

UK Overseas Territories and Crown Dependencies: 2011 Biodiversity snapshot.

South Georgia and South Sandwich Islands Appendices.

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This section includes a series of appendices that provide additional information relating to that provided in the South Georgia and South Sandwich Islands chapter of the publication: UK Overseas Territories and Crown Dependencies: 2011 Biodiversity snapshot.

All information relating to South Georgia and South Sandwich Islands is available at <http://jncc.defra.gov.uk/page-5754>

The entire publication is available for download at <http://jncc.defra.gov.uk/page-5821>

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Appendix 1: Multilateral Environmental agreements and implementation

Title (Abbreviated)	Title (Full)	Implementation
CMS (Bonn Convention)	Convention on the Conservation of Migratory Species of Wild Animals	
CMS ACAP	Convention on the Conservation of Migratory Species of Wild Animals - Agreement on the Conservation of Albatrosses and Petrels (ACAP)	
London Convention	Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter	
RAMSAR	Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar)	
ICRW(a)	International Convention on the Regulation of Whaling (a)	
Vienna Convention	Vienna Convention for the Protection of the Ozone Layer	
PEPAT Madrid Protocol	Protocol on Environmental Protection to the Antarctic Treaty	
Protocol ICCLOPD	Protocol to amend the International Convention on Civil Liability for Oil Pollution Damage of 29.11.1969	
Protocol ICCOPD	Protocol to amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage of 18.12.1971	
UNCLOS (UNC Fish Stocks)	Agreement for the Implementation of the Provisions of UNCL OS (10.12.1982) relating to the conservation & management of straddling fish stocks & highly migratory fish stocks	
UNESCO WHC	Convention concerning the Protection of the World Cultural and Natural Heritage	
Aarhus Convention	Access to information, public participation in decision-making and access to justice in environmental matters	
Montreal Protocol	Montreal Protocol on Substances that Deplete the Ozone Layer	

Appendix 2: National Legislation and Strategies

Legislation

Wildlife and Protected Areas Ordinance (www.sgisland.gs). This Ordinance is intended to provide protection for all of the Territory's native wildlife, to enable the declaration of Specially Protected Areas and Marine Protected Areas and, where appropriate, for species to be listed as Specially Protected. The Ordinance is in V parts.

Part I of the Ordinance is a preliminary section, which includes definitions of terms used.

Part II addresses the Protection of Wildlife. Section 6 affords protection to wild birds and protected wild mammals (cetaceans, seals and reindeer). Sections 8-9 deal with protection of native invertebrates and plants. Here plants and invertebrates are assumed to be native, unless it is shown to the contrary. Section 10 deals with the possession of wildlife, whilst Section 11 makes the introduction of non-native species, without a permit, an offence. Section 12 includes the prohibition of certain methods of capturing or killing wild birds or wild mammals. Section 13 introduces Schedules 1 to 4, which are lists of protected wild mammals, native invertebrates, native plants and specially protected species. It is intended that species covered by the Agreement on Conservation of Albatross & Petrels will be included as Specially Protected Species in Schedule 4. Section 15 deals with controls on imports and exports of wildlife.

Part III deals with Specially Protected Areas (SPAs) and Marine Protected Areas (MPAs). SPAs protect areas of land that are important ecologically, geologically or scientifically (Section 17) and will require management plans (Section 18). Section 19 includes provision for the designation of MPAs to protect flora or fauna, habitats, geological features or heritage in the marine environment.

Part IV addresses conditions under which a permit may be granted for activities that would otherwise be a contravention of this legislation.

Part V includes provisions in relation to offences under the ordinance and repeals the Wildlife and Protected Birds Ordinance 1913 and the Falkland Islands Dependencies Ordinance 1975.

Fisheries Ordinance

Fisheries Licensing Policy

Appendix 3: Specially Protected Areas

Specially Protected Areas (SPAs) have been designated on South Georgia to provide a high level of protection to areas of special conservation or scientific interest, areas which are rat-free, areas restricted due to health and safety concerns, heritage sites and sites designated for monitoring.

The SPA category replaces all previous categories and proposed categories for protected areas used on South Georgia. The aim is to produce a simple, more effective and more flexible management tool. Previous categories included Protected Areas, Environmentally Sensitive Areas (ESAs) and Open Areas from the Environmental Management Plan, 2000; and Sites of Special Scientific Interest (SSSI), Specially Protected Areas (SPAs) and Areas of Special Tourist Interest (ASTI) from the 1975 Conservation Ordinance.

Entry into any SPA is prohibited unless a site-specific permit has been granted by the Government of South Georgia. Management plans are being prepared and will indicate the boundary of each site and the activities which are prohibited, restricted or managed. Anchoring or cruising inshore and in bays close to SPAs is allowed.

The following Specially Protected Areas have been designated on South Georgia (see map):

1. Willis islands
2. Bird Island
3. Cape Paryadin Peninsula
4. All rat-free areas including
 - a. Albatross Island
 - b. Prion Island
 - c. Cape Rosa
5. Prince Olav Harbour whaling station
6. Leith whaling station
7. Stromness whaling station
8. Husvik whaling station
9. Cooper Island
10. Larsen Harbour
11. Annenkov Island
12. Fanning Ridge Coast
13. Nunez Peninsula

