ENVIRONMENTAL MANAGEMENT PLAN FOR SOUTH GEORGIA

Public consultation paper

Issued by British Antarctic Survey at the request of the Government of South Georgia and the South Sandwich Islands

February 1999

This consultation document sets out proposed policies under consideration by the Government of South Georgia and the South Sandwich Islands for the future management of South Georgia. It is issued to solicit comment and suggestions from the public about the proposed policies.

The Government will consider all responses before finalising the policies and making any necessary legislation for the future management of the island. The Government expects to publish the policies in an Environmental Management Plan later this year.

Views may be submitted by individuals and organisations on all or any part of this document. We would particularly welcome responses to the questions posed in Section 3.

All comments and suggestions must be received by 6 April 1999.

PLEASE SEND ALL CORRESPONDENCE BY LETTER, FAX OR EMAIL TO:

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1. INTRODUCTION

1.1 Location and general description

South Georgia is an isolated, mountainous sub-Antarctic island situated in the South Atlantic Ocean between $35^0$47' to 38^0 01'West and $53^0$58' to 54^0 53' South. It lies about 2000 km east of Tierra del Fuego, and 1390 km south-east of the Falkland Islands. It is approximately 170 km long and varies in width from 2 to 40 km, and its long axis lies in a north-west to south-east direction. Surrounded by cold waters originating from Antarctica, South Georgia has a harsher climate than expected from its latitude. More than 50% of the island is covered by permanent ice with many large glaciers reaching the sea at the head of fjords. The main mountain range, the Allardyce Range, has its highest point at Mount Paget (2960 m).

There are many rocks off-shore and a few small islands, the principal ones being Willis Island and Bird Island off the north-west tip, Cooper Island off the south-east tip, and Annenkov Island, 15 km to the south-west.

Apart from the British Antarctic Survey's research station at Bird Island, a small military detachment and Government representatives at King Edward Point and Grytviken, there is no permanent habitation on South Georgia.

1.2 Discovery and the history of man's intervention

South Georgia was probably discovered by a London merchant Antoine La Roché in 1675, but it was not until 1775 that the first recorded landing was made by Captain James Cook. A detailed account of the history of South Georgia is given by Headland (1984).

Exploration and expeditions

In the early days following its discovery, apart from the activities of sealers, there was little exploration of, and few expeditions to South Georgia. Detailed exploration of the island did not get underway until August 1882, when the German International Polar Year Expedition built a research station in Royal Bay and worked there for about a year studying aspects of meteorology, geology, glaciology, zoology and botany. There followed many more expeditions which, in the early days, concentrated on the coast, leaving the interior largely unexplored. Further details of exploration of, and expeditions to South Georgia are given in Headland (1984).

One of the main outputs from the early exploration of, and expeditions to South Georgia was the production of charts, starting with Captain Cook's which was drawn after his landing on the island in January 1775 and contained 18 named features. New charts and maps were produced during the sealing era and as a result of more detailed exploration of the island in the late 1800s and early 1900s. The first Royal Naval

Hydrographic Charts for South Georgia were published in 1906. Updated hydrographic charts have been issued on a regular basis by the Admiralty Hydrographic Office. Current charts are from 1991 comprising 'Harbours and anchorages of South Georgia' and 'Approaches to South Georgia'. The first Gazetteer for South Georgia was produced in 1954 and contained 452 entries of place names and features.

The first extensive journey inland was Sir Ernest Shackleton's now famous trek across the island from King Haakon Bay to Stromness, which he undertook in May 1916 to raise the alarm about the sinking of his ship *Endurance*, and to organise the rescue of his men stranded at Elephant Island in the South Shetland Islands.

The first scientific expedition to explore inland was the Kohl-Larsen expedition of 1928-29. Knowledge about the interior of South Georgia was further improved by the annual expeditions of the South Georgia Survey led by Duncan Carse between 1951 and 1957. The map produced as a result of Carse's Survey remains in use today, with only a few amendments. The last of these ad-hoc scientific expeditions were the expeditions to Bird Island funded by the United States Antarctic Research Programme (USARP) between 1958 and 1964; these expeditions were supported by the Falkland Islands Dependencies Survey (FIDS) which was the predecessor to the British Antarctic Survey.

Since 1967 there has been a continuous scientific research programme at South Georgia conducted by, or in collaboration with the British Antarctic Survey, using its stations at King Edward Point (until 1982) and Bird Island for year round work, and Husvik and other sites for summer field camps. In addition the Survey's marine life scientists have undertaken studies of the seas around the island. As a result there is significant knowledge of the geology, glaciology, meteorology and biology of the island and its surrounding seas.

