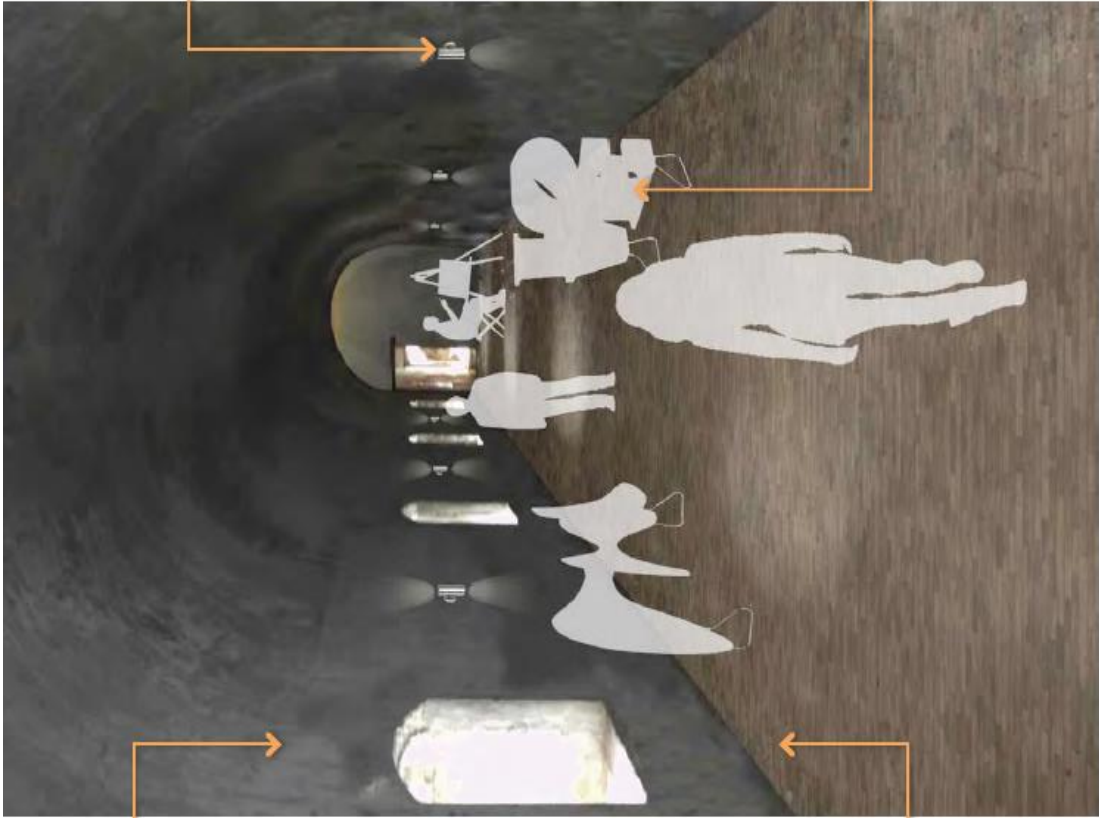


POTENTIAL:

- With a relatively minimal intervention, the Forbes and Upper All's Well lookouts could be re-opened to the public, affording spectacular views northwards.
- Site are currently readily accessible to the public, but with no running maintenance could represent a safety hazard.
- Steps up offer a more strenuous walk for hikers looking for a more advanced trail, while the remaining parts of the Northern Defences are almost entirely level and an easy trail for visitors of all fitness levels.
- Potential link to Princess Caroline's Battery, WWII tunnels could be created.



Patch repairs
Existing structures cleaned and patch repaired as necessary



Lighting
Minimal intervention can have dramatic visual effect and help give new uses to derelict structures

New uses
With minimal intervention, existing spaces could be appropriated for new uses, such as event spaces, galleries, workshops, etc.

Preservation
Historic military buildings preserved and given interpretation, vandalism curbed

Gibraltar Nature Reserve: The Great Eastside Sand Slopes

A brief history of the Eastside Sand Slopes

The Great Eastside Sand Slopes form an extensive area (approximately 45 hectares) of largely consolidated windblown sands that extend from above Sandy Bay in the south to Catalan Bay to the North. These sands, which contain a high percentage of uniform quartz grains, originated outside Gibraltar, since there are almost no quartz-bearing strata on the Rock. The sand slope was formed during the Quaternary period, when the area to the east was a dry sandy plain and wind action deposited the sand upon existing scree breccias and boulder conglomerate (Rose & Rosenbaum, 1991).

At one time the Talus slopes to the north and south, together with the Sand Slopes, formed one contiguous mass. However, the Catalan and Sandy Bay quarries, opened by the Admiralty in 1895 to provide material for the Dockyard extensions, isolated the Eastside Sand Slopes from the Talus slopes. The talus extremities, located below the major cliff faces - namely Spyglass and Rock Gun - seem to have accumulated the largest quantity of rock boulder material. This has formed the conglomerate scree breccias but is still covered by a sandy layer. The central portion, where the Eastside Sand Slopes are located, has undergone less rock deposition from above, but has a greater accumulation of windblown sands, substantially differentiating this geological structure from the adjacent Talus slopes.

Drawings from the 1800s depicting Catalan Bay show that the Sand Slope was almost devoid of vegetation and this confirms the presence of goats and grazing activity. In 1903, the City's Chief Engineer came up with a plan to cover the 10 acre slope with corrugated iron sheets to collect potable water. This resulted in most of the Sand Slope habitat being lost and with it, a number of plant and animal species including the Black Wheatear (*Oenanthe leucura*) which probably relied on this habitat. The water catchments were deemed obsolete in 1991 with the advent of desalination plants in Gibraltar, thus promulgating their removal and restoration of the habitat in the 1990s. This provided a unique opportunity for fulfilling one of the main requirements of the Biodiversity Convention, under Article 8(f) which states:

“Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies”

The restoration process was extremely laborious and consisted of the removal of the corrugated iron sheets, followed by the installation of a biodegradable mesh to stabilise the slope. A re-seeding programme followed thereafter, using native grasses and shrubs in close consultation with the GONHS. This was carried out by experts from the Gibraltar Botanic Gardens. An excellent account of the restoration of the Eastside sand slope is provided by Cortes *et al* (2000).

In addition to the removal of the water catchment and the reseeded of the slopes, a complex network of strong rockfall protection fencing was installed. Three lines of defensive fencing are currently installed to protect the residential complex of Both Worlds that lies immediately below the slope.



Figure 7. Eastside Sand Slopes



Current Status

Regular surveys are carried out by the GONHS and the Botanic Gardens to assess the ecological status of the sand slope, which contains two EU listed habitat types: Dunes with *Euphorbia terracina* and *Malcomietalia* dune grassland. These are predominantly found in the lower sections of the sand slope and both habitats are currently under threat from the spread of invasives. Plant species found here are similar to those found in the adjacent talus component of the Reserve.

Table 4. Some of the plant species found in the Sand Slopes.

| Common Name | Scientific Name |
|-----------------------------|--|
| Wild Leek | <i>Allium ampeloprasum</i> |
| Snapdragon | <i>Antirrhinum majus</i> |
| White Asphodel | <i>Asphodelus albus</i> |
| Dwarf Fan-palm | <i>Chaemerops humilis</i> |
| Cocks Foot | <i>Dactylis glomerata</i> |
| Wild Carrot | <i>Daucus carota</i> |
| Squirting Cucumber | <i>Ecballium elaterium</i> |
| Sea Holly | <i>Eryngium maritimum</i> |
| Giant Tangier Fennel | <i>Ferula tingitana</i> |
| Yellow-horned Poppy | <i>Glaucium flavum</i> |
| Hoary Mustard | <i>Hirschfeldia incana</i> |
| Tree Mallow | <i>Lavatera arborea</i> |
| Sweet Alison | <i>Lobularia maritima</i> |
| Wild Olive | <i>Olea europea</i> |
| Gibraltar Restharrow | <i>Ononis natrix</i> |
| Cottonweed | <i>Otanthus maritimus</i> |
| Silver Parynochia | <i>Paronychia argentea</i> |
| Smilgrass | <i>Piptatheum miliaceum</i> |
| Buck's-horn Plantain | <i>Plantago coronopus</i> |
| Dock sp. | <i>Rumex sp</i> |
| Sweet Scabious | <i>Scabiosa atropurpurea</i> |
| Silver Ragwort | <i>Jacobaea maritima</i> |
| Pink Mediterranean Catchfly | <i>Silene colorata</i> |
| Sticky Catchfly | <i>Silene nicaeensis</i> |
| Blunt-leaved Catchfly | <i>Silene obtusifolia</i> |
| Brown Bluebell | <i>Dipcadi serotinum</i> subsp. <i>Serotinum</i> |
| Violet Larkspur | <i>Delphinium nanum</i> |

Sampling activities carried out to date indicate that the slope has a rich invertebrate abundance and diversity consisting of Lepidoptera (butterflies & moths), Coleoptera (beetles), Orthoptera (crickets and grasshoppers), arachnids, including the Iberian Scorpion (*Buthus cf. ibericus*) among many other invertebrate groups.

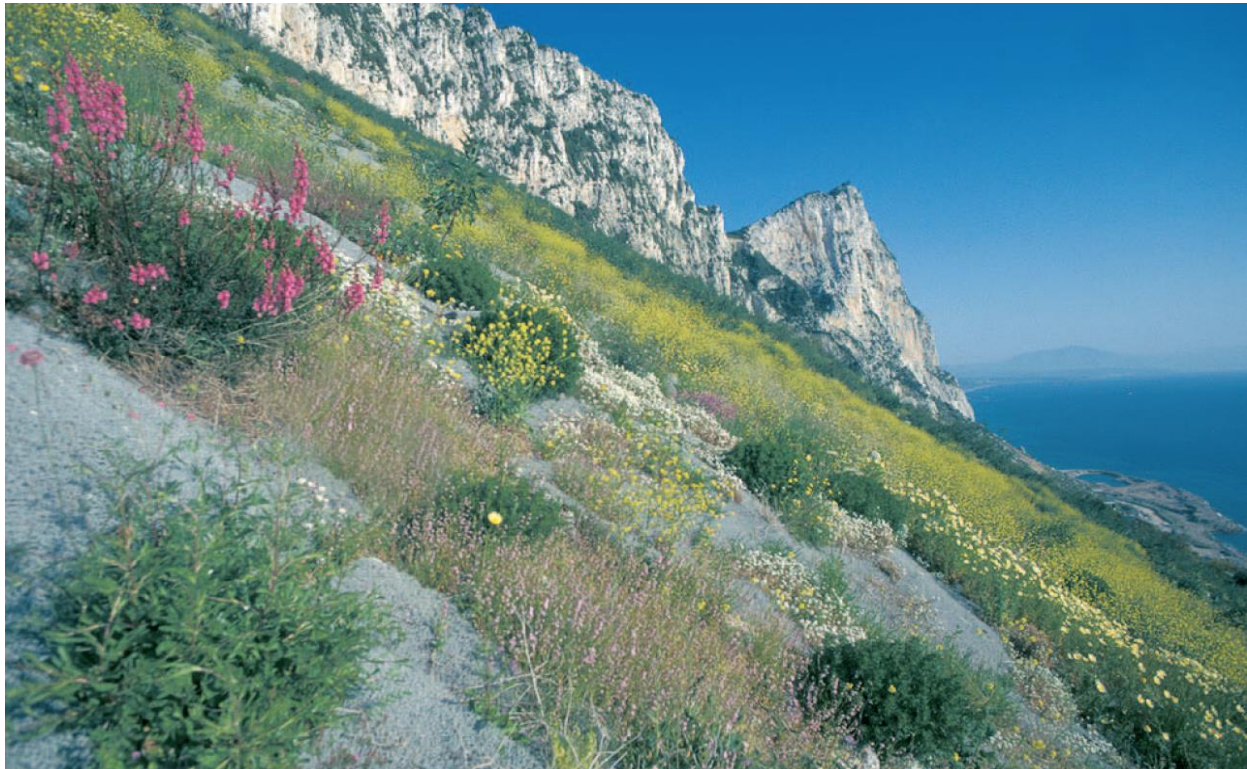
Avian records for the site include the year-round presence of Barbary Partridges (*Alectoris barbara*), Common Kestrel (*Falco tinnuculus*), Little Owl (*Athene noctua*), Peregrine Falcon (*Falco peregrinus*) and Blue Rock Thrush (*Monticola solitarius*). Other birds that regularly use the slopes include the Black Redstart (*Phoenicurus ochrurus*) and the Common Chiffchaff (*Phylloscopus collybita*). The cliffs above the sand slopes are also known to harbour a pair of the European Eagle Owl (*Bubo Bubo*), although sightings are not common due to the nocturnal habits of this species. Interestingly, records of the Zitting Cisticola (*Cisticola juncidis*) have become more frequent in this habitat than anywhere else in Gibraltar.