Figure 1: Map of terrestrial Protected Areas

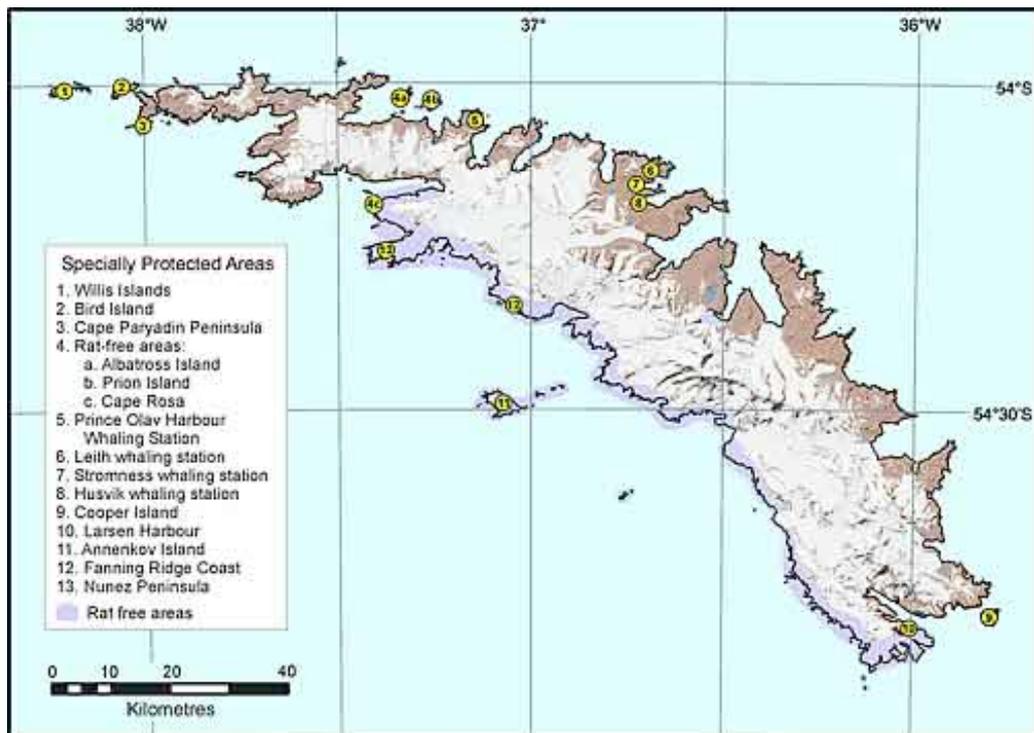
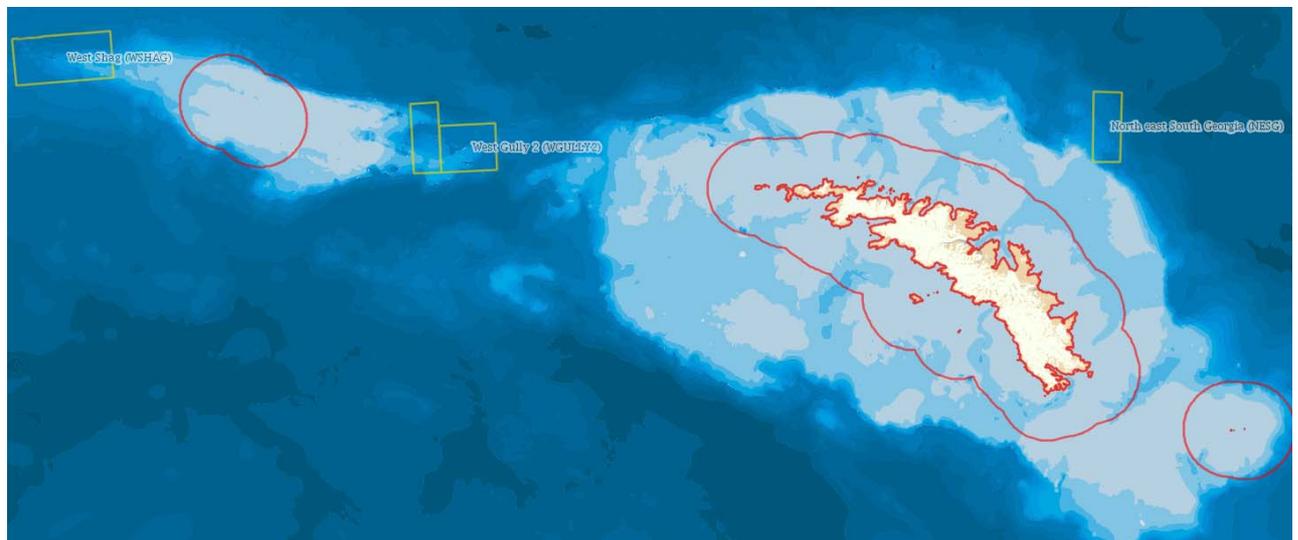


Figure 2: Map of marine management areas– red zones highlight the 12nm no fishing area, whilst yellow boxes show Restricted Impact Areas



Appendix 4: Ecosystem/habitats

Figure 3: Map of vegetated areas on South Georgia



Plant communities

Five broad categories of plant communities are recognized and generally occupy habitats mostly in the coastal lowlands up to around 100m altitude (200m in sheltered areas). However, because of topographic and environmental gradients, much of the vegetation comprises a series of intermediate zones sharing floristic features of adjacent communities.

Grassland communities

Four different types of grasslands occur within this broad community type.

Tussac grassland community Tussac, *Poa flabellata*, is the largest plant species on the island and is widely distributed forming a distinctive zone of vegetation in wet to moderately dry areas along most of the coast, and on raised beaches and coastal cliffs. Tussocks may be 0.5 to 1 m in diameter and may reach 2m in height. Individual plants shade out other competing species with the result that tussac grass becomes the dominant species and densely packed 'closed' communities are developed. 'Closed' tussac communities cover extensive areas of Bird Island and the northwestern end of South Georgia, particularly in the Elsehul area. However, 'open' tussac communities are common on well-drained slopes; in these areas the plants are smaller and shorter, allowing other species to grow between. For

example, Antarctic hair grass *Deschampsia antarctica* and Antarctic starwort *Callitriche antarctica*. Mosses and lichens are also found, particularly in undisturbed areas of 'open' tussac.

Tussac leaf bases are rich in carbohydrate and are heavily grazed by the introduced reindeer. Rats also feed on the leaf bases and seeds.

Seal and penguin colonies, which are often found in tussac grassland on low lying ground, damage the grassland and in extreme cases the plants can be killed. Burrowing petrels are common in tussac. Albatross colonies are also common on steep tussac covered hillsides; however, the common on steep tussac covered hillsides, however the birds cause little damage to the plant community.

Dry grassland community. Short tussock-forming grassland, dominated by tufted fescue, *Festuca contracta*, is species-rich and is the climax vegetation over much of the relatively sheltered north-east coast of South Georgia (notably around Cumberland and Stromness bays). The densest development of this grass occurs on well-drained north-facing slopes, often behind the coastal tussac fringe. *Festuca* grassland varies from very dense grass cover with scattered other species present, to intermediate community types where the grass becomes more sparse as the community grades into other distinctive types.

Wet grassland community Flat areas on raised beaches, especially behind the tussac zone, and also on other level sites retaining water, are often dominated by the Antarctic hair grass, *Deschampsia antarctica* with several species of moss amongst the grass. A similar community develops on much drier, gravelly, level terrain, although the sward is usually more open and the plants smaller.