Sealing industry

Captain Cook's reports of the presence of fur seals at the island aroused the interest of British and American sealers. Sealing began at South Georgia in 1778 and continued until about 1825. British and American vessels participated and the sealers frequently lived ashore for several months at a time. By 1825, the Antarctic fur seal population had been very heavily exploited, and as a consequence, sealing became uneconomic. In the 1870s, however, sealing recommenced at South Georgia for a few years but soon ceased because of small and rapidly diminishing catches. In 1908, legislation was made by the British administration to protect fur seals at South Georgia and other Falkland Island Dependencies, including all the breeding grounds of the Antarctic fur seal in the South Atlantic Ocean. This legislation brought the fur seal industry at South Georgia to a close, leading to the eventual recovery of the fur seal population on the island.

Elephant seals were also exploited at South Georgia during the 19th century, but not to the same extent as the fur seal. Oil extracted from the carcasses was the main seal product, and was equivalent in use and selling price to whale oil. Fewer elephant seals were taken than fur seals, but the population nevertheless declined at South Georgia during the 19th century. However, the South Georgia population recovered sufficiently for a land-based elephant seal oil extraction industry to start at the island in 1909, run by the whaling companies.

In order to ensure the sustainable management of the elephant seal industry at South Georgia, regulations incorporating conservation principles were made by the British administration in 1909 (The Seal Fisheries Ordinance of the Falkland Islands, including the Dependencies). For example, the quota of seals caught in any one season was restricted to 6000 adult bulls; hunting was prohibited during the breeding season, and at certain parts of the island. In 1948 an arbitrary decision to increase the quota to 7500 bulls had an adverse effect on the population, which started to decline. After a study of the biology of the elephant seal, the original quota of 6000 bulls was re-instated in 1952, and a sustainable management system was introduced. Elephant sealing continued alongside the whaling industry until whaling ceased in the mid-1960s.

Whaling industry

In 1904, the Norwegian C.A.Larsen established the first land-based whaling station on South Georgia at Grytviken in Cumberland Bay. Even though there was a poor market for whale oil and the distances to these markets were great, Larsen's venture was successful. The abundance of whales around South Georgia and Larsen's success led to a rapid increase in the size of the whaling industry, and six stations were in operation at the island by 1912 -13. Most companies operated from the shore-based stations, but some operated from factory ships anchored in-shore with additional facilities on land. Between the two World Wars the shore-based industry declined steadily, and never regained its early vigour. Competition from petrochemical products and vegetable-based oil products was one factor which contributed to the decline; but the main factors were the increasing scarcity of whales around South Georgia, and the rapid expansion in the use of pelagic factory ships. The whaling industry ceased operations at South Georgia in 1965.

Legislation enacted by the British administration at South Georgia was in place from the early days of the whaling industry to ensure its sustainable management in the seas around the island. This restricted the number of licences issued for whaling operations; prohibited the exploitation of right whales; and prohibited the exploitation of whales accompanied by calves. The legislation also required all parts of the whale to be used, and a duty was levied on the oil produced. However, these restrictions and the duty, led some companies to seek to avoid the controls by operating the whole whaling process on the high seas. This became possible in 1925 when the first pelagic whale-factory ship started to operate in the Southern Ocean.

Whaling on the high seas led to significant reductions in the populations of exploited whale species at South Georgia, and in many other seas around the world. As a result, international agreements have been developed to control the whaling industry. The International Whaling Commission (IWC) set up under the International Convention for the Regulation of Whaling agreed in 1946, is charged with managing world whale stocks. However, even with the IWC's current moratorium on commercial whaling, recovery is slow for animals with such low rates of reproduction. Populations of most of the species exploited off South Georgia and elsewhere in the world are still at a small fraction of their pre-exploitation abundance.

The growth of the whaling industry led to the establishment of a local administration: in 1909 a British Stipendary Magistrate was sent to the island and a permanent British administration established at King Edward Point. The administration of the industry was supported by scientific research. For example, between 1925 and 1932, the Discovery Investigations, which were funded by the Falkland Island Dependencies whale-oil duty, studied the natural history of the seas around the Antarctic, including around South Georgia, with particular reference to the whale population.

At the peak of the whaling industry the human population at the island often exceeded 1000 during the summer whaling season, but fell to fewer than 200 during the winter when whaling ceased. Following the closure of the whaling industry at the island in 1965, the administration remained at King Edward Point until 1969, when it was transferred to the British Antarctic Survey who established a multi-disciplinary scientific research station there.