Frequent reptile monitoring is currently lacking for the slopes, even though a number of species are found in this component of the Reserve. Two of the characteristic reptile species found on the slopes and the talus are the skinks. These are lizards with vestigial legs that move by serpentine 'S'-shaped movements on the sand. Two species are found in Gibraltar; the Three-toed Skink (*Chalcides striatus*) and Bedriaga's Skink (*Chalcides bedriagai*), the latter being an EU protected species. Once frequently found on the isthmus' sandy habitat, its distribution has now been considerably reduced and restricted to the sand slopes, the talus and parts of the Upper Rock. Other prominent reptiles found on the slopes include the Horseshoe Whip Snake (*Coluber hippocrepis*) and the False Smooth Snake (*Macroprotodon cucullatus*).

Bat monitoring carried out by the Gib-Bats team shows that the slopes are being used by the Isabelline Serotine (*Epistesicus isabellinus*), European free-tailed (*Tadarida teniotis*) Schreiber's Bent-wing (*Miniopterus Schreibersii*) and possibly Greater Mouse-eared (*Myotis Myotis*) and *Nyctalus* bat species. The Barbary Macaques (*Macaca sylvanus*) also use the extent of the sand slopes whilst foraging, making this component an important element of the Macaque Management Plan.

The Great Eastside Sand Slopes



Factors affecting the Sand Slope

Ongoing monitoring shows that the most prominent threat affecting the ecological integrity of the sand slope is the spread of invasive species. Table 5 summarises the main invasive species growing on the slopes.

Table 5. Invasive species found growing on the Sand Slopes.

| Common Name | Scientific Name |
|----------------------|---------------------------------|
| Red-eyed Wattle | <i>Acacia cyclops</i> |
| Golden Wreath Wattle | <i>Acacia saligna</i> |
| Century Plant | <i>Agave americana</i> |
| Green Century Plant | <i>Agave ghiesbreghtii</i> |
| Tree Aloe | <i>Aloe arborescens</i> |
| Hottentot Fig | <i>Carpobrotus edulis</i> |
| Red Gum | <i>Eucalyptus camaldulensis</i> |
| Shrub Tobacco | <i>Nicotiana glauca</i> |
| Prickly Pear | <i>Opuntia ficus-indica</i> |
| Bermuda Buttercup | <i>Oxalis pes-caprae</i> |
| Cape Wattle | <i>Paraserianthes lophantha</i> |
| Canary Palm | <i>Phoenix canariensis</i> |
| Spineless Yucca | <i>Yucca elephantipes</i> |

The Red-eyed wattle (*Acacia cyclops*), Hottentot fig (*Carpobrotus edulis*) and Century plant (*Agave americana*) in particular are affecting the long-term ecological integrity of the sand slope, due to the areas that they have covered despite the removal efforts of the Nature Reserve Management Team. Their growth is restricted to the lower margins of the sand slopes, but it may only be a question of time before these invasive species spread further to the upper reaches of the slope unless action is taken.

Other threats to the sand slopes include:

- Habitat succession e.g. growth of the European Wild olive (*Olea europaea*);
- Risk of extensive fire;
- Urban development leading to the loss of habitat;
- Installation of rock fall defences;
- Vandalism and disturbance;
- Illegal poaching.

The risk of fire on any habitat in Gibraltar is great, due to the dry conditions that prevail during the summer and early autumn. However, fire is a natural element of grassland ecosystems and is important for their long-term survival, preventing encroachment by woody plants. It is nevertheless essential that fires do not occur too often, that they do not affect the area during those times of year when the fauna is breeding and that they only affect part of the slopes on any one occasion.

The presence of feral cats poses a problem that has increased in recent years. This is a damaging species that does not have a legitimate role within our wildlife communities in the Nature Reserve and poses a serious threat to the population of the Barbary partridge (*Alectoris barbara*) that breed on the sand slopes.

Illegal poaching of birds, particularly migrating finches and thrushes, has also been reported on occasion in this component of the reserve.

Management measures

Although ecological monitoring is already taking place and numerous invasive species removal efforts have concentrated on some sections of the slopes, it is clear that additional measures need to be implemented in order to better improve our understanding and the value of this important component of the Nature Reserve. These include:



Peregrine Falcon

- Increased surveillance monitoring of flora and fauna, including reptile species;
- Increased surveillance monitoring of cave habitats (see caves section);
- Increasing Environmental Enforcement patrols;
- Systematic removal of invasive and alien species, especially *Acacia cyclops*, *Carpobrotus edulis* and *Agave* spp.;
- Installing Nature Reserve demarcation and fire hazard signs;
- Re-seeding where necessary and/or transfer of key plant species from the Isthmus and Talus habitats;
- Introduction of invertebrate species and transfer from the Isthmus and Talus habitats;
- Re-introduction of sand dune species from the wider Cadiz Province such as *Juniperus* spp and the Spiny-footed lizard (*Acanthodactylus erythrurus*);
- Re-populating the Barbary Partridge (*Alectoris barbara*) and Wild Rabbit (*Oryctolagus cuniculus*) and exploring the re-introduction of the Black Wheatear (*Oenanthe leucura*);
- Removal of obsolete metal structures.



Top Left: Spanish Festoon butterfly. Right: Gibraltar Candytuft. Bottom Left: Wild rabbit. Right: Emperor Dragonfly.

Gibraltar Nature Reserve: Talus Slopes

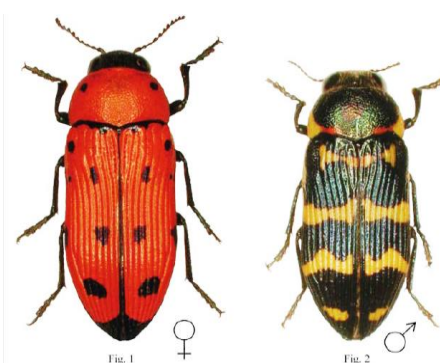
The Talus Slopes comprise a unique and important habitat in Gibraltar, especially since the isthmus' sandy habitat has been almost totally urbanised. Together with the Sand Slopes, they are a refuge for sand-dwelling species of flora and fauna. The talus slope is adjacent and to the North of the sand slope. It is a relatively undisturbed habitat and this is partly due to its steep terrain and inaccessible nature. Human activity has not influenced the vegetation of the area in recent years although goat herds from Catalan Bay were allowed to roam freely on these slopes in the past. A lack of records prevents detailed comparison of the present plant community with the original one.

Current status

At present, the habitat of the talus is characterised as sandy garrigue, composed mainly of grasses and low-growing shrubs. Of these, one of the most conspicuous plants forming small clumps is the Gibraltar Restharrow (*Ononis natrix ramosissima ramosissima*). This variety is exclusive to the Rock of Gibraltar and is therefore one of the flagship taxa of this habitat. Table 6 lists some of the special plants that can be found on the talus.

Table 6. Some of the plant species found on the Talus slope.

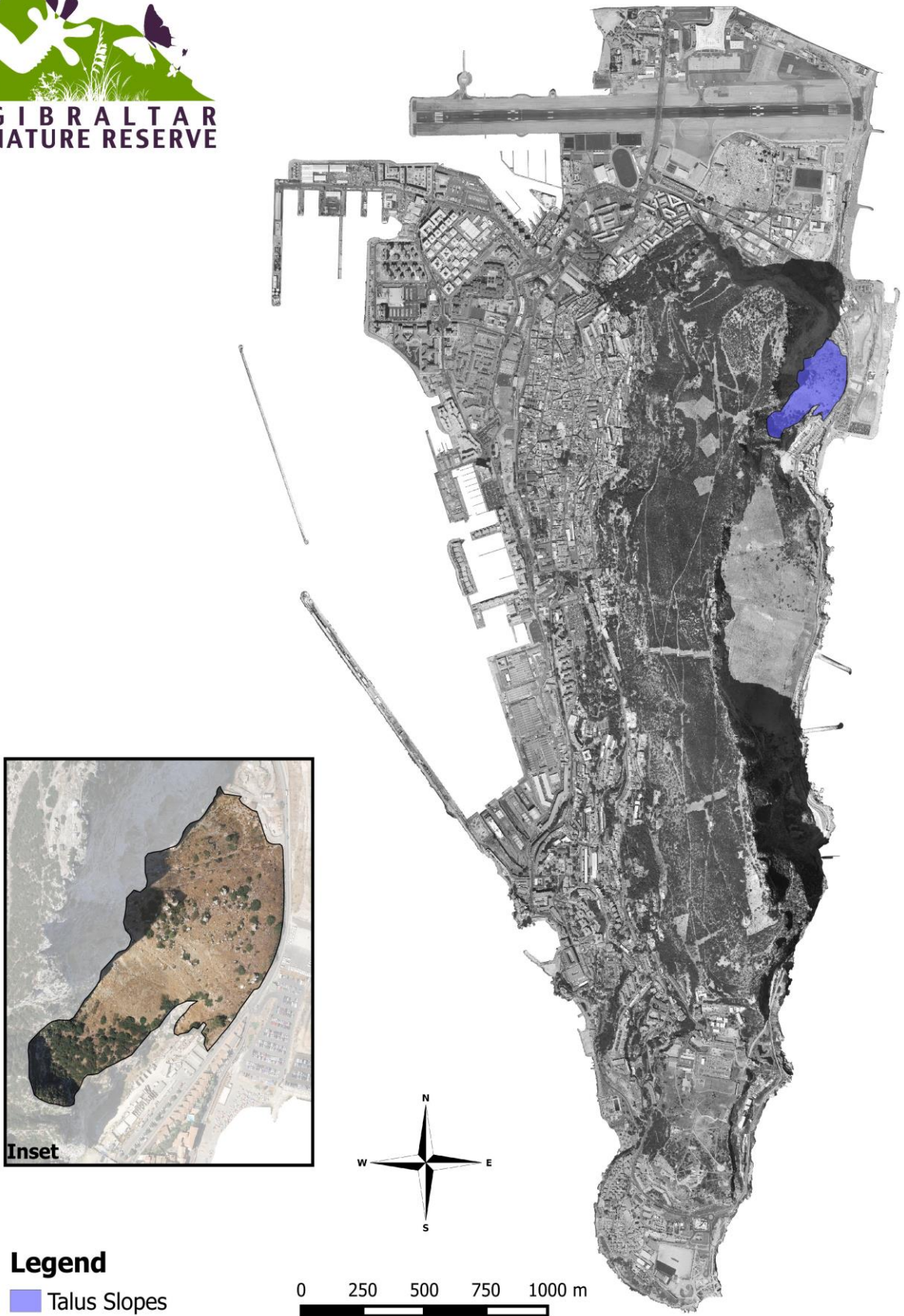
| Common Name | Scientific Name |
|----------------------------------|---------------------------------------|
| Gibraltar Restharrow | <i>Ononis natrix var. ramosissima</i> |
| Montpellier Broom | <i>Teline monspessulana</i> |
| Parsley | <i>Petroselinum crispum</i> |
| Giant or Large -flowered Mullein | <i>Verbascum giganteum</i> |
| Silver Sea Stock | <i>Malcolmia littorea</i> |
| Erect Dorycnium | <i>Dorycnium rectum</i> |
| Gibraltar Candytuft | <i>Iberis gibraltarica</i> |



Left: Northern Talus Slope. Right: The Jewel Beetle *Buprestis (Yamina) sanguinea* subspecies *calpetana* – An attractive and rare insect that was recently discovered on the rock by Dr. Keith Bensusan and Charles Perez (GONHS). This species is found on the Talus Slope living on stands of the Joint pine (*Ephedra fragilis*).



Figure 8. Location of the Northern Talus Slope.

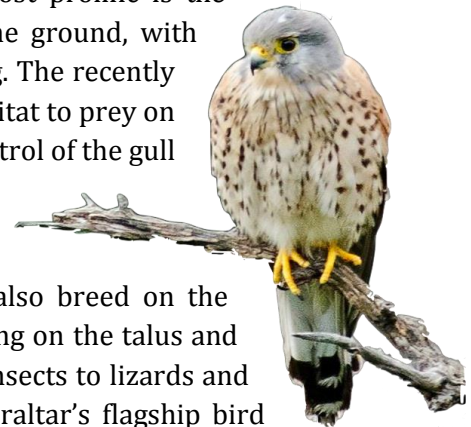


Legend

 Talus Slopes

Amongst the larger plants and shrubs found on the talus are the European Wild Olive (*Olea europaea*), Osyris (*Osyris lanceolata*), Lentisc (*Pistacia lentiscus*) and Joint-Pine (*Ephedra fragilis*). Alien and invasive species have also become established on the Talus such as the Tree Aloe (*Aloe arborescens*), Shrub Tobacco (*Nicotiana glauca*) and the Hottentot fig (*Carpobrotus edulis*). The Hottentot Fig is an invasive species that was originally used in stabilising sandy habitats and slopes. Although useful in preventing wind-blown erosion, it fails to adequately anchor the sand and soil due to its weak root structure. The species is known for its characteristic blanket growth, which excludes most other plants and is particularly damaging to native flora and fauna.

The Talus also supports a variety of fauna. Among the most prolific is the Yellow-legged Gull (*Larus michahellis*), which breeds on the ground, with most pairs rearing between two to three young in the spring. The recently established Eagle Owls (*Bubo bubo*) have been using this habitat to prey on the gulls. This potentially provides a natural or biological control of the gull population. Efforts to safeguard this species are therefore included as part of the plan.