Introduced grasses. In cases of excessive reindeer grazing of communities dominated by *Acaena magellanica* and *Poa flabellata*, the introduced grass *Poa annua* (and also *P. pratensis*, in places around Stromness Bay) has colonised the impacted sites and developed extensive lawns. *Poa annua* is tolerant of a wide range of environmental conditions, and of heavy grazing.

Bog and mire communities

Three types of wet community can be defined. Bog occurs most extensively where there is impeded drainage on low-lying ground around the island, as in valley floors and basins between low hills. Under these conditions peat may accumulate to at least 3m in depth. The base of some of these bogs has been radiocarbon-dated at around 9500 years old. Brown rush (*Rostkovia magellanica*) is the dominant higher plant, often with small amounts of *Acaena magellanica* and *Deschampsia Antarctica*. There is usually a dense understory of mosses and liverworts. Extensive areas of this type of community have been recorded in Sphagnum Valley and the southern valley at Husvik.

Seepage slopes where there is a continuous supply of water below the surface usually support mire communities dominated by the rust-brown coloured moss *Tortula robusta*, with a low cover of the rushes *Juncus scheuchzerioides* and *Rostkovia magellanica*. There is no peat development in these communities.

Mire communities also occur where springs issue from the ground, and also along the margins of small streams; these are referred to as flush communities. Mosses usually dominate (*Brachythecium* spp., *Pohlia wahlenbergii*, *Philonotis polymorpha*) and sometimes the hard mat forming liverwort *Marchantia berteroana*; *Acaena magellanica* and *Juncus scheuchzerioides* are also often common.

Herbfield community

The woody-stemmed herb *Acaena magellanica* dominates a community which is typical of sheltered slopes near the shore and on flat stony flood plains adjacent to streams, usually with the moss *Tortulla robusta*.

Moss bank community

The moss bank community is very distinctive compact turf up to one metre thick, being formed predominantly by *Polytrichum strictum*, usually with some *Chorisodontium aciphyllum*. The short rush *Juncus scheuchzerioides* is often present, and there is usually a variety of lichens loosely attached to the moss surface.

Fellfield community

Fellfield communities occur on dry stony ground, usually in exposed windswept sites and are characterised by an open vegetation of scattered mosses and lichens and various higher plants. They occur on glacier forelands, glacial outwash fans, flood plains, ridge crests, plateaux and summits, screes and rock faces. Of the higher plants, *Acaena magellanica*, *Acaena tenera*, *Deschampsia antarctica*, *Festuca contracta*, *Phleum alpinum* and *Rostkovia magellanica* are usually present, and this is the typical habitat of the Magellanic clubmoss *Lycopodium magellanicum*. Many short mosses (including *Polytrichum* spp.) and lichens (e.g. *Cladollia* spp., *Pseudocyphellaria* spp., *Stereocaulon* spp.) are usually present.

Lowland rock ledge communities often have ferns present; typically brittle bladder-fern, *Cystopteris fragilis*, and shield-fern *Polystichum mohrioides*. Damp cracks in the rocks may contain the filmy-fern *Hymenophyllum falklandicum* and/or *Grammitis poeppigiana*.

Freshwater vegetation

There are no emergent plants in the lakes and ponds. However, some species of moss (*Drepanocladus* spp., *Warnstorfia* spp.) growing at the margin of such water bodies extend into the water for several metres, forming a floating spongy mat in which occasional higher plants become rooted (e.g. *Acaena magellanica*, *Callitriche antarctica*, *Deschampsia antarctica*, *Juncus scheuchzerioides*). Submerged rock, stones and mud to a depth of 1-2m often have mosses and liverworts growing on them, and a few mosses and algae grow at depths to 30m (e.g. *Drepanocladus longifolius*). Several species of moss also grow attached to rock in streams and waterfalls. Shallow muddy bottoms may be covered by various filamentous green algae and gelatinous colonies of the cyanobacterium *Nostoc commune*. Nutrient rich wet areas around penguin rookeries or elephant seal wallows often have a bright green cover of the alga *Prasiola crispa*. In summer, melting glaciers, icefields and late

snow patches sometimes become stained with pink or red patches (and occasionally green) formed by dense aggregations of single-celled snow algae.

Appendix 5: Species

Species

Birds: 80 recorded bird species, 31 of them breeding

Seals: 4 species

Invertebrates: 9 beetle, 14 fly, 20 springtail, 4 flea and louse, 6 spider, 91 free-living mite and 47 parasitic mite species.

Plants: 18 species of native flowering plant, 6 species of native ferns, one species of native clubmoss, ~200 species native moss, ~200 species of native lichens and numerous species of native fungi. There are up to 44 species of introduced plant, some of which lie within exclusion zones around the disused whaling stations and are difficult to confirm.

Approximately 100 species of fish have been recorded around South Georgia, including 13 species of Antarctic cods, 20 species of lantern fish and six species of grenadiers. **The marine algal flora is extremely diverse with over 100 species recorded. At least 12 species of cetacean are regularly seen around South Georgia. There are also numerous species**

Native Marine Invertebrates

The bottom-dwelling invertebrate communities in the seas around South Georgia, are dominated by sessile, particle feeding organisms such as sponges, tubeworms and molluscs with associated mobile predatory groups such as echinoderms (e.g. starfish, brittle-stars and sea urchins) and crustaceans.

These communities around South Georgia, and in the Southern Ocean generally, are characterised by high species diversity and abundance; high biomass; gigantism; high levels of endemism, largely reflecting the wide range of habitats available and limited dispersal of developing larvae, which tend to be protected in broods during development instead of being released into the water (although some recent research has shown that pelagic dispersal of larval invertebrates is more common than previously recognised); slow growth rates; delayed maturation; and an incomplete range of invertebrate groups.

Examples of gigantism are seen with nemertine worms which can be over 1 metre long, and isopods which are large compared with their relatives elsewhere. Higher numbers of species and higher densities of animals are found in shallow waters with reductions in numbers with increasing depths. Although decapod crustacea are not typical of the Antarctic demersal fauna there are populations of the crabs *Paralomis spinosissima* and *Paralomis Formosa* around South Georgia. These are found on the shelf and shelf break around the island and have attracted limited commercial interest fishing for them using pots.