Fishing

Commercial fishing in the Atlantic sector of the Southern Ocean has been undertaken since the late 1960s, and continues to be a major economic activity. Within this large area, the seas surrounding South Georgia are productive fishing grounds. Further details on the development of South Georgia fisheries and their management are in Section 3.3.

Recent events and developments

In April 1982, King Edward Point was occupied briefly by Argentinian troops as part of Argentina's military campaign to establish sovereignty over the island along with the Falkland Islands. Argentina was unsuccessful and since the end of the conflict in 1982, a British army garrison has been present at King Edward Point. The garrison is due to leave the island in 2000/01.

Since 1970, there have been regular tourist visits to South Georgia, mainly ship-based, but also including a significant number of yachts. Tourists come to observe the island's abundant wildlife and rugged scenery, and to find out more about its history.

Some tourists remain ashore to participate in more adventurous pursuits such as climbing, skiing and retracing Shackleton's route.

1.3 Current legal status

Until 1985 South Georgia and the South Sandwich Islands were administered as a Dependency of the Falkland Islands. On 3 October 1985, the British Government designated South Georgia and the South Sandwich Islands (SGSSI) as a British overseas territory in it own right, as defined in The South Georgia and South Sandwich Islands Order, 1985. The geographical effect of the 1985 Order was to define the territory as 'all islands and territories whatsoever situated between the 20th degree of west longitude and the 50th degree of west longitude which are situated between the 50th parallel of south latitude and the 60th parallel of south latitude.'

Since the 1985 Order, the Governor of the Falkland Islands has also been designated the Commissioner for SGSSI. Legal, financial and administrative arrangements for the governance of SGSSI are operated by the Commissioner in Stanley. International relations and defence are managed by the Government of SGSSI and the Foreign and Commonwealth Office in the UK. Local administration is the responsibility of the Marine Officer at King Edward Point. Since 1982 the Magistrate has been the officer in command of the military garrison at King Edward Point. When the military leave South Georgia, the magistrate will be the station commander of the British Antarctic Survey's research station at King Edward Point. Laws, proclamations and other official business are notified through The South Georgia and South Sandwich Islands Gazette.

In 1989, the Government of SGSSI established the territorial sea around South Georgia (including Shag Rocks, Black Rock, Clerke Rock and the Office Boys) and all islands in the South Sandwich Islands by The South Georgia and South Sandwich Islands (Territorial Sea) Order 1989 No. 1995. The Order defined the territorial sea as 'that part of the sea which is situated within 12 nautical miles' from appropriate points on the island's coastline, together with the seabed of the territorial sea and its subsoil.

In 1993, the Government proclaimed a Maritime Zone of 200 nautical miles around SGSSI to allow for the conservation and management of the waters of the Zone, and its seabed and subsoil, as well as the natural resources thereof. The inner boundary of the Maritime Zone is the outer limit of the territorial sea (Proclamation (Maritime Zone) No.1 of 1993), and the seaward boundary is 200 nautical miles from the low-water line or other baseline points defined in the 1989 Territorial Sea Order.

1.4 Legislation relevant to the Environmental Management Plan

This section outlines the principal legislation affecting the management of South Georgia, including relevant international legislation to which the UK is a signatory and ordinances made by the Commissioner; highlights the ordinances which the Government proposes to amend or revoke in the light of proposed changes to

environmental policies as presented in this Plan; and describes the Government's proposed legislative framework for dealing with new policies presented in this Plan, such as Environmental Impact Assessment (EIA). None of the obligations and rights imposed by this Plan can be interpreted as overriding the relevant legislation. A comprehensive list of the legislation currently in force at South Georgia and the South Sandwich Islands is presented in Annex 1.

The list below includes legislation and ordinances enacted prior to October 1985, when the British Government abolished the designation of the Falkland Island Dependencies, and replaced it by the designation of South Georgia and the South Sandwich Islands. The 1985 Order which terminated government of the territory as a Dependency of the Falkland Islands, had the effect of saving laws in force in the territory immediately before commencement of that Order.

The territory of South Georgia and the South Sandwich Islands is outside the area subject to the Antarctic Treaty (1961) and accordingly the British Government is not obliged to implement the provisions of the Treaty in SGSSI.