Common Kestrel

Several pairs of the Common Kestrel (*Falco tinnunculus*) also breed on the eastern side of the Rock. The birds are regularly seen foraging on the talus and the sand slopes. They feed on a variety of prey, from large insects to lizards and small birds. The Barbary Partridge (*Alectoris barbara*), Gibraltar's flagship bird species, can also be regularly seen on the talus slope. A small population was established here and attempts are now being made to restore their numbers in this habitat, as part of the wider Barbary Partridge re-population programme.

Table 7. Key bird species using the Talus habitat.

| Common Name | Scientific name |
|--------------------|-----------------------------|
| Common Kestrel | <i>Falco tinnunculus</i> |
| Yellow-legged Gull | <i>Larus michahellis</i> |
| Barbary Partridge | <i>Alectoris barbara</i> |
| Little Owl | <i>Athene noctua</i> |
| Eagle Owl | <i>Bubo bubo</i> |
| Blue Rock Thrush | <i>Monticola solitarius</i> |
| Black Redstart | <i>Phoenicurus ochruros</i> |
| Stonechat | <i>Saxicola rubicola</i> |

The habitat of the Talus slope is ideal for various reptile species. Both the Horseshoe Whip Snake (*Coluber hippocrepis*) and the False Smooth Snake (*Macroprotodon cucullatus*) are recorded here. The Andalusian Wall Lizard (*Podarcis vaucheri*) and the Moorish Gecko (*Tarentola mauritanica*) can be found on the rocky parts of the Talus and also the cliff base, whereas the Algerian Sand Racer (*Psammodromus algirus*) occurs mainly on or near shrubs.

As with the Great Sand Slopes, the Talus slopes hold a rich community of sand-loving invertebrates, including Lepidoptera (butterflies & moths), Coleoptera (beetles) and Orthoptera (crickets and grasshoppers), among other groups. At least five species of antlion have been seen regularly in this habitat. The Thread-winged Lacewing (*Nemoptera bipennis*) can be seen in late



May and June and is easily recognised by its yellow, lace-like forewings and ribbon-like hind wings. Grasshoppers can be seen in abundance in late spring, with several species pending identification. These feed mainly on grasses and are therefore important in this habitat. Coleoptera include various darkling beetles (family Tenebrionidae), which are very common in this habitat. Many of these beetles also frequented the isthmus, but in the same way as the Skinks, they are now mainly found on the east side slopes. One beetle species, *Buprestis (Yamina) sanguinea* can be found on the Joint Pine (*Ephedra fragilis*), a shrub that grows well on the Talus slope. This species is rare globally, found only in small areas of north and central Spain and North Africa, with an isolated population at Gibraltar that forms the endemic subspecies *calpetana*. It is therefore another key species of this habitat, as is *Nemoptera bipennis*. Among the lepidopteran fauna of this habitat are grass-loving moth species, including several species of the family Noctuidae and *Cymbalophora pudica* of the Tiger Moth family (Arctiidae).

Factors affecting the Talus Slopes

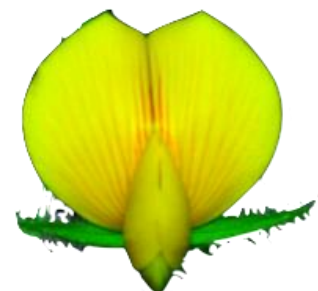
There are relatively few factors affecting the ecological status of the Talus slopes at present, but this could change in the near future due to increasing urban development on the east side. Main factors affecting the Talus Slope include:

- Human disturbance and illegal flytipping;
- Speed of invasive and alien species.

Management measures

The difficulty associated with accessing the Talus has restricted the amount of research carried out in this component of the Gibraltar Nature Reserve whilst also providing protection from human disturbance. There are also clear similarities with the Great Sand Slope and most of the conservation measures that apply to that component of the Reserve are applicable to the Talus slope. Conservation measures that apply to the Talus slope therefore include:

- Removal of all waste items accumulated as a result of illegal fly tipping activities;
- Installation of Nature Reserve demarcation and fire hazard signs;
- Increased surveillance monitoring of flora and fauna;
- Systematic removal of invasive and alien species, especially *Carpobrotus edulis*, *Agave* spp. and *Aloe arborescens*;
- Re-seeding and/or transfer of key plant species from the Isthmus habitats;
- Introduction of key invertebrate species and transfer from the Isthmus habitats;
- Re-populating the Barbary Partridge (*Alectoris barbara*) and Wild Rabbit (*Oryctolagus cuniculus*) and exploring the re-introduction of the Black Wheatear (*Oenanthe leucura*);
- Increasing Environmental Enforcement patrols;
- Prohibition of destructive activities such as bicycle/motor cycle scrambling;
- Preventing detrimental cliff stabilisation works where possible.



Gibraltar Restharrow

Gibraltar Nature Reserve: The Mount Gardens

Built in 1797, the Mount is one of Gibraltar's hidden heritage assets, with a historic link to Gibraltar's natural history that is frequently overlooked. In 1903, Sarah Angelina Acland visited her brother Admiral Sir William Acland in Gibraltar, who resided in the Mount. Sarah Acland was a keen photographer and is to date considered one of the pioneers of colour photography. In 1904 she exhibited 33 three-colour prints in London under the title '*The Home of the Osprey, Gibraltar*'. Acland took photographs of Europa Point, the Mount and also a photo of the ornithologist Colonel William Willoughby Cole Verner. Colonel Verner lived in Gibraltar during that time and together with his friend, Howard Irby, paved the way for the first guide to the birds found in Gibraltar and the wider region in the book titled '*The Ornithology of the Straits of Gibraltar*', published in 1894.

Left - The Mount circa 1890. Right - Colonel Verner.



Current Status

Today the Mount's gardens contain a unique collection of mature trees, many of them remnants of Gibraltar's original vegetation. These include the Algerian Oak (*Quercus anariensis*), Bay Laurel (*Laurus nobilis*), Field Elm (*Ulmus minor*) and Nettle Trees (*Celtis australis*) including also some exotic species such as Magnolias (*Magnolia grandiflora*), Indian Laurel (*Ficus microcarpa*), Atlantic Cedar (*Cedrus atlantica*) and Dragon Trees (*Dracaena draco*). The Mount is one of the few areas where mature stands of woodland exist within the Gibraltar Nature Reserve. Although most of the understory found at the Mount is managed, it has a special character that gives the site a true woodland feel. Similar to the Upper Rock, dominant plant species found growing beneath the canopy include the Intermediate Periwinkle (*Vinca difformis*), Bear's Breech (*Acanthus mollis*), *Rubus ulmifolius* and Common Ivy (*Hedera helix*).



Intermediate Periwinkle



Figure 9. Location of the Mount Gardens.



The grounds surrounding the main building at the Mount have been used as a garden ever since the Mount was constructed in the late 18th Century. This has inevitably resulted in some exotic flora becoming a feature of this component of the Reserve and its surroundings. Some exotic species, such as *Eucalyptus* spp. or *Cupressus sempervirens* pose little or no threat to native flora. However, other exotics such as *Ailanthus altissima* and *Senecio angulatus* pose a very serious threat given the rate at which they spread and smother native flora.

The Mount's gardens provide excellent habitat for resident and migratory birds. Characteristic woodland bird species that breed or regularly use this component of the Reserve include species such as the Blue tit, Great tit, Spotted flycatcher, Chiffchaff spp., Greenfinch and Chaffinch. Larger birds such as the Sparrowhawk, Common Kestrel and the Tawny Owl are also recorded, along with many other species which have included Woodcock and Yellow-browed Warbler. Bats, particularly *Pipistrellus* spp, are also known to use the Mount. Just as with the adjacent Upper Rock component of the Reserve, the Mount's gardens are rich in insect life and the area is one of the strongholds for the EU-protected Funnel web spider (*Macrothele calpeana*). Other notable species such as the Hummingbird Hawk Moth (*Macroglossum stellatarum*) and the Black Carpenter Bee (*Xylocopa violacea*) are common in the Mount during the Spring. It is the main stronghold of xylophagous (feeding on or boring on wood) and saprophagous (feeding on decaying matter) insects on the Rock.

Factors affecting the Mount

The main factors currently affecting this component of the Reserve include:

- Mismanagement of woodland habitat;
- Litter;
- Invasive exotic and alien species;
- Encroachment by urban developments.

Proposed measures

Although the gardens at the Mount have been managed for some time, a different approach needs to be followed in order to improve its ecological value whilst maintaining its aesthetic charm. Some of the required management measures are very similar to those that need to be implemented in the adjacent Upper Rock component of the Reserve. Measures that need to be adopted include:

- Systematic removal of invasive exotic shrubs and alien species;
- Implementing a replanting programme which should include species such as *Ceratonia siliqua*, *Fraxinus angustifolia*, *Quercus rotundifolia* and *Quercus canariensis*;
- Ensuring that exotic trees that die back are not removed but left on the ground;
- Installation and monitoring of nest boxes for woodland bird species such as tit and owl nest boxes;
- Installation and monitoring of bat boxes;
- Creating pond habitats;
- Increased surveillance monitoring of flora and fauna;
- Increasing Environmental Enforcement patrols;
- Installing new habitat and wildlife interpretation panels;
- Installing Nature Reserve demarcation and fire hazard signs.



Gibraltar Nature Reserve: Jacob's Ladder



Hoopoe

Located in the south-west part of Gibraltar, this recently protected area forms an important extension of the Windmill Hill Flats component of the Reserve. Connected by means of a steep wooden ladder, which probably gave rise to its name, this vegetated corner below Windmill Hill is currently made up of dense maquis habitat although it formerly consisted of a mosaic of garrigue and maquis. Its location beneath a historic wave cut platform faces the full force of the prevailing south westerly winds and this has resulted in the canopy adopting a peculiar 'wind blown' shape. In addition to the dense maquis, there is also an area that has been cleared of vegetation to resemble pseudosteppe habitat. This favours some of the species of flora and fauna that inhabit the site. Cliff habitat is also prevalent along the upper reaches of Jacob's Ladder and this adds further ecological value and importance to this component of the Reserve.

Current Status

Jacob's Ladder is an important site for many interesting plants. 195 species have been recorded from this area. Some years ago a single Bee Orchid (*Ophrys apifera*) was growing here, but this has not re-appeared.

Table 7. Some of the plant species found on Jacob's ladder.

| Species | Common name | Comments |
|-------------------------------|------------------------|--|
| <i>Echium parviflorum</i> | Small-flowered Bugloss | Fairly common on Windmill Hill Flats, and scattered around Europa Flats area. Very rare elsewhere on the Rock. |
| <i>Hyoseris scabra</i> | Lesser Hyoseris | A very rare plant. Only a handful seen along this trail, and a couple on Windmill Hill Flats. Not found elsewhere on the Rock. |
| <i>Chaenorrhinum villosum</i> | Cliff-hanger | Growing on the cliff face above the area. Normally seen growing around cave entrances, cliffs on the Rock and on old walls. |
| <i>Iberis gibraltaria</i> | Gibraltar Candytuft | Schedule 3 plant. Growing on the cliff face above the area. Widespread throughout Gibraltar |
| <i>Melilotus sulcatus</i> | Furrowed Melilot | A rare plant. Grows in scattered places about the Rock: East Side, Northern Defences, etc. |
| <i>Petroselinum crispum</i> | Parsley | Schedule 3 plant. Growing on the cliff face above the area. The main stand for this species is the North Face of the Rock. |
| <i>Rapistrum rugosum</i> | Bastard Cabbage | A rare plant. Found mainly on Windmill Hill flats and Mediterranean Steps. |

| | | |
|--------------------------------|------------------------------|---|
| <i>Reseda luteola</i> | Dyer's Rocket | A rare plant. Found mainly on Windmill Hill Flats, and very scattered elsewhere, such as the Northern Defences. |
| <i>Rumex induratus</i> | Shield Dock | This Dock is quite widespread around southern parts of the Rock. Very few found elsewhere. |
| <i>Succowia balearica</i> | Succowia | Schedule 3 plant. Quite common throughout Gibraltar. |
| <i>Thymus willdenowii</i> | Gibraltar Thyme | Schedule 3 plant. Growing on the cliffs above the area. Widespread throughout the Rock. |
| <i>Trifolium angustifolium</i> | Narrow-leaved Crimson Clover | A rare plant. Only found here and on Windmill Hill Flats. |

The area is also known to be a breeding and roosting site for the Barbary Partridge (*Alectoris barbara*) as well as one of the first landing sites for migrant birds crossing the Strait of Gibraltar. Unfortunately, due to the lack of habitat management in the past, the number of partridges and Wild Rabbit (*Oryctolagus cuniculus*) recorded in the area has decreased significantly. Continued ecological surveillance monitoring of the area is required to better understand how species found within the wider Reserve, particularly mammals, insects and reptiles, use this area.