Of the pelagic fauna, Antarctic Krill (*Euphasia superba*) dominate the planktonic invertebrate community in the seas around South Georgia, accounting for about half the biomass. In addition to the krill, there are 13 species of squid and one species of pelagic octopus around the island.

Native Littoral Invertebrate Species

In contrast with the rich invertebrate fauna offshore, South Georgia's foreshores have low species diversity and abundance as a result of their exposure to sub-zero temperatures, ice abrasion in winter, and lack of regular tidal change. The intertidal zone has only existed for 10,000 to 14,000 years, and therefore the fauna is of recent origin, consisting almost entirely of brooding species or direct developers. The shore of Stromness Bay is probably amongst the richest on the island, as the bay has no glacial input. Zonation is apparent at these shores and at some others on the island, with a succession of communities of seaweeds and invertebrates including small bivalves, such as *Kidderia bicolor*, gastropods, such as the limpet *Nacella concinna*; and annelid worms, such as *Lumbricillus spp.* Sixteen species of prostigmatid mites have also been recorded on South Georgia's foreshores and coastal waters.

Native Terrestrial Invertebrates

The arthropod fauna comprises about 230 species, of which one third are endemic. Of these 230 species, there are around 45 free-living insect species, including nine Coleoptera (beetles), 14 Diptera (flies) and 20 Collembola (springtails); about 40 species of fleas and lice; and about 145 species of arachnids, including six species of spider (three of which are endemic to the island), 91 free-living and 47 parasitic Acarina (mites). Some groups of insects are notable by their absence from South Georgia, in particular lepidopterans (butterflies and moths) and curculionid beetles (weevils) which are found on other sub-Antarctic islands such as Marion and Crozet. Biting flies which inhabit almost all other tundra regions in the world are also absent from South Georgia.

Most of the 45 species of free-living insects are found in the coastal lowlands, although some beetles and flies inhabit the *Festuca* grassland further inland and at higher altitudes, and some species of springtail are found wherever moss growth occurs. Some beetles, e.g. two staphylinids, are commonly found in bird and rat nests. The flies tend to be common around seal wallows, penguin colonies and rotting kelp on the shore.

Only one of the six spider species is abundant; three are endemic and the other three are introductions. The mite fauna is comparatively rich and contains members of four orders: 45 feather mites; 33 gamasid mites; 27 prostigmatid mites; and 33 beetle mites. The 91 species of free-living mites exploit a wide range of terrestrial habitats on the island. At least two species are predatory and hunt smaller mites and springtails. Other species inhabit soil and plant litter where they play an important role in decomposition and recycling of plant nutrients. The 47 species of parasitic mites are mainly associated with the vertebrate fauna such as feather mites on birds and nasal mites (e.g. *Halarachne miroungae*) on elephant seals.

Other arthropod ectoparasites of the island's avian fauna include 38 Mallophaga (biting lice), one sucking louse and two species of flea. The seals, reindeer and rats also host some of these ectoparasites.

A particular feature of South Georgia insect fauna is that only a few of the insect groups which are normally capable of flight can do so; this is an adaptation common to insects

inhabiting windy, isolated islands. Another interesting adaptation of the arthropods is their response to the severe environment. In particular the presence in their body fluids of antifreeze compounds which increase their ability for cold survival by maintaining their body fluids in the liquid phase at sub-zero temperatures.

The island's native arthropods are potentially at risk of displacement and/or predation as a result of alien invertebrate introductions by man. For example the native Collembola, *Cryptopygus antarcticus*, may be at risk of displacement from certain habitats, as a result of successful competition from the two introduced species of Collembola, *Hypogastura purpescens* and *Hypogastura viatica*. The arthropods are also at risk of predation by rats and, in one or two areas, by mice.

Other terrestrial invertebrates include protozoa and amoebae which are generally found in mineral materials, peats, soils and guano. Smith (1982) found 75 species of protozoa from four different families; it appeared that the diversity of protozoan fauna in the different habitats was related to the degree of development of the soil and associated vegetation.

Freshwater invertebrates

A limited number of South Georgia's lakes and rivers have been studied to date and their communities are generally simple ecosystems in terms of species numbers and food web dynamics. Fish, large aquatic plants and molluscs are absent, and there are few insect larvae.

Recent work has recorded 70 species of invertebrates from 19 lakes in the northeast coastal lowlands at South Georgia, including five species of cladocera, three species of copepods, 54 species of rotifers, and several species of annelids and nematodes. Many species of protozoans, amoebae and tardigrades were also recorded. In addition the world's most southerly aquatic diving beetle (*Lancetes angusticollis*) is found in many lakes and ponds. It is possible that additional invertebrate species will be recorded by a more systematic survey of lakes and rivers elsewhere on the island.

Table 1: Native mammals species list

Common name	Species	IUCN Category
Fur seal	<i>Arctocephalus gazella</i>	Least Concern
Southern elephant seal	<i>Mirounga leonina</i>	Least Concern
Weddell seal	<i>Leptonychotes weddellii</i>	Least Concern

Table 2: Native Vascular flora species list

Common name	Species	IUCN Category
Hard fern	<i>Blechnum penna-marina</i>	
Brittle bladder fern	<i>Cystopteris fragilis</i>	
Strap fern	<i>Grammitis poeppigiana</i>	
Falklands filmy fern	<i>Hymenophyllum falklandicum</i>	
Adder's tongue	<i>Ophioglossum crotalophoroides</i>	
Shield fern	<i>Polystichum mohrioides</i>	

Magellanic clubmoss	<i>Lycopodium magellanicum</i>	
Magellanic fox-tail	<i>Alopecurus magellanicus</i>	
Antarctic hairgrass	<i>Deschampsia antarctica</i>	
Festuca	<i>Festuca contracta</i>	
Tussac grass	<i>Poa flabellata</i>	
Alpine cat's tail	<i>Phleum alpinum</i>	
Sedge	<i>Uncinia macrolepis</i>	
Lesser rush	<i>Juncus inconspicuus</i>	
Greater rush	<i>Juncus scheuchzerioides</i>	
Brown rush	<i>Rostkovia magellanica</i>	
Greater burnet	<i>Acaena magellanica</i>	
Lesser burnet	<i>Acaena tenera</i>	
Hybrid burnet	<i>Acaena magellanica x tenera</i>	
Antarctic starwort	<i>Callitriche antarctica</i>	
Sub-antarctic pearlwort	<i>Colobanthus subulatus</i>	
Antarctic pearlwort	<i>Colobanthus quitensis</i>	
Antarctic bedstraw	<i>Galium antarcticum</i>	
Water blinks	<i>Montia fontana</i>	
Antarctic buttercup	<i>Ranunculus biternatus</i>	