Relevant international legislation

The International Convention for the Regulation of Whaling (1946) provides for the management of world whale stocks through appropriate conservation measures developed by the International Whaling Commission (IWC). As a signatory to the Convention, the UK and consequently the SGSSI Government complies with the Convention's obligations.

The Convention on Trade in Endangered Species (CITES) was agreed in 1973 and provides for the control of the importation and exportation of endangered species. The Proclamation made in 1981 under the Falkland Island's Customs Ordinance gives effect to the Convention in South Georgia and the South Sandwich Islands.

The Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) came into force in 1982. The UK is a signatory to CCAMLR, and a Member of the Commission which seeks to implement the Convention. CCAMLR regulates fisheries activities in Antarctic waters including waters around South Georgia, by means of conservation measures and resolutions adopted by the Commission. The Fisheries (Conservation and Management) Ordinance 1993, gives effect, amongst other things, to the Government's obligations under the Convention.

Ordinances enacted by the Government

Falkland Islands Dependencies Conservation Ordinance (1975) provides for the designation of protected areas on South Georgia and the South Sandwich Islands and for regulations to protect fauna and flora. The Government proposes to revoke this Ordinance and replace it with appropriate legislation to implement the Government's new conservation policy described in Section 3.4 of this Plan.

Wild Mammals and Birds (Export) Regulations (1975) provides for the export, under licence, and the charging of fees for the export of wild animals and birds. The Government proposes to revoke these Regulations in line with the new conservation policy described in Section 3.4 of this Plan.

The Fisheries (Transhipment and Export) Regulations (1990) prohibit the transhipment of fish or transportation of fish from internal waters and the territorial sea of South Georgia and the South Sandwich Islands without the authority of a licence. They provide for the grant of licences to tranship or transport fish (and other target species) and for the payment of fees to do so. Cumberland Bay East is the recognised transhipment harbour in the Regulations. In 1998 amended Regulations came into force to increase the transhipment fee; the amended Regulations are the Fisheries (Transhipment and Export) (Amendment) Regulations 1998.

The Visitors Ordinance (1992) makes provision in relation to sums to be paid by persons arriving in South Georgia. In 1998 subsidiary legislation came into force under Section 6(1) of the Ordinance, cited as the Visitor (Landing Fees) Regulations 1998, which increased the passenger landing fee.

The South Georgia Museum Trust Ordinance (1992) established the South Georgia Museum Trust; provides for the transfer of certain lands and objects in South Georgia to the Trust; defines the functions of the Trust; and provides for certain operational activities. The Government intends to amend this Ordinance to provide for the additional role of the Museum as an information centre.

The Customs (Fees) Regulations (1992) set fees for ships and yachts requiring the services of a customs officer for any purpose under the customs laws. In 1998 subsidiary legislation came into force, cited as the Custom (Fees) (Amendment) Regulations 1998, which increased the customs fees.

The Fisheries (Conservation and Management) Ordinance (1993) provides for the regulation, conservation and management of the fishing waters of South Georgia and the South Sandwich Islands, comprising internal waters, the territorial sea and the Maritime Zone which extends to 200 nautical miles from the shore. The Ordinance gives effect to the Government's conservation and management obligations under CCAMLR. It also provides the framework for licensing and enforcement of fishing, and the penalties for illegal fishing in the South Georgia Maritime Zone. It requires that all vessels wanting to fish within the Maritime Zone must have a licence from the Government. It provides scope for the licence fee to be varied, as required, in relation to certain factors such as the size of the vessel, on-board processing facilities, specific fishing areas and periods. Depending on the outcome of the ongoing review of fishing licensing options (Section 3.3 of this Plan), the Government intends to amend the Ordinance as necessary.

The Harbour Fees Regulations (1994) set harbour dues for South Georgia and the South Sandwich Islands. In 1998 amended Regulations came into force to set revised

harbour dues; the amended Regulations are the Harbour (Fees) (Amendment) Regulations 1998. When the Government reviews fees and charges in 2000, it intends to consider, amongst other things, whether to charge chartered yachts a higher flat rate fee than private yachts.

The Antarctic Regulations (1997) were enacted under the UK's Antarctic Act 1994 (Overseas Territories) Order 1995. They prescribe, amongst other things, the procedure by which applications can be made for permits to visit Antarctica under the Act, including provisions relating to environmental evaluations, production of permits and their revocation or suspension.

In summary all the Ordinances and Regulations listed above will continue to be in force when this Plan is published. However, in due course the Government intends to revoke the 1975 Conservation Ordinance and the 1975 Wild Mammals and Birds (Export) Regulations and develop new conservation legislation.