Factors affecting Jacob's Ladder

Jacob's Ladder has always been a relatively quiet area with minimal human disturbance, although this seems to be changing following recent habitat clearance works. The main factors currently affecting the site can be summarised as:

- Habitat succession;
- Alien species;
- Human disturbance and litter.

Management measures

The management of Jacob's Ladder should be facilitated by its relatively small size. Certain key management measures need to be implemented and others continued to ensure that the site is maintained or achieves a more favourable conservation status. These can be summarised as:

- Installing a gate at the entrance of the Reserve and securing the site to control visitor access;
- Continuation of the high maquis clearance programme when necessary;
- Increased surveillance monitoring of flora and fauna;
- Increasing Environmental Enforcement patrols;
- Installing habitat and wildlife interpretation panels;
- Installing Nature Reserve demarcation and fire hazard signs;
- Re-populating the site with Barbary Partridges (*Alectoris barbara*) and Wild Rabbits (*Oryctolagus cuniculus*);
- Regular removal of litter and debris, especially around cliff base;
- Preventing detrimental cliff stabilisation works where possible.



Figure 10. Location of Jacob's Ladder.



Gibraltar Nature Reserve: Windmill Hill Flats

Windmill Hill is the only remaining natural area of largely undeveloped, flat open space in Gibraltar. It has been a Ministry of Defence (MOD) military training area for decades and continues to play an important role for the armed forces to this day. Like many other military training sites in Europe, where access to the wider public is restricted, this has resulted in Windmill Hill being somewhat secluded and this has favoured the wildlife.

The habitats found at Windmill Hill consist mainly of garrigue, pseudosteppe and vegetated sea cliffs. They hold a distinctive community of plants, many of which are found only at this location. The site is also a major stronghold for numerous resident and wintering birds and the most important stopover site in Gibraltar for many migrant passerine birds (Cortes, 1996). Given its ecological importance, the site is afforded triple protection and is designated as part of the Gibraltar Nature Reserve under the Nature Protection Act 1991, an MOD Conservation Area and also an EU protected NATURA 2000 site under the Habitats Directive.

View North from Windmill Hill Flats



Current Status

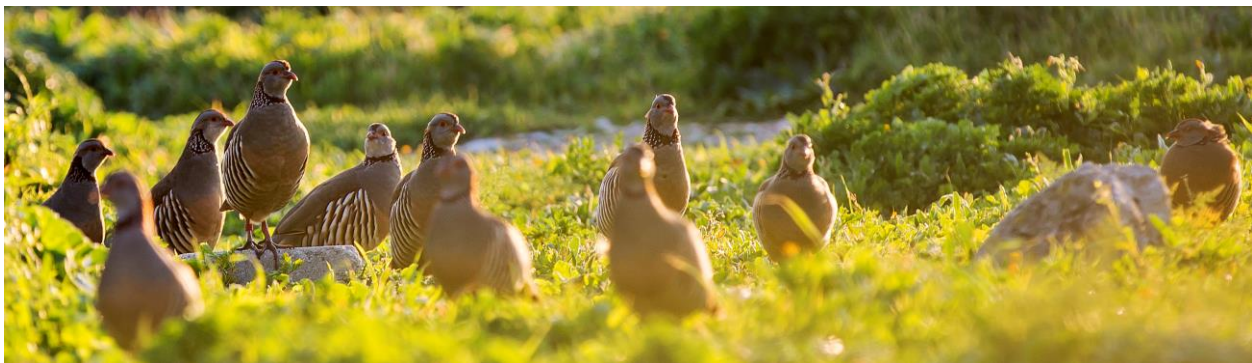
Windmill Hill has primarily been subjected to disturbance from military training activities and minor developments over time. Despite these activities and the fact that the soil covering most of the flats is thin and of poor quality, the flora and fauna of the area thrive to make this one of the prime sites for wildlife in Gibraltar. Some of the unique plants found here and nowhere else in Gibraltar include the Southern Autumn Crocus (*Crocus serotinus* subsp. *salzmannii*), Bastard



Toadflax (*Thesium humile*), Saw-tooth Plantain (*Plantago serraria*), Wild Clary (*Salvia verbenaca*), Dagger Flower (*Mantisalca salmantica*), Pygmy Cudweed (*Filago pygmaea*), Ovate Goat Grass (*Aegilops geniculata*), Italian Sainfoin (*Hedysarum coronarium*) and Winged Pea (*Lotus tetragonolobus*). Other rare species found on the flats include the Bee Orchid (*Ophrys apifera*) and the Warty Spurge (*Euphorbia squamigera*).

The fauna of the flats is as varied as the flora. Passerine migrants that stand out are species of open ground and scrub such as Northern and Black-eared Wheatears (*Oenanthe oenanthe* & *O. hispanica*), Whinchats (*Saxicola rubetra*), Subalpine and Spectacled Warblers (*Sylvia cantillans* & *S. conspicillata*), Whitethroat (*Sylvia communis*), Tawny Pipit (*Anthus campestris*) and Yellow Wagtails (*Motacilla flava*). Its prominence geographically helps to attract many vagrants. More unusual but regular species include Stone Curlew (*Burhinus oedicephalus*) and Short-eared Owl (*Asio flammeus*). Windmill Hill hosts occasional breeding Zitting Cisticolas (*Cisticola juncidis*) and has traditionally been the stronghold of the Barbary Partridge (*Alectoris barbara*) although this species has recently experienced a severe decline. Other characteristic residents include the Blue Rock Thrush (*Monticola solitarius*) and Spotless Starling (*Sturnus unicolor*). Windmill Hill is also an important wintering site for Meadow Pipits (*Anthus pratensis*), Black Redstarts (*Phoenicurus ochruros*), European Stonechats (*Saxicola rubicola*), finches and the occasional Thekla Lark (*Galerida theklae*) and Skylark (*Alauda arvensis*). Together with the isthmus, it is the only site in Gibraltar where larks are regularly recorded.

A covey of Barbary Partridges at dusk on Windmill Hill Flats



Reptiles thrive on Windmill Hill Flats, given the site's southerly aspect and open ground, which receives long hours of sunlight. Some of the last records of Ocellated Lizard (*Timon lepidus*) in Gibraltar have been from Windmill Hill. Snake species such as the Horseshoe Whip Snake (*Coluber hippocrepis*), Montpellier Snake (*Malpolon monspessulanus*) and Ladder Snake (*Elaphe scalaris*) are also found here.

Invertebrates also abound due to the area's rich floral diversity. Numerous beetle species that develop within flowering plants are common at Windmill Hill. Similarly, nectar-rich flowers are teaming with hoverflies and bees during the spring. Species found in the area include the Gibraltar snail (*Oestophora calpeana*), Leaf beetles such as *Tituboea biguttata*, *Bembix* digger wasps and praying mantises (*Mantis religiosa*, *Sphodromantis viridis* & *Ameles spallanzania*). Butterflies are another feature of Windmill Hill. It is the local stronghold of the Provence Hairstreak (*Tomares ballus*), Southern Brown (*Argus aricia cramera*) and Green-striped White butterfly (*Euchloe belemia*). Swallowtails (*Papilio machaon*) are also found in the flats along

with migrating Painted Ladies (*Vanessa cardui*) that can often be recorded in their hundreds. These migrations sometimes coincide with those of dragonflies such as the Red-veined Darter (*Sympetrum fonscolombii*).

Unsurprisingly, Windmill Hill is also an important area for mammals, particularly bat species given the abundance of food. These include *Pipistrelle* spp., European free-tailed bat (*Tadarida teniotis*) and Schreiber's Bent-wing bats (*Miniopterus schreibersii*). There is also an indication that Greater mouse-eared Bats (*Myotis myotis*) and possibly *Nyctalus* spp. forage over Windmill Hill Flats. Wild rabbits (*Oryctolagus cuniculus*) are also found on Windmill Hill but their numbers have recently declined.

Top: Blue Rock Thrush. Below: Montpellier Snake.



Figure 11. Location of Windmill Hill Flats.



Factors affecting Windmill Hill Flats

The spread of several invasive species is seriously affecting the area. The most serious is the Kikuyu Grass (*Pennisetum clandestinum*). Other species include the Hottentot Fig (*Carpobrotus edulis*) and the Tree Aloe (*Aloe arborescens*). Aside from the spread of invasive and alien species, disturbance from military activities continues to be an issue, although there have been some improvements following the publication of the MOD's Integrated Rural Management Plan (IRMP). The creation of the MOD Conservation Group was a key measure of the IRMP, aimed at protecting biodiversity and heritage assets in Gibraltar. This group is now meeting on a quarterly basis and it is important for this to continue. The restoration of the artificial pond that was constructed in the early 1980s in Windmill Hill is another key measure of the IRMP that will help improve the site's ecological value. The factors currently affecting Windmill Hill can therefore be summarised as:

- Habitat succession e.g. growth of the European Wild Olive (*Olea europaea*);
- Risk of fire;
- Military activity and developments leading to the loss of habitat;
- Spread of invasive and alien species;
- Disturbance.

Management measures

Only adequate, sustained management will ensure the continued protection of this vitally important component of the Nature Reserve. The management of the site will be directly dependent on the Integrated Rural Management Plan and its application by the MOD, with the assistance of the Department of the Environment and Climate Change. Measures required to ensure that the site is maintained in favourable conservation condition include:

- Continued liaison between the MOD, Department of the Environment and Climate Change and the GONHS to ensure that all military training activities or developments do not have a significant impact on flora and fauna;
- Removal of all waste items accumulated as a result of illegal fly tipping activities;
- Prevention of habitat succession where relevant;
- Systematic removal of invasive and alien species especially Hottentot Fig (*Carpobrotus edulis*), Tree Aloe (*Aloe arborescens*) and Kikuyu Grass (*Pennisetum clandestinum*);
- Re-populating the Barbary Partridge (*Alectoris barbara*) and Wild Rabbit (*Oryctolagus cuniculus*).
- Increasing Environmental Enforcement patrols;
- Preventing detrimental cliff stabilisation works where possible;
- Restoration and continued management of the artificial pond;
- Installing habitat and wildlife interpretation panels;
- Installing Nature Reserve demarcation and fire hazard signs;
- Continued surveillance monitoring of flora and fauna.



Seven-spot lady beetle



Gibraltar Nature Reserve: Europa Point Foreshore

Europa Point Foreshore is the narrow strip of land that slopes gently into the sea immediately below the walls and cliffs at Europa Point. As a result of continued coastal development and urbanisation along other areas of Gibraltar, this component of the Reserve has become one of the few remaining natural stretches of limestone coastline. Its unique location overlooking the Strait frequently exposes the foreshore to gale force winds and harsh saline conditions which are not suitable for any but the hardiest of plants and animals. The intertidal or littoral zone within the foreshore marks the commencement of yet another Reserve that extends beyond the foreshore and well into the Strait of Gibraltar, namely the EU protected Southern Waters of Gibraltar SAC/SPA and the Gibraltar Marine Nature Reserve Area.



Current Status

126 plant species have been recorded in this area so far. The rather exposed, coastal nature of the habitat excludes most species found in the wider Gibraltar Nature Reserve. Some of the plants found here include the bright yellow Mediterranean beach daisy (*Asteriscus maritimus*), which adds colour to the area; the edible Rock samphire (*Crithmum maritimum*) which grows almost down to the waterline, the Wild carrot (*Daucus carota* subsp *maximus*) with its umbrella-like mass of tiny white flowers, the Squirting cucumber (*Ecballium elaterium*) with seed pods which, when ripe, burst and squirt seeds for metres around, the grey-leaved Yellow horned poppy (*Glaucium flavum*), the Tangier pea (*Lathyrus tingitanus*) which is rarely found elsewhere on the Rock, the Gibraltar sea lavender (*Limonium emarginatum*) which is endemic to the Strait of Gibraltar, the rare Coastal ragwort (*Senecio leucanthemifolius*) which is becoming very rare elsewhere along the Strait, the Grey-leaved Cineraria (*Cineraria maritima*) which is often planted in gardens and the Shrubby seablite (*Suaeda vera*) which in Gibraltar is only found at this site. All these species are particularly well-suited to surviving the harsh conditions of the habitat, but they will not survive in other habitats.