Table 3: Native and endemic birds species list

Common name	Species	IUCN Category
King penguin	<i>Aptenodytes patagonicus</i>	
Adelie penguin	<i>Pygoscelis adeliae</i>	
Chinstrap penguin	<i>Pygoscelis antarctica</i>	
Gentoo penguin	<i>Pygoscelis papua</i>	Near threatened
Macaroni penguin	<i>Eudyptes chrysolophus</i>	Vulnerable
Rockhopper penguin	<i>Eudyptes chrysocome</i>	Vulnerable
Wandering albatross	<i>Diomedea exulans</i>	Vulnerable
Black-browed albatross	<i>Thalassarche melanophris</i>	Endangered
Grey-headed albatross	<i>Thalassarche chrysotoma</i>	Vulnerable
Light-mantled sooty albatross	<i>Phoebastria palpebrata</i>	Near threatened
Southern giant petrel	<i>Macronectes giganteus</i>	Least concern
Northern giant petrel	<i>Macronectes halli</i>	Least concern
Cape petrel	<i>Daption capense</i>	
Snow petrel	<i>Pagodroma nivea</i>	
Antarctic prion	<i>Pachyptila desolata</i>	
Fairy prion	<i>Pachyptila turtur</i>	
Blue prion	<i>Halobaena caerulea</i>	
White-chinned petrel	<i>Procellaria cinerea</i>	Vulnerable
Wilson's storm petrel	<i>Oceanites oceanicus</i>	
Black-bellied storm petrel	<i>Fregetta tropica</i>	
Grey-backed storm petrel	<i>Garrodia nereis</i>	
South Georgia diving petrel	<i>Pelecanoides georgicus</i>	
Common diving petrel	<i>Pelecanoides urinatrix exsul</i>	
South Georgia shag	<i>Phalacrocorax georgianus</i>	
South Georgia pintail	<i>Anas georgica georgica</i>	
Speckled teal	<i>Anas flavirostris</i>	
Snowy sheathbill	<i>Chionis alba</i>	

Brown skua	<i>Catharacta loennbergi</i>	
Kelp gull	<i>Larus dominicanus</i>	
Antarctic tern	<i>Sterna vittata georgiae</i>	
South Georgia pipit	<i>Anthus antarcticus</i>	Near threatened

Table 4: Native and endemic fish

Class	Family	Common name	Species
Agnatha	Petromyzontes	Lampreys	<i>Geotria australis</i>
Chondrichthyes	Rajidae	Skates	<i>Raja georgiana</i>
Chondrichthyes	Rajidae	Skates	<i>Bathyraja meridionalis</i>
Chondrichthyes	Lamnidae	Porbeagle/Mackerel shark	<i>Lamna nasus</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Aethotaxis mitopteryx</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Dissostichus eleginoides</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Gobionotothen gibberifrons</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Gobionotothen marionensis</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Lepidonotothen larseni</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Lepidonotothen nudifrons</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Lepidonotothen squamifrons</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Notothenia rossii</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Notothenia coriiceps</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Trematomus vicarius</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Trematomus hansonii</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Paranotothenia magellanica</i>
Osteichthyes	Nototheniidae	Antarctic cods	<i>Patagonotothen guntheri</i>
Osteichthyes	Bathyracidae	Dragon fish	<i>Psilodraco breviceps</i>
Osteichthyes	Bathyracidae	Dragon fish	<i>Parachaenichthys georgianus</i>
Osteichthyes	Bathyracidae	Dragon fish	<i>Bathyraco antarcticus</i>
Osteichthyes	Bathyracidae	Dragon fish	<i>Bathyraco joannae</i>
Osteichthyes	Harpagiferidae	Spiny plunder fish	<i>Harpagifer georgianus</i>
Osteichthyes	Artedidraconidae	Plunder fish	<i>Artedidraco mirus</i>
Osteichthyes	Channichthyidae	Icefish	<i>Pseudochaenichthys georgianus</i>
Osteichthyes	Channichthyidae	Icefish	<i>Chaenocephalus aceratus</i>
Osteichthyes	Channichthyidae	Icefish	<i>Champocephalus gunnari</i>
Osteichthyes	Channichthyidae	Icefish	<i>Champocephalus esox</i>
Osteichthyes	Liparidae	Snail fish	<i>Careproctus georgianus</i>
Osteichthyes	Liparidae	Snail fish	<i>Paraliparus gracilis</i>
Osteichthyes	Liparidae	Snail fish	<i>Paraliparus kreffti</i>
Osteichthyes	Liparidae	Snail fish	<i>Paraliparus stehmanni</i>
Osteichthyes	Liparidae	Snail fish	<i>Paraliparus tetrapteryx</i>
Osteichthyes	Zoarcidae	Eel-pouts	<i>Melanostigma gelatinosum</i>
Osteichthyes	Zoarcidae	Eel-pouts	<i>Lycodapus antarcticus</i>
Osteichthyes	Zoarcidae	Eel-pouts	<i>Lycenchelys antarctica</i>
Osteichthyes	Zoarcidae	Eel-pouts	<i>Lycenchelys bellingshauselli</i>
Osteichthyes	Zoarcidae	Eel-pouts	<i>Oidiphorus mcallisteri</i>
Osteichthyes	Centrolophidae	Driftfish	<i>Icichthys australis</i>
Osteichthyes	Muraenolepididae	Eel cod	<i>Muraenolepis sp.</i>
Osteichthyes	Bothidae	Flounder	<i>Mancopsetta maculata</i>
Osteichthyes	Paralepididae	Barracudinas	<i>Notolepis coatsi</i>
Osteichthyes	Paralepididae	Barracudinas	<i>Notolepis annulata</i>