Proposed legislative framework for dealing with new policies

The Government proposes to develop appropriate new legislation on visitor management to implement the new visitor management policies described in Section 3.6.3 of this Plan.

The Government is considering implementing environmental management policies covering waste management, use of hazardous materials, prevention of marine pollution and fuel supply, storage and use (as described in Section 3.8 of this Plan), by developing legislation based on procedures in place in the British Antarctic Territory.

The Government intends to implement Environmental Impact Assessment and planning procedures, as described in Section 3.8.1, to ensure adequate environmental protection. In practice the proposed procedures require proposers of an activity and/or wishing to construct or extend buildings and other structures, to contact the Government about their proposal. The Government would then advise the proponent how to proceed on a case by case basis. Adequate advance notice of proposed activities from proposers would be required by Government to allow for the appropriate level of Environmental Impact Assessment to be decided and undertaken.

2. RESOURCE INVENTORY

2.1 Climate

South Georgia lies to the south of the Polar Front and is exposed to a persistent stream of depressions moving east across the Scotia Sea throughout the year. The climate can be summarised as cold, wet, windy and cloudy. The mountains and exposed south-

west coast of the island are colder, wetter, cloudier and windier than the north-east coast, but there are no systematic records for these areas.

Meteorological records began in 1905 at Grytviken, moving later to King Edward Point, and continue to the present day. For the period 1951 to 1980 (Headland, 1984) they show an average annual temperature of +2.0 °C, with an average summer temperature (from December to February) of +4.8 °C, and an average winter temperature (from June to August) of - 1.2 °C. Temperatures show considerable within-month variability. Föhn winds occur on the north-east side of the island and produce localised rapid increases in temperature when they occur. Catabatic winds are a regular occurrence with gusts frequently reaching gale force; moderate synoptic winds can be accelerated up to over 100 mph in the lea of the island.

Precipitation occurs throughout the year and is very variable from year to year and around the island; the annual average for the period 1951 to 1980 at King Edward Point was 1601.5 mm. Snow falls throughout the year but in summer does not usually lie for more than a few days at sea level. There is no record of permafrost on South Georgia.

2.2 Geomagnetic field

South Georgia lies within a region known as the South Atlantic Geomagnetic Anomaly (SAGA), where Earth's magnetic field is at its weakest. Within the SAGA, energetic particles from the radiation belts are preferentially lost in the stratosphere, mesosphere and thermosphere where they cause changes in atmospheric composition, and to the global electric circuit. The total magnetic field reduced by 2% between 1975 and 1982 at South Georgia, a change greater than anywhere else in the world. These factors, combined with it remoteness make South Georgia is an important site both for studies of the internal geomagnetic field, and some aspects of global change.

The first geomagnetic field measurements on South Georgia were made at Royal Bay during the first International Polar Year 1882-83 by the German Expedition (Headland, 1992). Further observations were made at King Edward Point in 1916 during the fourth cruise of the *Carnegie*. The British Antarctic Survey operated a continuous programme of measurements at King Edward Point from 1971 to the end of March 1982, when measurements ceased.

2.3 Geology, geomorphology, soils and water resources

Geology

Macdonald *et al.* (1987) produced a detailed map of the geology of South Georgia based on an extensive survey undertaken between 1969 and1977 and subsequent additional investigations. The map and the accompanying supplementary text are the the most up to date summary of the geology and build on earlier work on the island

undertaken sporadically since 1882. This earlier work is discussed by Headland (1984) and Macdonald *et al.* (1987) which provide bibliographies of the main published geological work on South Georgia.

The island of South Georgia is the emergent part of a small block of continental crust of around 350 x 200 km. The block has a roughly rectangular shape with its long axis oriented from the north-west to the south-east. The edge of the block falls away steeply, especially to the north and south. A discontinuous line of small but high blocks, including Shag Rocks, lies to the north-west forming the North Scotia Ridge which connects to the South American continent east of Tierra del Fuego. To the south-east, a line of seamounts connects South Georgia to the volcanically and tectonically active arc of the South Sandwich Islands. Even though South Georgia is situated close to the north-eastern part of the tectonically active Scotia Plate and has volcanically active neighbours in the South Sandwich Islands, it is almost without seismic activity.