Top right: The Foreshore. Bottom Left: *L. sinuatum*/Middle: *L. emarginatum*/ Right: *S. leucanthemifolius*

Table 8. Important plant species found in Europa Foreshore.

| Species | Common name | Comments |
|--|------------------------|---|
| <i>Catapodium marinum</i> | Sea Fern-grass | Not very common. Found mainly on the Europa Flats area. |
| <i>Cichorium pumilum</i> | Wild Endive | Not very common. Found mainly on Windmill Hill Flats, but a few on Harding's Battery, and a number on the Foreshore. |
| <i>Euphorbia segetalis</i> var. <i>pinea</i> | Corn Spurge | Not very common. Only found on southern parts of the Rock. |
| <i>Frankenia laevis</i> | Sea Heath | Quite common. Generally found on southern parts of the Rock. |
| <i>Hyoscyamus albus</i> | White Henbane | A rare plant. Usually found on waste ground around town, and along the littoral. |
| <i>Lathyrus tingitanus</i> | Tangier Pea | A very rare plant. Previously found in various places around the Rock, but now only found on the Foreshore. |
| <i>Lavatera mauritanica</i> subsp. <i>davaei</i> | Moroccan Mallow | Found on southern parts of the Rock, with scattered plants on Med. Steps and the East Side. |
| <i>Limonium emarginatum</i> | Gibraltar Sea Lavender | A schedule 3 plant. Quite common and widespread all around the littoral. |
| <i>Limonium sinuatum</i> | Winged Sea Lavender | Quite common and widespread on southern parts of the Rock, including Windmill Hill Flats. |
| <i>Melilotus segetalis</i> | Field Melilot | A rare plant. May be found very scattered in various places, but mainly on the Foreshore. |
| <i>Moraea sisyrinchium</i> | Barbary Nut | Quite common and widespread on southern parts of the Rock, including Windmill Hill Flats. |
| <i>Parapholis filiformis</i> | Slender Sea Hard-grass | A rare plant. Only found on Europa Flats and Foreshore. |
| <i>Parapholis incurva</i> | Curved Sea Hard-grass | Fairly common and widespread along the littoral. |
| <i>Rumex induratus</i> | Shield Dock | Quite widespread around southern parts of the Rock. Very few found elsewhere. |
| <i>Senecio leucanthemifolius</i> | Coastal Ragwort | A rare plant. A few plants found along the cliff top around Governor's Cottage, but its main stand is on the Foreshore. |
| <i>Suaeda vera</i> | Shrubby Seablite | A rare plant. Only found on the Foreshore. |



Europa foreshore is also a good location to spot seabirds and waders that are relatively difficult to see in other areas of Gibraltar. Some of the characteristic species recorded in this quiet corner of the Reserve include the Turnstone (*Arenaria interpres*), Oystercatcher (*Haematopus ostralegus*), Common Kingfisher (*Alcedo atthis*), Whimbrel (*Numenius phaeopus*), Common Sandpiper (*Actitis hypoleucos*), Mediterranean Shag (*Phalacrocorax aristotelis desmarestii*), Comorant (*Phalacrocorax carbo*), Northern Gannet (*Morus bassanus*), Sandwich Tern (*Sterna sandvicensis*), Black Headed Gull (*Larus ridibundus*) and Audouin's Gull (*Larus audouinii*).

Figure 12. Location of Europa Point Foreshore.



Vagrant species can also be observed on the foreshore; a recent rarity that generated much interest in Gibraltar was the first record of a Purple Sandpiper (*Calidris maritima*).

Foreshore birds. Left: Turnstone. Right: Common Sandpiper.



Moving away from the immediate coastal fringe, there are other species that can be regularly found on the foreshore such as the Black Redstart (*Phoenicurus ochruros*), Spotless Starling (*Sturnus unicolor*), Meadow Pipit (*Anthus pratensis*), Blue Rock Thrush (*Monticola solitarius*), Common Chiffchaff (*Phylloscopus collybita*), European Stonechat (*Saxicola rubicola*), Whinchat (*Saxicola rubetra*), Northern Wheatear (*Oenanthe oenanthe*), White Wagtail (*Motacilla alba*), Grey Wagtail (*Motacilla cinerea*) and Sardinian Warbler (*Sylvia melanocephala*). Dartford Warblers (*Sylvia undata*) are also found in the foreshore occasionally.

Invertebrates also thrive at Europa Foreshore, with recent research focusing on ants, beetles, snails and butterflies. Reptiles are also common and generally include the Andalusian Wall Lizard (*Podarcis vaucheri*) and the Moorish Gecko (*Tarentola mauritanica*). In contrast, mammalian life on the foreshore is very poor, although data on how bats use the site are currently lacking.

Aerial view of Europa Foreshore



Factors affecting Europa Point Foreshore

New residential buildings and the indiscriminate disposal of building debris, surplus domestic appliances and refuse are some of the main factors that have impacted the foreshore over the years. Alien invasive flora have also left their mark and had a profound impact on floral diversity. Notable species that have taken a foothold on the foreshore include the Century Plant (*Agave americana*), Hottentot Fig (*Carpobrotus edulis*) and the Prickly Pear (*Opuntia ficus-indica*).

The main factors currently affecting Europa Foreshore can therefore be summarised as:

- Spread of invasive and alien species;
- Litter;
- Human disturbance and trampling;
- Illegal fly tipping;

Management measures

Measures required to ensure that Europa Foreshore is maintained in a favourable conservation condition include:

- Installing and maintaining balustrades to minimise erosion, and a picnic area and viewing platform with interpretation panels;
- Restoring heritage assets such as WWII bunkers and tunnels;
- Removal of all building debris, refuse and other materials found on the foreshore;
- Restricting access to the foreshore after sunset until sunrise;
- Systematic removal of alien and invasive species;
- Increasing surveillance monitoring of flora and fauna;
- Increasing Environmental Enforcement patrols;
- Installing wildlife and heritage interpretation panels;
- Installing Nature Reserve demarcation signs;
- Installing litter bins and regularly removing litter.

Ongoing measures: boardwalk and viewing platform at Europa Foreshore.



Foreshore birds. Left: Sardinian Warbler. Right: European Stonechat.



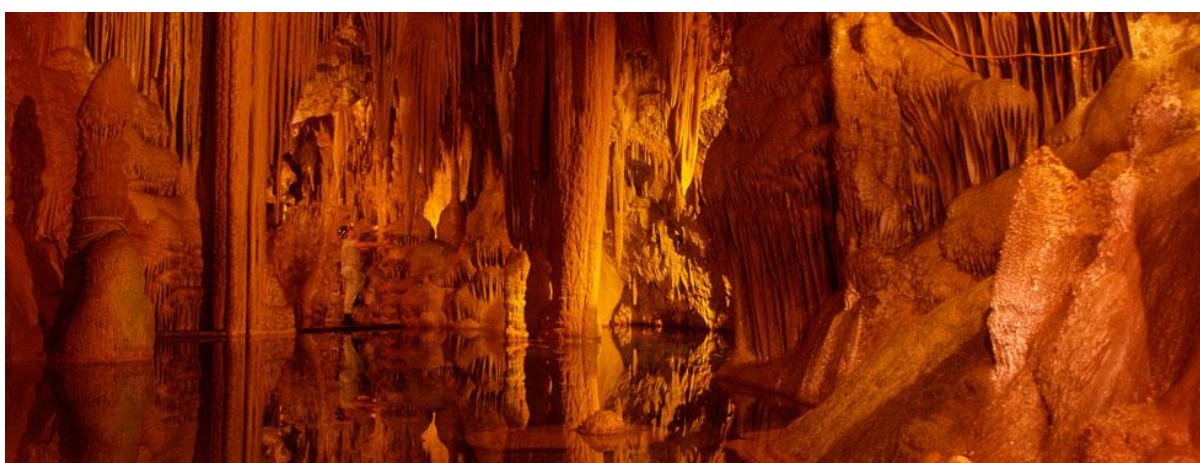
Department of the Environment, Heritage & Climate Change removing litter as part of 'Clean up the World Day'.



Gibraltar's Caves

Caves are an integral part of our natural environment, with unique and fragile features. The Gibraltar Nature Reserve is riddled with caves, a few of them forming part of the Reserve's main tourist attractions, such as the famous St. Michael's Cave complex. Ongoing work carried out by both the GONHS Caves Science Unit and the Gibraltar Museum's Caving Unit has revealed that there are well over 200 caves in Gibraltar - a marked increase in those recorded from the 143 caves identified by George Palao as part of his pioneering work in the Gibraltar Cave Research Group during the 1960s and 70s. A large majority of the caves recorded in Gibraltar are not open to the public and are classified as an EU protected habitat, requiring special protection measures in line with the requirements of the Habitats Directive.

New St. Michael's Cave



Caves are considered an important habitat for many reasons other than their inherent geological and archaeological importance. They provide refuge for a variety of specialised animals and plants found in Gibraltar including mosses, algae and fungi. Holes and ledges found in the entrance zone of caves can provide nesting or roosting sites for bird species such as Pallid and Alpine Swifts, Spotless Starlings, Wrens, Crag Martins and even seabirds. Ledges in the caves at Governor's beach for example have been frequently used as a nesting site by Gibraltar's small population of Mediterranean Shags for some time.

Not surprisingly, bats are the flagship species associated with this EU protected habitat type and much has been learnt recently following the creation of the Gib-Bats Project. This is a collaborative study on historic and current bat populations found in Gibraltar. The project aims to further understand and gain knowledge on bat protection, conservation as well as raise awareness on issues affecting bats.



Right: Male Isabelline Serotine Bat



Gib-Bats team members and collaborators. From left to right: Albert Yome, Stephen Warr, Tyson Holmes, Giovanni Santini, James Shipman, John Sanchez, Stewart Finlayson & Tom August.

Some of Gibraltar’s caves are also renowned for their impressive subterranean aquatic habitats, such as drip pools and lakes. The Ragged Staff Cave, located deep in Ragged Staff tunnel, is one of those cave systems. It contains a lake christened ‘The Silent Pool’ by its discoverers which is over 30 metres deep and holds an as-yet undescribed amphipod previously unknown to science. A harvestman (an arachnid) from the caves of Gibraltar also awaits description. A number of other lakes are found within this near pristine cave system which continues to be meticulously studied by both local and international scientists. Some of Gibraltar’s caves are therefore at the forefront of climate change studies through analysis of speleotherms in paleoclimate applications.



GONHS Cave Science Unit in action: John Paul Latin downloads drip discharge and temperature data in Straw chamber (Ragged Staff Cave system).



Current Status

Due to the relatively large number of caves found in Gibraltar, together with the lack of biological or geological data for some caves, it is difficult to provide a general assessment of their conservation status. It is nevertheless clear that most of the caves that are accessible to the public are in need of protection measures to improve their conservation status. Using Martin's Cave as a prime example, this was the last cave to hold a large colony of bats along Mediterranean Steps. To date, it continues to be affected by vandalism, despite repeated attempts to restrict visitor access. Other caves and artificial chambers found within the Reserve are similarly affected.

Colony of roosting Schreiber's bent-winged bats



Uncontrolled cave tourism is also an issue that needs to be addressed, since this can have a detrimental impact on caves and cave dwelling organisms, as is the case with New St. Michael's cave. Illegal caving activities, unauthorised excavations and litter deposition are also prevalent within and outside the Reserve network and these issues need to be controlled and regulated. There are also some cave systems that have been subjected to increased vibrations, disturbance and even damage as a result of construction activities, such as those found in the North Gorge. Glen Rocky, Glen Rocky Shelter and Judge's Caves are the largest cave systems in this area and are an excellent example of fissure caves as opposed to the karst caves found in the Upper Rock. It is worth pointing out that historical records show that Glen Rocky Shelter Cave is one of the main sites in Gibraltar where records of Horseshoe bats (*Rhinolophus* spp.) exist.

Factors affecting caves

- Litter and graffiti;
- Illegal caving activities including excavations;
- Uncontrolled caving tours;
- Accidental and intentional disturbance to cave ecology;
- Alteration to cave environments e.g. changes in air flows and increased temperatures;
- Physical damage due to development.

Management measures

There is a striking need for more ecological data for most of the caves found in Gibraltar. This should include surveys of plants, insects, bats and other species known to inhabit caves and extend all the way from cave entrances to dark zones including aquatic habitats. In addition, there are numerous other pressing measures that need to be implemented both within and outside the Reserve network. These include:

- Enacting new legislation to provide more robust protection for caves;
- Establishing a Cave Management Committee;
- Increasing surveillance monitoring of cave flora and fauna;
- Restricting and/or prohibiting visitor access to sensitive caves or tunnels;
- Assisting the GONHS Cave Science Unit in monitoring cave environments;
- Assisting the Gib-Bats project and implementing key measures advocated by the Gib-Bats Project where possible;
- Installing information panels in the vicinity of caves that are regularly accessed by the public (e.g. Mediterranean Steps and St. Michael's Cave system);
- Regularly cleaning caves, particularly those accessible to the public;
- Increasing Environmental Enforcement patrols and security including CCTV and perimeter fencing or grilles where relevant;
- Publishing awareness material intended to promote the conservation of caves and features therein;
- Establishing a list of approved Cave Tour Guides.

Gibraltar funnel web spider - An EU protected species that can be found in the entrance zone of some cave habitats.