Osteichthyes	Paralepididae	Barracudinas	<i>Magnisudis prionosa</i>
Osteichthyes	Scopelarchidae	Pearl eye	<i>Benthalbella elongata</i>
Osteichthyes	Scopelarchidae	Pearl eye	<i>Benthalbella macropinna</i>
Osteichthyes	Gempylidae	Snake mackerel	<i>Paradiplospinus gracilis</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Kreffichthys anderssoni</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Protomyctophum tenisoni</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Protomyctophum normani</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Protomyctophum bolini</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Protomyctophum parallelum</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Protomyctophum andriashevi</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Protomyctophum choriodon</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Protomyctophum gemmatum</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Electrona antarctica</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Electrona carlsbergi</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Electrona subaspera</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Nannobranchium achirus</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Gymnoscopelus braueri</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Gymnoscopelus nicholsi</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Gymnoscopelus opisthopterus</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Gymnoscopelus bolini</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Gymnoscopelus fraseri</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Gymnoscopelus piabilis</i>
Osteichthyes	Myctophidae	Lantern fish	<i>Gymnoscopelus hintonoides</i>
Osteichthyes	Bathylagidae	Deepsea smelt	<i>Bathylagus antarcticus</i>
Osteichthyes	Bathylagidae	Deepsea smelt	<i>Bathylagus gracilis</i>
Osteichthyes	Bathylagidae	Deepsea smelt	<i>Bathylagus tenuis</i>
Osteichthyes	Microstomalidae		<i>Nansenia antarctica</i>
Osteichthyes	Gonostomatiidae	Bristlemouth	<i>Cyclothone microdon</i>
Osteichthyes	Gonostomatiidae	Bristlemouth	<i>Cyclothone pseudopallida</i>
Osteichthyes	Notosudidae		<i>Scopelosaurus hamiltoni</i>
Osteichthyes	Stomiidae	Scaly dragonfish	<i>Borostomias antarcticus</i>
Osteichthyes	Stomiidae	Scaly dragonfish	<i>Stomias gracilis</i>
Osteichthyes	Anopteroidea	Daggertooth	<i>Anopterus pharao</i>
Osteichthyes	Moridae	Deepsea cod	<i>Antimora rostrata</i>
Osteichthyes	Moridae	Deepsea cod	<i>Halargyreus johnsonii</i>
Osteichthyes	Gadidae	Cod	<i>Micromesistius australis</i>
Osteichthyes	Macrouridae	Grenadier	<i>Coelorinchus fasciatus</i>
Osteichthyes	Macrouridae	Grenadier	<i>Coelorinchus marinii</i>
Osteichthyes	Macrouridae	Grenadier	<i>Coryphaenoides armatus</i>
Osteichthyes	Macrouridae	Grenadier	<i>Cynomacurus piriei</i>
Osteichthyes	Macrouridae	Grenadier	<i>Macrourus holotrachys</i>
Osteichthyes	Macrouridae	Grenadier	<i>Macrourus whitsoni</i>
Osteichthyes	Macrouridae	Grenadier	<i>Macrourus carinatus</i>
Osteichthyes	Carapidae	Pearlfish	<i>Echiodon cryomargarites</i>
Osteichthyes	Ceratiidae	Seadevil	<i>Ceratius tentaculatus</i>
Osteichthyes	Lampridae	Opah	<i>Lampris guttatus</i>
Osteichthyes	Lampridae	Opah	<i>Lampris immaculatus</i>
Osteichthyes	Melamphaidae	Bigscale fish	<i>Poromitra crassiceps</i>
Osteichthyes	Melamphaidae	Bigscale fish	<i>Sio nordenskjoldii</i>

Appendix 6: Threats

Introduced marine species

Currently, the presence of marine invasive species is not known. A project scheduled for late 2010 will place settlement plates in key sites. They will be strategically placed in areas of known anchorages and moorings to indicate the arrival of new species, and in areas of no known (or minimal) shipping activity to provide a baseline of native marine species. Biosecurity measures relating to hull fouling and ballast water are being investigated.