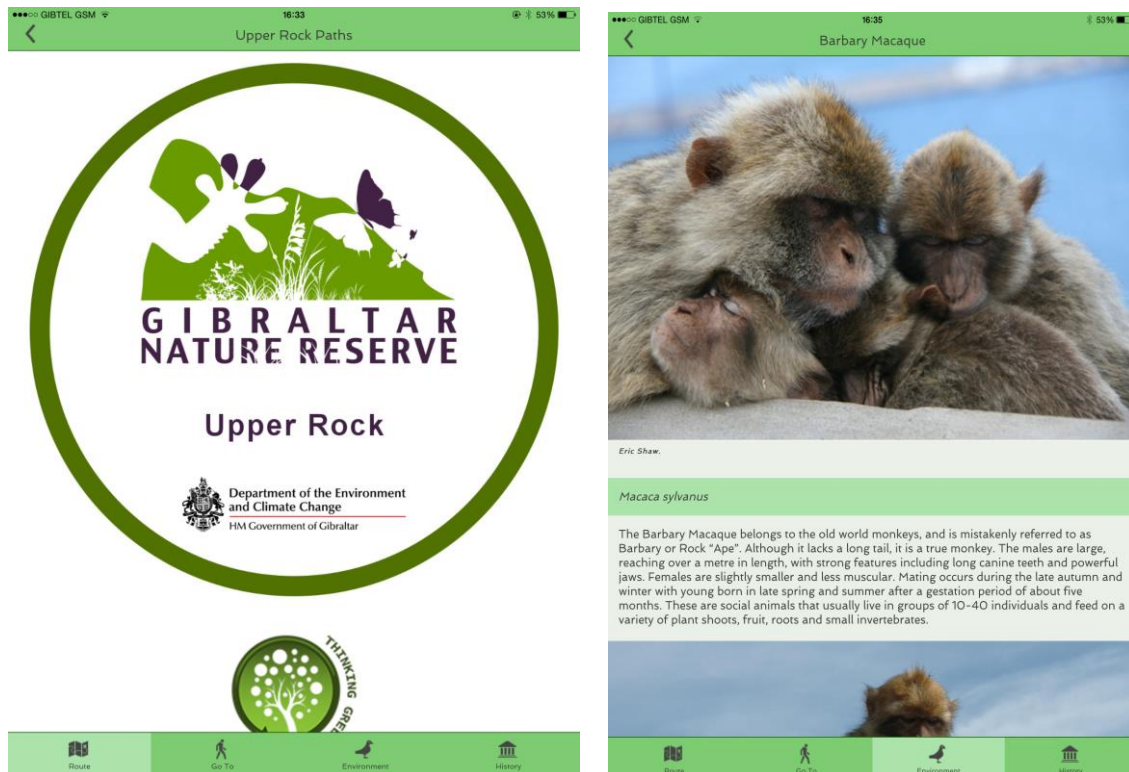
Thematic trails and general improvements in the reserve

The Gibraltar Nature Reserve, particularly the Upper Rock, is renowned for its unique trails that meander through the extent of the Reserve. These combine the Nature Reserve's natural beauty and stunning views with some sites of historic interest that do not feature widely as part of the more mainstream 'Rock tours'. Notable trails include the Mediterranean Steps, Inglis Way, Royal Anglian Way and Douglas Path.

One of the key objectives of this plan is to diversify the products available in the Gibraltar Nature Reserve. In order to help meet this requirement, a thematic trail network approach will be adopted. Different trails will therefore cater for different visitor expectations and abilities. In addition, the trails will be intersected by 'trail nodes' which correspond to some of the main attractions within the Reserve such as Jews' Gate, the Moorish Castle and St. Michael's Cave.

Four trail networks have been developed namely the 'Nature Lover', the 'History Buff', the 'Thrill seeker' and the 'Monkey trail'. Each trail has its own logo to help guide the user. In addition to improving and maintaining the trails in good condition, the plan also aims to improve all the main trail nodes, as well as other prominent sites, found within the Reserve. As part of the revamped trail network a Gibraltar Nature Reserve Application (GNR App) has been developed which is available on iTunes and Android platforms. The GNR App will be continuously developed and improved in conjunction with stakeholders. Other useful mobile applications will also be developed such as a Barbary Macaque Interactive Game to help residents and visitors understand the ecology and behaviour of one of Gibraltar's flagship species.

Gibraltar Nature Reserve Mobile Application



Thematic trail network and nodes



'The Nature Lover'

Devil's Gap Footpath, Devil's Gap, Genoese, Tovey and Princess Caroline's Batteries, Inglis Way.



'The History Buff'

Devil's Gap, Genoese, O'Hara's, Lord Airey's and Princess Caroline's Batteries; Royal Anglian Way, Moorish Castle and Tower of Homage.



'The Thrill-seeker'

Europa Point, Europa Advance Batteries, Windmill Hill, Jew's Gate, Mediterranean Steps, Lord Airey's and O'Hara's Batteries, Charles V Wall, Royal Anglian Way.



'The Monkey Trail'

Queen's Road Tunnel, Genoese Battery, Ape's Den, St Michael's Cave, Prince Phillip's Arch.



Node A.
Princess Caroline's Battery



Node B.
Moorish Castle



Node C.
Devil's Gap Battery



Node D.
Ape's Den

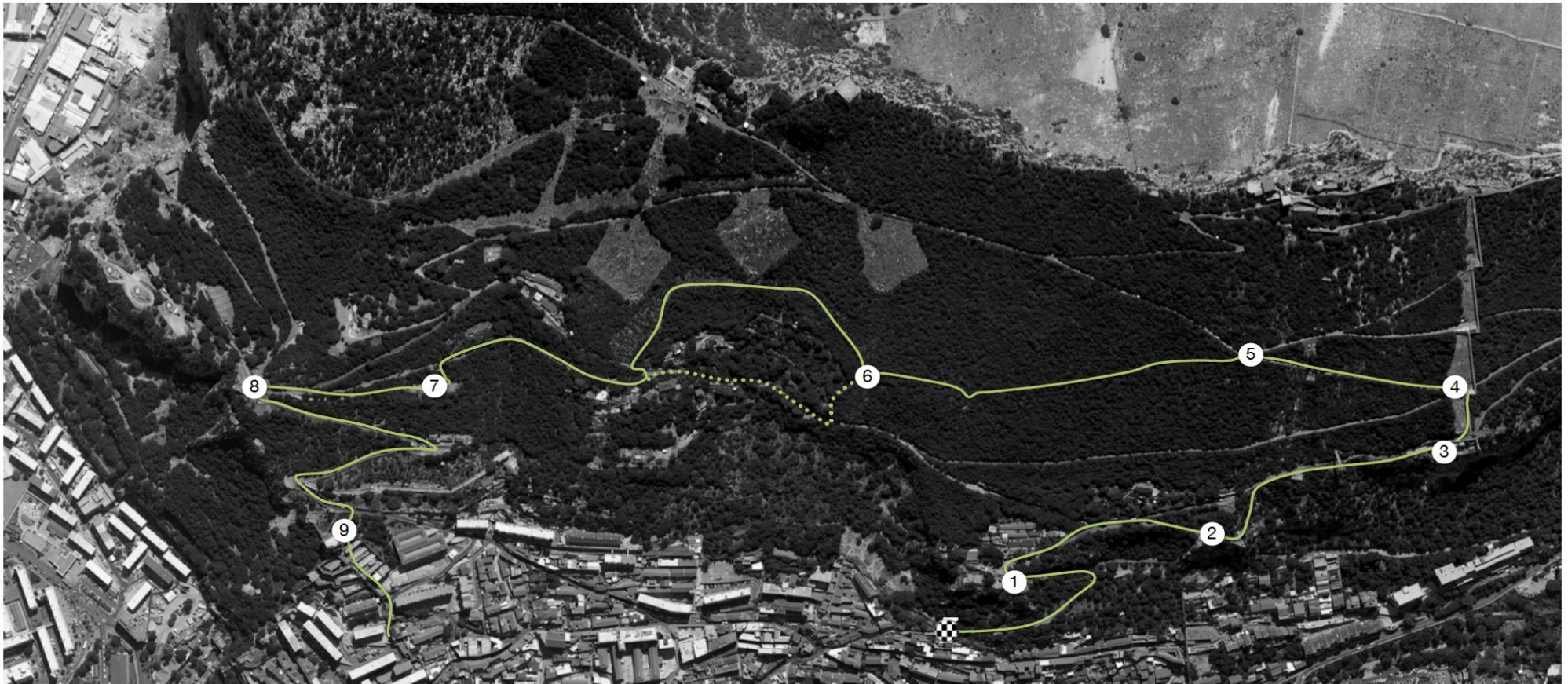


Node E.
St. Michael's Cave



Node F.
Jew's Gate

'The Nature Lover' Trail





Route and connections:

 Devil's Gap Path


 1. Devil's Gap Battery

 2. Genoese Battery


 3. Ape's Den / Prince Ferdinand's Battery

 4. Start of Inglis Way, adjacent to Charles V Wall

 5. Connection to Signal Station Road

 6. Route fork, adjacent to MoD nursery

 7. Tovey Battery

 8. Prince Caroline's Battery and lookout

 9. Moorish Castle – Tower of Homage

'The History Buff' Trail



Main Route:

 Start/Finish: Devil's Gap Footpath, entrance to Nature Reserve

1. Devil's Gap Battery

South Route:

2. Genoese Battery

3. Prince Ferdinand's Battery / Ape's Den

4. Royal Anglian Way / Rooke Battery

5. St. Michael's Cave

North Route:

6. Tovey Battery

7. Princess Caroline's Battery

8. City Under Siege Exhibition

9. Tower of Homage, Moorish Castle

Extended Route Sites:

A. Spur Battery

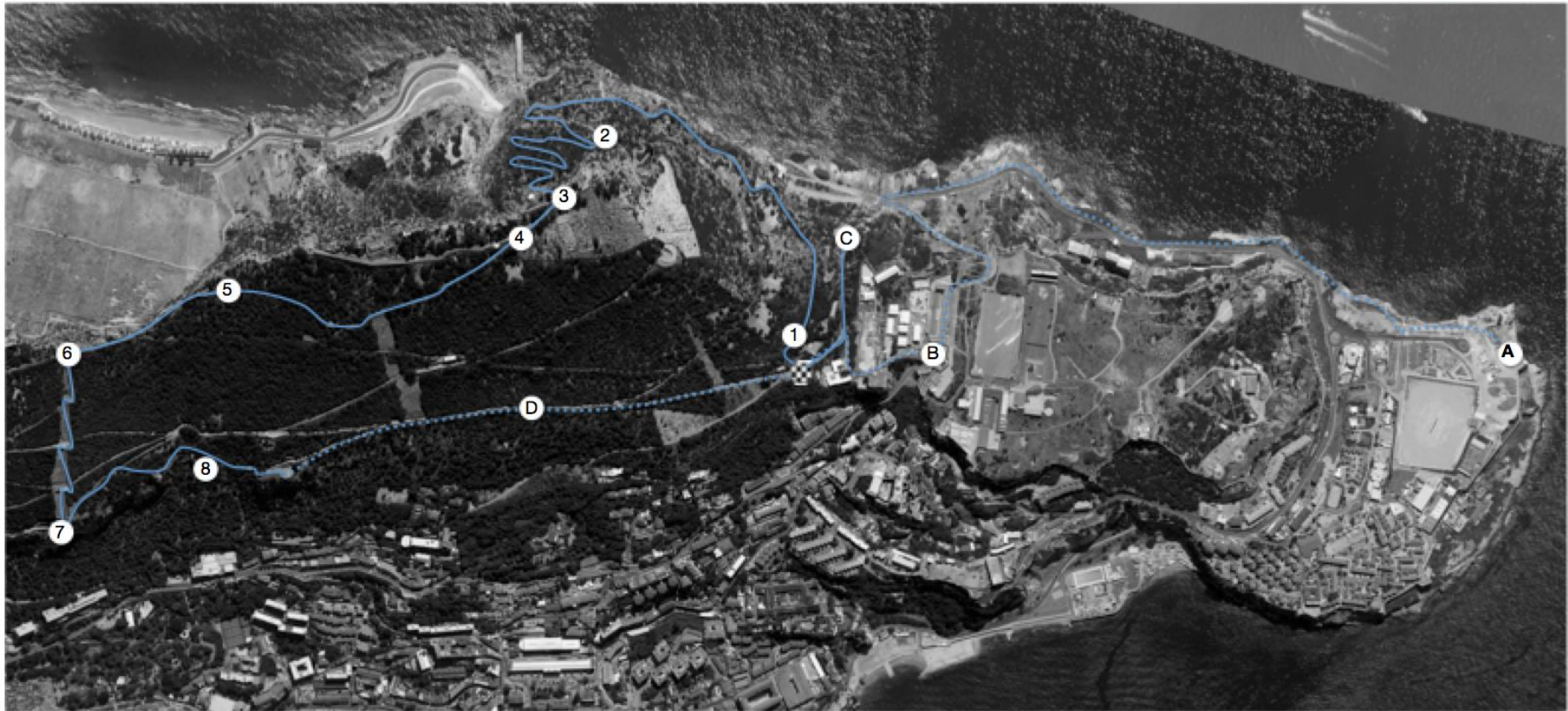
B. Douglas Path / Mount Misery

C. O'Hara's, Lord Airey's Battery

D. WWII Tunnels, Princess Royals Batteries

E. Great Siege Tunnels

'The Thrill-seeker' Trail



Route and connections:

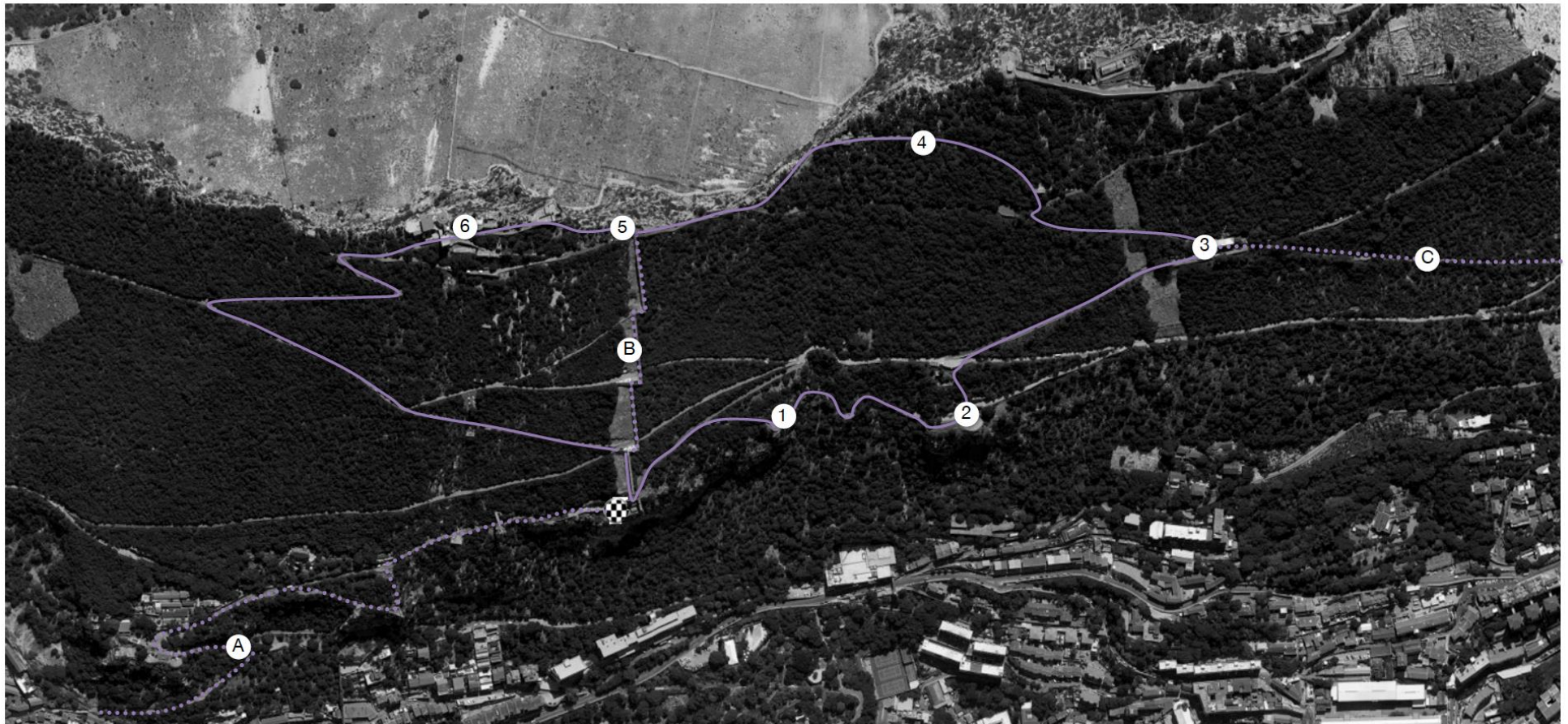
- ⊗ Jew's Gate, Entrance to Nature Reserve
- 1. Start of Mediterranean Steps Trail
- 2. Connection to Spyglass Battery
- 3. O'Hara's, Lord Airey's Batteries
- 4. Tracer's 'Stay Behind Cave'

- 5. Douglas Path / Mount Misery
- 6. Top of Charles V Wall
- 7. Ape's Den, Princess Ferdinand's Battery
- 8. Royal Anglian Way, Rooke Battery


Potential connections:

- A. East side trail to Europa Point
- B. Windmill Hill
- C. Levant Battery
- D. Circular trail back to Jew's Gate

'The Monkey' Trail



Route and connections:

 Ape's Den, Princess Ferdinand's Battery

1. Royal Anglian Way

2. Rooke Battery

3. St Michael's Cave

4. Douglas Path

5. Prince Phillip's Arch , top of Charles V Wall

6. Cable Car Station

A. Connection to Devil's Gap Path

B. Alternative route via Charles V Wall

C. Connection to Jew's Gate

Devil's Gap Path – Common entrance point to pedestrian trails



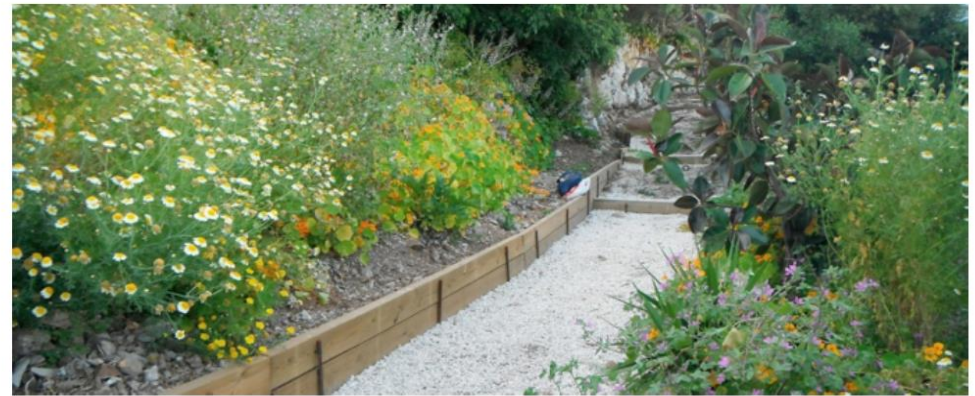
Previous condition:

- Narrow and overgrown path, poorly maintained
- No signage, refuse bins or seating areas
- Limited use by visitors, entrance point poorly indicated



Summary of works undertaken:

- Path made wider and re-surfaced.
- Balustrading, benches, bins and interpretation signs added.
- Rubbish and debris removed, gabions and retaining elements added to contain terrain.



Devil's Gap Battery – improved site



Previous condition:

- No balustrade to perimeter with considerable sheer drop.
- Area un-kept, bin in poor state of repair.
- Areas below battery closed off from public.



Summary of works undertaken:

- Balustrade installed to perimeter, to match typical detail employed elsewhere.
- Rubbish and debris removed, bin replaced. Signage due to be installed.
- Chambers below surveyed, for potential future use.



Genoese Battery – re-opened site



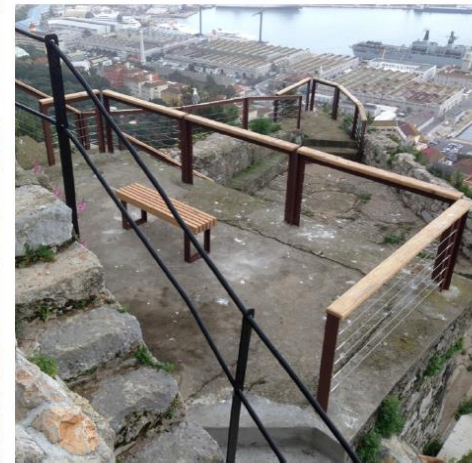
Previous condition:

- Poorly maintained site, historic bunkers and structures in a state of collapse.
- Path in a poor condition, balustrading collapsing in areas.
- No signage, bins or seating.



Summary of works undertaken:

- Path re-surfaced, new stairs created to link portion of site that had been disconnected.
- New balustrading added, bunkers securely cordoned off for future intervention.
- Signage, seating and bins added. Derelict structure refurbished into covered seating area.



Inglis Way – improved trail



Previous condition:

- Path generally in a fairly good condition.
- Poor signage, lack of clear indication of trail entrance.
- Some areas with difficult access over existing services.



Summary of works undertaken:

- Entrance area re-surfaced and balustrade added to area adjacent to road.
- Signage added at both ends of trail, with directional information provided of adjacent sites.
- Steps and balustrade added in specific locations where access required improvement.

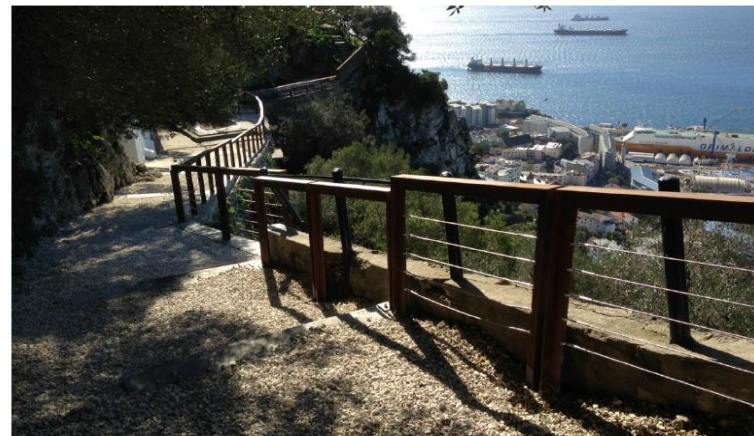


Royal Anglian Way - improved trail



Previous condition:

- Site accessible to the public, but with no active maintenance, interpretation, seating or way-finding.
- Balustrade collapsed in places. Brackets supporting services fallen off.
- Bunkers, tunnels and chambers filled with debris, closed off from public.



Summary of works under way:

- Balustrading replaced to match typical details and extended to areas previously unsecured.
- Seating, signage and bins added. Rubbish and debris cleared, tunnels and chambers restored for future re-use.
- Services re-routed so as not pass over pedestrian path and to reduce visual impact.
- Steps and path connecting to Queen's lookout re-instated.

Royal Anglian Way



New attractions:

- Suspended bridge spanning over 70m between existing battery gun emplacements.
- Chambers and tunnels being re-opened for interpretation and possible new use such as for cafeteria.

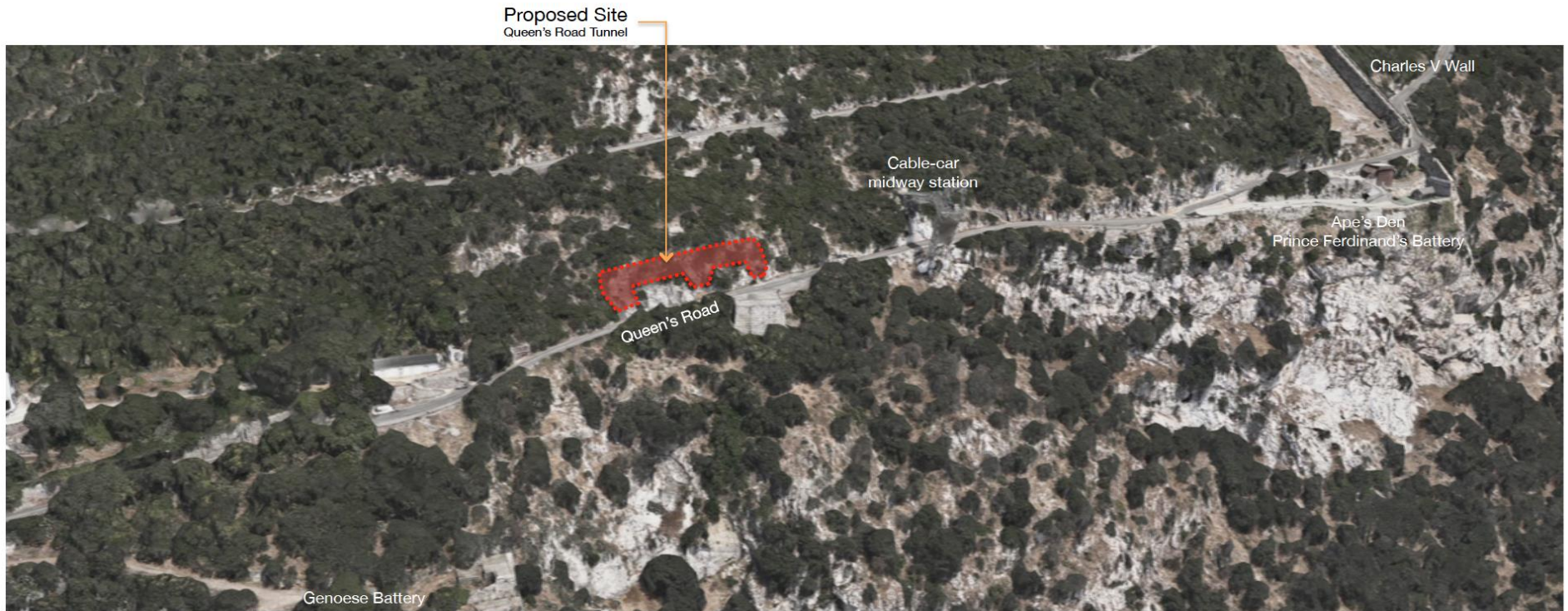


Queen's Road Tunnel – site being re-posed as new Macaque interpretation centre



Existing Condition:

Existing disused military tunnel adjacent to Queen's Road, in close proximity to Ape's Den / Prince Ferdinand's Battery and Genoese Battery.