Introduced terrestrial species

Figure 4: Map of introduced mammals

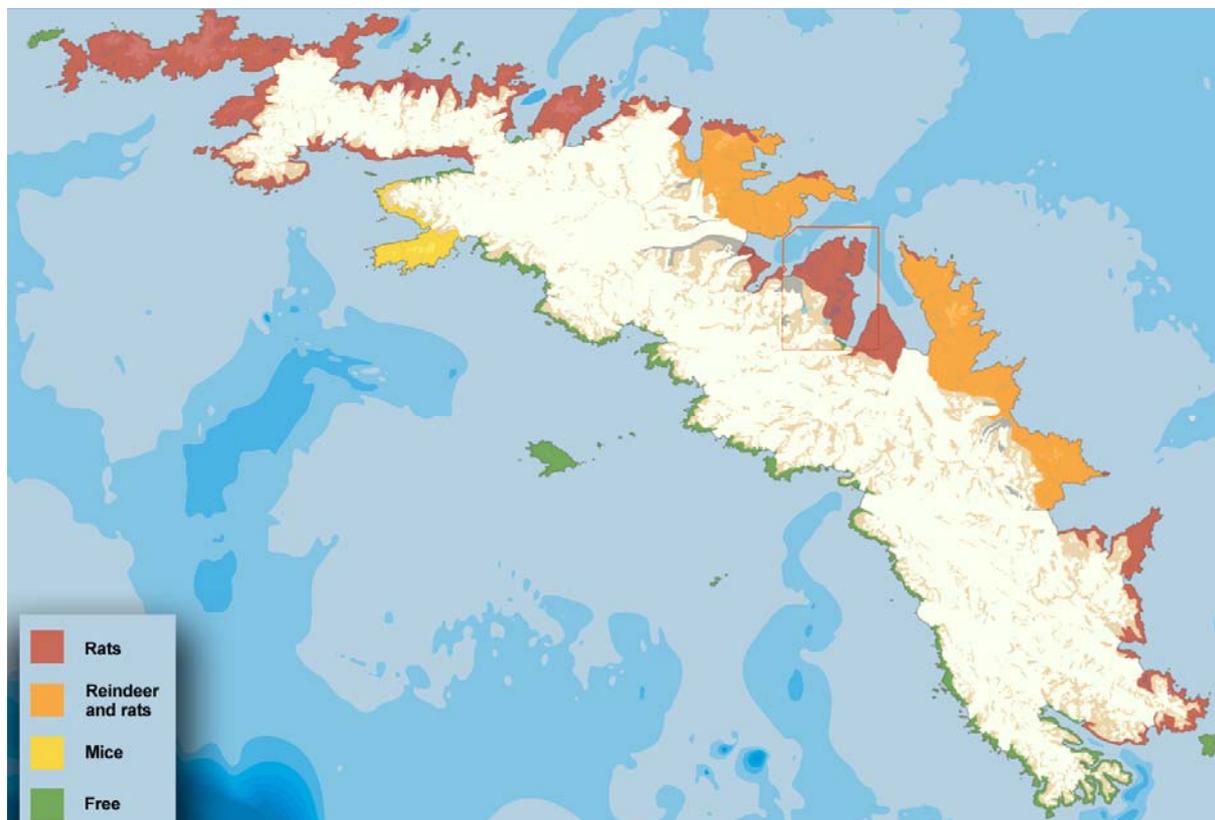


Table 5: Introduced mammals

Common Name	Species	Status
Reindeer	<i>Rangifer tarandus</i>	Management under consideration
Brown/Norway rat	<i>Rattus norvegicus</i>	Phased whole island eradication to start March 2011
House mouse	<i>Mus musculus</i>	Due to be eradicated under the Island wide rat eradication project

Table 6: Introduced Invertebrates

Order	Family	Common name	Species
Araneae	Agelenidae	House spider	<i>Tegenaria domestica</i>
Araneae	Anyphaenidae	Spider	<i>Negayan sp.</i>
Coleoptera	Byrrhidae	Pill beetle	<i>Chalicosphearium sp.</i>
Coleoptera	Carabidae	Ground beetle	<i>Oopterus soledadinus</i>
Coleoptera	Carabidae	Ground beetle	<i>Trechisibus antarcticus</i>
Coleoptera	Dytiscidae		<i>Lancetes angusticollis</i>
Coleoptera	Lathridiidae	Plaster beetle	<i>Aridius spathe</i>
Coleoptera	Perimylopidae		<i>Perimylops antarcticus</i>
Coleoptera	Perimylopidae		<i>Hydromedion sparsutum</i>
Coleoptera	Perimylopidae		<i>Perimylopid sp.</i>
Collembola	Hypogastruridae	Springtail	<i>Hypogastura purpurescens</i>
Collembola	Hypogastruridae	Sewage springtail	<i>Hypogastura viatica</i>
Diptera	Calliphoridae	Bluebottle	<i>Calliphora vicina</i>
Diptera	Calliphoridae	Blow fly	<i>Protophormia terraenovae</i>
Diptera	Chironomidae		<i>Eretmoptera murphyi</i>
Diptera	Mycetophilidae	Fungus gnat	<i>Mycoma bifida</i>
Diptera	Pallopteridae		<i>pallopterid sp.</i>
Diptera	Psychodidae	Moth fly	<i>Psychoda parthenogenetica</i>
Diptera	Scatopsidae	Lesser dung fly	<i>Scatopse notata</i>
Diptera	Sciaridae	Peat fly	<i>Lycoriella caesar</i>
Diptera	Sciaridae	Peat fly	<i>Bradysia sp.</i>
Diptera	Sphaeroceridae		<i>Antrops truncipennis</i>
Diptera	Syrphidae	Hoverfly	<i>Eristalis croceimaculata</i>
Diptera	Trichoceridae	Winter gnat	<i>Trichocera regelationis</i>
Hemiptera	Aphididae	Aphid	<i>Jacksonia papillata</i>
Hemiptera	Aphididae	Oat aphid	<i>Rhopalosiphum padi</i>
Hemiptera	Aphididae		<i>Aphidinine sp, possibly Aphis sp</i>
Hemiptera	Cicadellidae	Leaf hopper	<i>Ribautiana sp</i>
Hymenoptera	Eulophidae	Chalcidoid wasp	<i>Pediobius sp</i>
Hymenoptera	Mymaridae		<i>Notomymar aptenosoma</i>
Lepidoptera	Pyralidae	Cacao moth	<i>Ephestia elutella</i>
Lepidoptera	Pyralidae	Indian meal moth	<i>Plodia interpunctella</i>
Lepidoptera	Noctuidae	Dark sword-grass moth	<i>Agrotis ipsilon</i>
Lepidoptera	Yponomeutidae	Diamondback moth	<i>Plutella xylostella</i>
Oligochaeta	Lumbricoidea	Earthworm	<i>Dendrodrilus rubidus</i>
Thysanoptera	Phlaeothripidae		<i>Hoplothrips fungi</i>
Thysanoptera	Thripidae		<i>Aptinothrips stylifer</i>
Thysanoptera	Thripidae		<i>Limothrips cerealium</i>

Table 7: Introduced plants

Species	Family	Classification	Invasive potential	Notes and Recommendations
<i>Achillea millefolium</i>	Compositae	Restricted naturalised	Low	Eradication recommended
<i>Achillea ptarmica</i>	Compositae	Restricted naturalised		
<i>Agrostis canina</i>	Poaceae			
<i>Agrostis capillaris</i>	Poaceae	Widespread naturalised	High	High Priority for eradication - highly invasive. Further survey and mapping recommended
<i>Agrostis vinealis</i>	Poaceae	Restricted naturalised	Low	Eradication recommended
<i>Alchemilla monticola</i>	Rosaceae	Transient		
<i>Allium schoenoprasum</i>	Alliaceae	Persistent		
<i>Anthoxanthum odoratum</i>	Poaceae			Further survey work at Husvik recommended
<i>Anthriscus sylvestris</i>	Umbelliferae	Persistent	High	Priority for eradication - may be setting viable seed
<i>Artemisia sp.</i>	Compositae	Persistent		
<i>Capsella bursa-pastoris</i>	Cruciferae	Persistent		
<i>Cardamine flexuosa</i>	Cruciferae		High	Priority for eradication - highly invasive
<i>Carex aquatilis</i>	Cyperaceae	Persistent	Low	Eradication recommended
<i>Carex nigra</i>	Cyperaceae	Restricted naturalised	Low	Eradication recommended
<i>Cerastium fontanum</i>	Caryophyllaceae	Widespread naturalised	High	So widespread eradication impractical
<i>Deschampsia cespitosa</i>	Poaceae	Widespread naturalised	Low	Eradication recommended
<i>Deschampsia flexuosa</i>	Poaceae	Restricted naturalised		Further survey work at Husvik recommended
<i>Elymus repens</i>	Poaceae	Restricted naturalised	Low	Eradication recommended
<i>Empetrum rubrum</i>	Empetraceae	Persistent		Further survey work at Hestesletten recommended
<i>Festuca ovina</i>	Poaceae			
<i>Festuca rubra</i>	Poaceae	Restricted naturalised	Low	Eradication recommended
<i>Juncus filiformis</i>	Juncaceae	Restricted naturalised		
<i>Lotus corniculatus</i>	Leguminosae			

<i>Nardus stricta</i>	Poaceae	Persistent	Low	Eradication recommended
<i>Plantago media</i>	Plantaginaceae	Persistent		
<i>Poa annua</i>	Poaceae	Widespread naturalised	High	So widespread eradication impractical
<i>Poa pratensis</i>	Poaceae	Widespread naturalised	High	So widespread eradication impractical
<i>Poa trivialis</i>	Poaceae	Restricted naturalised		Further survey work at Grytviken recommended
<i>Pratia repens</i>	Campanulaceae	Restricted naturalised	Low	Eradication recommended
<i>Ranunculus acris</i>	Ranunculaceae	Persistent		
<i>Ranunculus repens</i>	Ranunculaceae	Restricted naturalised	High	Priority for eradication - may be setting viable seed
<i>Rorippa islandica</i>	Cruciferae	Persistent		
<i>Rumex acetosella</i>	Polygonaceae	Widespread naturalised	High	Priority for eradication - highly invasive. Further survey and mapping recommended
<i>Rumex crispus</i>	Polygonaceae	Persistent	Low	Eradication recommended
<i>Sagina procumbens</i>	Caryophyllaceae	Persistent	High	Priority for eradication - may be setting viable seed
<i>Sinapis sp.</i>	Cruciferae			
<i>Sonchus sp.</i>	Compositae			
<i>Stellaria media</i>	Caryophyllaceae	Transient		
<i>Taraxacum officinale</i>	Compositae	Widespread naturalised	High	So widespread eradication impractical
<i>Trifolium hybridum</i>	Leguminosae	Persistent		
<i>Trifolium repens</i>	Poaceae	Persistent	Low	Eradication recommended
<i>Trisetum spicatum</i>	Poaceae	Widespread naturalised	High	So widespread eradication impractical. Further survey and mapping recommended
<i>Vaccinium vitis-idaea</i>	Ericaceae	Restricted naturalised	Low	Eradication recommended
<i>Veronica serpyllifolia</i>	Scrophulariaceae	Persistent	High	Priority for eradication - may be setting viable seed

Climate change

Mainland South Georgia is effectively subdivided into numerous smaller “mainland islands” by glaciers, which act as natural barriers to the spread of seeds, animals and disease, both alien and native. At present, glaciers protect a safe haven along the south coast, free of the worst invasive species as described below. Glaciers are retreating at an increasing rate. Their effectiveness as a barrier is declining, and the safety of the south coast is under threat. Only 8% of South Georgia is vegetated, so those areas free of invasive species are vitally important.

Current studies estimate that 97% of South Georgia’s marine glaciers have retreated in the past 50 years. The majority have retreated by about 500 m, but one notable glacier has retreated over 4km. The rate of retreat is also increasing, with averages from <10m per year in the 1950s to almost 40m per year in the current day. If glaciers on the north east coast are considered separately, the rate of change is between 60m-400m per year. Those on the south coast are retreating at a rate of approx 10m per year.

Further information is available in Cook, A.J., Poncet, S., Cooper A. P. R., Herbert, D. J. and Christie, D. (2010). Glacier retreat on South Georgia and implications for the spread of rats. *Antarctic Science*. [Online] First View Article. Available from: doi: 10.1017/S0954102010000064 [Accessed 18th February 2010].

Mitigation against the effects of glacial retreat

Cessation or reversal of retreat seems unlikely; indeed the rate of decline seems to be accelerating. There is limited time available before some previously safe areas are opened up to invasion by introduced species. Eradication of major invasive threats is being considered.

The Government of South Georgia (GSGSSI) produced a feasibility study for the eradication of rats in 2007. The South Georgia Heritage Trust are currently fundraising for an island wide eradication of rats and mice, and are actively working towards the first stage of the project. Work is due to start in March 2011, and will continue every summer season through to 2015.

GSGSSI have stated their intent to remove at least one of the two reindeer herds in their management plan, and options are currently being considered.

Increased Invasiveness and vulnerability to Invasion

The presence of invasive introduced species is the single greatest threat to the biodiversity of South Georgia. The presence of invasives on an island makes it more vulnerable to new invasions. Consequently, South Georgia has recently been identified as the single most vulnerable island in the sub-Antarctic to alien invasion (Frenot et al, 2005).

The location of South Georgia below the Antarctic Convergence creates an extreme, cold environment that limits the establishment of aliens. As the climate warms up, the risk of a new establishment increases. Already present (“harmless”) aliens may become invasive, as

may native species. Other than managing those species already present, it is vital to prevent their further spread and the introduction of new species.

Biosecurity - South Georgia has no airstrip, so all transport is by sea. Shipping data was analysed to identify main vector routes, individual Biosecurity plans were produced, and are now in place for all vector routes.

Any expeditions must produce their own Biosecurity plans, in order to demonstrate awareness of the issues. A permit will not be awarded unless plans are approved.

Biosecurity is being incorporated into new SG legislation, which is under review.

A dedicated Biosecurity Facility has been built at South Georgia (funded between OTEP, GSGSSI and the South Atlantic Invasive Species Program (SAISP)), but emphasis on pre-border procedures due to lack of capability and manpower on island.

Response plans and monitoring systems are under development, in order to efficiently respond to a new incursion or reinvasion. Bird Island, as a key site, already has plans in place.

Kew Gardens and Buglife were commissioned to do a baseline survey of invasive species, in Dec08-Jan09, paid for by South Atlantic Invasive Species Program. This is a key project to the future management of the island.

Introduced marine species: Currently, the presence of marine invasive species is not known. A project carried out in 2010 placed settlement plates in key sites. They were strategically placed in areas of known anchorages and moorings to indicate the arrival of new species, and in areas of no known (or minimal) shipping activity to provide a baseline of native marine species. Biosecurity measures relating to hull fouling and ballast water are being investigated.

Appendix 7: Contacts

Associations:

South Georgia Association - www.southgeorgiaassociation.org

South Georgia Heritage Trust – www.sght.org

Oyas Venner (friends of South Georgia) - <http://oyasvenner.dmkpl.com>

Appendix 8: Bibliography

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