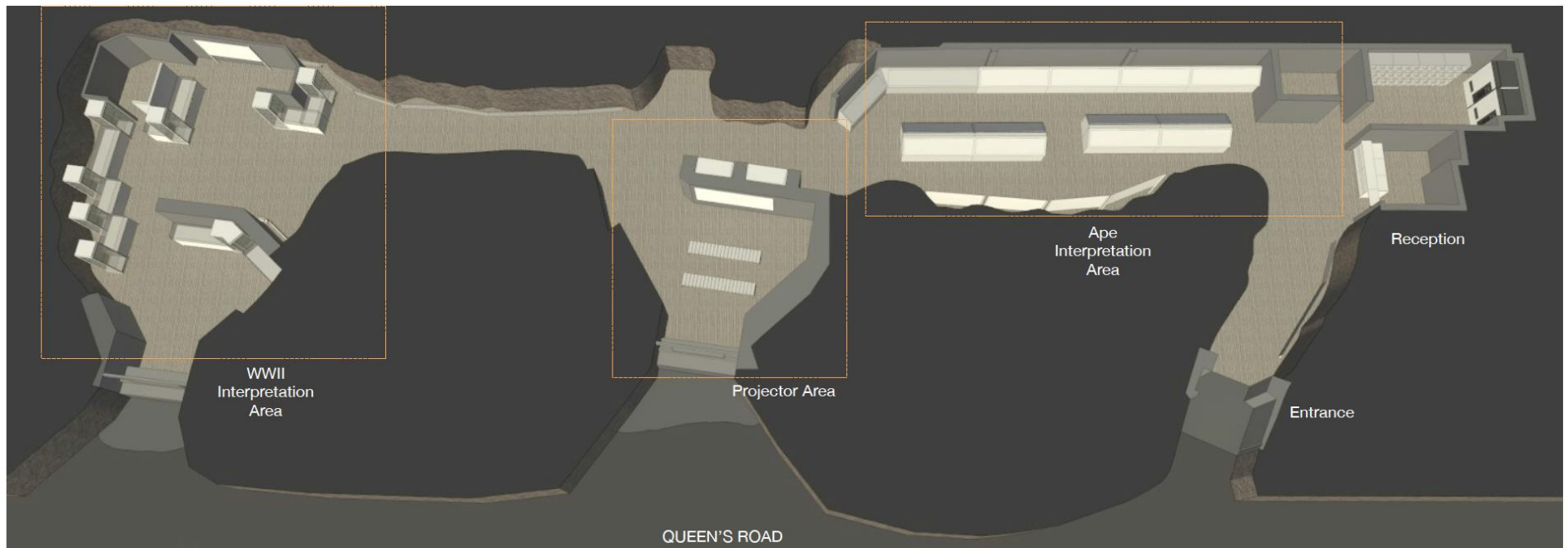


Queen's Road Tunnel – site being re-purposed as new Macaque interpretation centre



Proposed Intervention:

Internal fit-out to convert the site into an interpretation centre showcasing both WWII aspects and the native macaques. New illuminated display cases and information boards, lighting and projectors introduced.



Queen's Road Tunnel – site being re-purposed as new Macaque interpretation centre

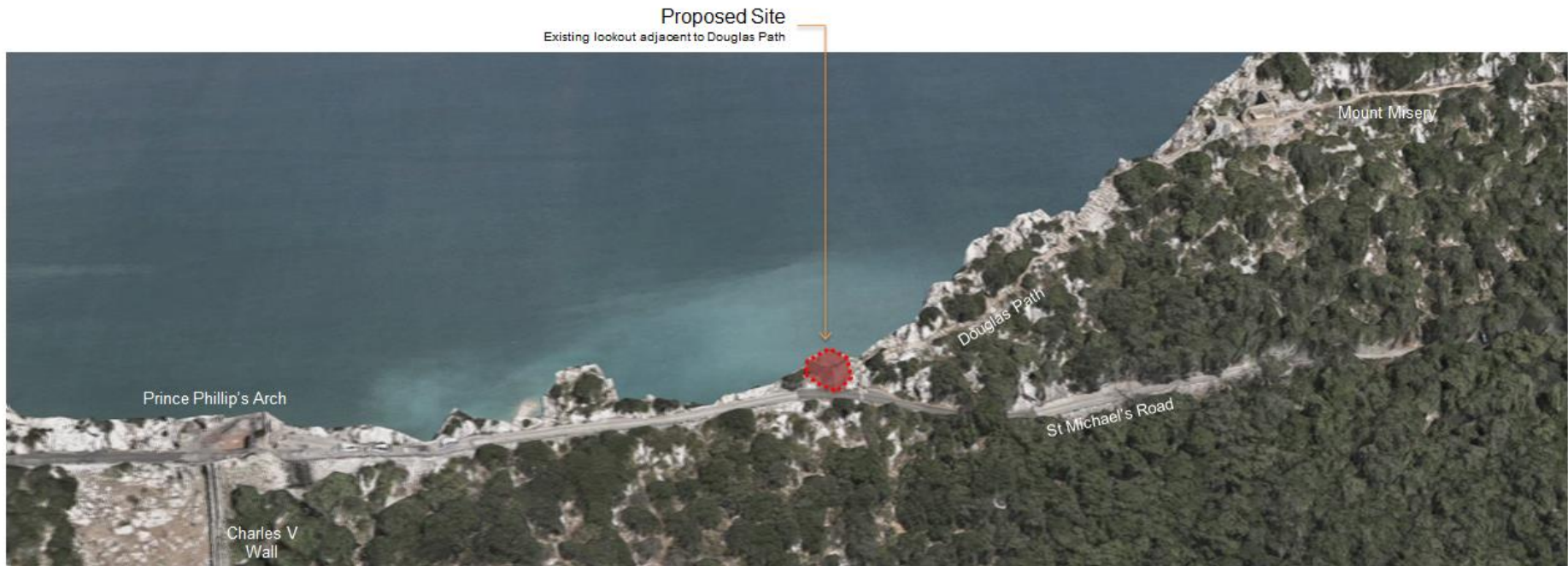


Mount Misery – new glass lookout being created around existing platform



Previous Condition:

Former military lookout/position finding cell adjacent to Douglas Path, St Michael's Road. Currently used as lookout by visitors to the Nature Reserve, but in a poor state of repair.



Mount Misery – new glass lookout created around existing platform



New Attraction

New glass extension affording 360° views to visitors.



Tovey Battery



CONDITION AND POTENTIAL:

- Batteries have been recently cleaned and painted, but lack any interpretation, signage or connections to routes and therefore attract few visitors
- Area running parallel to road, providing a straightforward possibility to separate vehicular and pedestrian traffic
- Level, open area, lends itself to creating a rest area marking the end of Inglis Way
- Possibility to provide recreation facilities, such as picnic area, children's playground, climbing wall, etc.

Princess Caroline, Anne, Amelia Batteries



CONDITION AND POTENTIAL:

- Areas with extensive historic military installations, privileged views and large open area, which goes unnoticed to many visitors who only see Princess Caroline's Batteries on the way up the rock.
- Impressive WWII Tunnels and Willis's Magazines, with good interpretation and lighting; but which are not all open to the general public.
- Opportunity to create larger rest area, serving a stop en route to the Upper Rock or down towards the town area.

Scientific research and Monitoring

The Gibraltar Nature Reserve lends itself to scientific research and the Ministry for the Environment and Climate Change supports the use of the reserve for research into species and habitats, or other appropriate areas of research. In all cases, permission is required before any research is carried out in line with the requirements of the Nature Protection Act 1991.

The Department of the Environment and Climate change requires at least one month notice of any research in order to grant permission, but more time may be needed if other entities need to be consulted. We advise that as much notice as possible is given, particularly if you need to arrange transport and accommodation in the area. The notice period is required as we have to consult with other entities such as the Nature Conservancy Council and organisations such as the Gibraltar Ornithological and Natural History Society.

What we need to know

In order to make an informed decision, the following information is required:

- Where exactly you wish to carry out the work;
- What the work entails;
- Whether you need to obtain samples;
- When you would like to undertake the work;
- A brief summary of the research aims and objectives.

Provision of research data and publications

It is a standard requirement for all research licenses that a copy of the results is made available to the Department of the Environment and Climate Change at no cost.

Health and Safety

The Department of the Environment and Climate Change endeavours to ensure the safety of the public within the reserve. However, where access is required away from public areas there may be hazards that need to be considered. It is the responsibility of the researcher to undertake suitable risk assessments and to have suitable insurance for the work being undertaken. Whilst the Department can advise on risks and hazards on its sites, it is your responsibility to ensure you work safely and have appropriate measures in place.

Further information

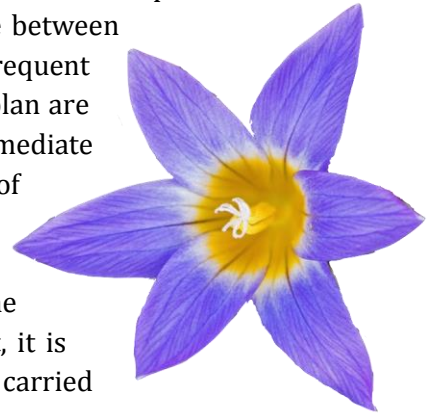
For more information on obtaining a research licence, please contact us on:

Department of the Environment, Heritage and Climate Change
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50 Town Range
Gibraltar
GX11 1AA
Email: info.environment@gibraltar.gov.gi
Website: www.thinkinggreen.gov.gi



Management Plan Summary

A wide range of measures have been included in the plan for all the different components that make up the Gibraltar Nature Reserve. A distinction needs to be made between those measures that require 'one-off' action and those where a more frequent schedule of works will be implemented to ensure that the aims of the plan are met. Similarly, some components of the reserve will require more immediate attention as opposed to those parts where there is a lesser likelihood of any significant ecological impacts occurring. Responsibility for determining the priority and exact frequency with which of each of the relevant measures in the plan shall be actioned will rest on the Department of the Environment and Climate Change. From the outset, it is clear that measures such as litter and graffiti removal will have to be carried



out on a routine basis whereas others, such as the clearance of undergrowth or the *Romulea clusiana* maintenance of the thematic trail network, may need less frequent but nevertheless systematic action. The re-introduction of species that were found in Gibraltar is one of the most ambitious and exciting measures included in the plan. This is a long-term measure that will require continuous effort and dedication. Co-operation with regional authorities and experts will play an important role in the delivery of this measure; one that will undoubtedly improve the value of the Gibraltar Nature Reserve.

Measures requiring a specific action to be undertaken will be prioritised on a three-tiered scale, being considered either of high, medium or low priority. The following criteria will be used to allocate priorities:

High priority: activities imperative to achieving the objectives and desired outcomes of the plan. They must be undertaken in the near future to avoid significant deterioration in natural, recreational or management resources.

Medium priority: activities necessary to achieve the objectives and desired outcomes but are not urgent.

Low priority: activities desirable to achieve management objectives and desired outcomes but which can wait until the necessary resources are available.

The creation of the Gibraltar Nature Reserve Management Board will assist the process of reviewing the implementation of each of the measures included in the plan and establishing management priorities and timeframes.

Increasing recreational opportunities and improving the visitor experience also forms a critical element of the plan. The Department of the Environment and Climate Change will therefore take into account new findings and recommendations as these are developed in consultation with stakeholders. Other management measures which are not included in the plan may subsequently be implemented provided that these are consistent with the overarching objectives of the Gibraltar Nature Reserve Management Plan.

Photo References

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| 2 | Stephen Warr | View of the Mediterranean Sea from the Middle Ridge, Upper Rock |
| 2 | Stephen Warr | Jacob's Ladder |
| 7 | Gerard Kelleher | Swallowtail Butterfly |
| 7 | Gilbert Gonzalez | Griffon Vulture being released by Vincent Robba after being rehabilitated by the GONHS Raptor Unit |
| 7 | Nicholas Ferrary | Andalusian wall lizard |
| 7 | Stephen Warr | Barbary macaque |
| 7 | Aaron Baglietto | Hummingbird Hawk Moth |
| 7 | Albert Yome | Schreiber's Bent-winged Bat |
| 11 | Imperial War Museum | Mk X gun facing north at Breakneck Battery, Upper Rock, in January 1942 |
| 13 | Clive Finlayson | Giant Tangier Fennel |
| 16 | Clive Finlayson | Short-toed Eagle |
| 16 | Tommy Finlayson | European Robin |
| 21 | Harry Van-Gils | Orb-weaving Spider |
| 28 | Victor Hermida | Sites of historic importance within the Northern Defences |
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| 59 | John Sanchez | Turnstone |
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| 61 | Shane Shacaluga | Sardinian Warbler |
| 61 | Paul Acolina | European Stonechat |
| 62 | Gib-Bats | Male Isabelline Serotine Bat |
| 65 | Shane Shacaluga | Gibraltar funnel web spider |

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