The geology of South Georgia largely comprises sedimentary rocks of various types, and is similar to that of the Southern Andes. All rock groups present on the island can also be found in Tierra del Fuego. The South Georgia block is believed to have formed part of the Pacific margin of Gondwana, and the rocks typify the various stages in the evolution of an active plate margin and marine basin. The igneous rocks in the south and west are remnants of the ancient volcanic arc. Sedimentary rocks in the marine basin were folded and uplifted about 80 million years ago prior to separation of South Georgia from South America. Intensely folded rocks can be seen in many rock faces on the island.

The island comprises five distinctive geological sequences which are dominated by sedimentary rocks: these are the Cumberland Bay, Sandebugten, Cooper Bay, Annekov Island and Ducloz Head Formations. In addition, the Larsen Harbour Complex and the Drygalski Fjord Complex in the south comprise the island's oldest and most varied rocks.

The Cumberland Bay Formation forms well over half of the island and most of the high peaks. It is a thick sequence of volcaniclastic sandstones and shales, and is intruded by various quartz- and feldspar-rich veins. It is derived from a series of active volcanic islands which existed 110 to 140 million years ago. A major fault zone separates the Cumberland Bay Formation from the Sandebugten Formation which lies to the east between the Barff Peninsula and Royal Bay. This formation comprises sandstones and shales derived from the eastern side of the Gondwana continent; it also contains fragments of granites and sediments typical of a continental margin. Similar sedimentary sequences are found in the Cooper Bay Formation in the southern part of South Georgia.

Remnants of the volcanic arc are found to the south west of South Georgia on Hauge Reef, the Pickersgill Islands and Annenkov Island, where andesite and gabbro plutons

80 to100 million years old, are intruded into finely banded rocks such as mudstones and non-stratified conglomerates. These sequences comprise the Annenkov Island Formation which is about 3 km thick. Similar rocks are also found nearby on the mainland at Ducloz Head.

The Drygalski Fjord Complex and the Larsen Harbour Complex, which are separated by a fault zone, provide evidence of the island's previous volcanic history when it was part of the original continental margin of Gondwana. The Drygalski Fjord Complex forms part of the Salvesen Range, in the central part of southern South Georgia, with jagged peaks rising to over 2000m. It is composed of gneisses and schists, intruded by a variety of granites and gabbros. The Larsen Harbour Complex is composed of lavas and rocks which are typical of ocean floor rocks throughout the world.

Fossils. Numerous and varied fossils are found on Annenkov Island, for example ammonites, bivalves and fossil wood. Elsewhere at South Georgia there are a limited number of sites where fossils can be found.

Marine Geology. The surface of the South Georgia island block is relatively smooth, but broken up by channels up to tens of kms wide and over 100m deep. These submarine valleys are consistent with the major glaciers onshore, and continue as far as the shelf edge, which falls off from the 500m isobath to abyssal depths. The rock formations offshore are continuous with those found on the island.

Geomorphology

The dominant physical feature of South Georgia is the heavily-dissected mountainous backbone, comprising the Allardyce and the Salvesen Ranges, which extends over two-thirds of the length of the island. Mount Paget in the Allardyce Range is the island's highest peak at 2960m; in addition there are 19 other peaks over 2000m. North-west of the Allardyce Range the peaks are more scattered and lower at around 700 to 1,000 m high. More than 50% of the island is under permanent ice cover, whilst the remainder consists of steep-sided valleys and coastal lowlands often containing extensive deposits of glacial debris.

Apart from a coastal fringe there is little extensive ice-free ground on the 'windward' south-west side of the island and most glaciers extend down to sea-level. The more sheltered north- east side is indented by fjords with intervening peninsulas which are generally lower than 650m. The peninsulas are either ice-free or contain small cirque glaciers and ice fields. The major valleys on this side of the island are occupied by large glaciers with sources high in the mountains.

The permanent snow line lies about 450 to 600 metres above sea level on the north-east coast, depending on the degree of exposure, but is much lower at about 300 metres above sea level on the south-west coast.

Deposits of moraines of varying complexities and sizes are found in the ice-free areas and provide evidence of the island's glacier history. Rock debris is also found as moraines on the surface of, and terminus of the island's glaciers and as rockfalls and screes on mountain slopes. Occasionally, large rockfalls occur. This debris is caused by highly active rock weathering and makes a distinctive contribution to the island's physical geography.

The coastline of South Georgia is characterised by extensive wave-cut platforms surrounding headlands, and at the head of sheltered bays there are beaches of sand or shingle. Glacial meltwater has provided the sediment to construct some of the largest sand and gravel beaches found south of the Polar Frontal Zone. Raised beaches of one to ten metres above sea level generally occur as tussock-covered flat-topped terraces underlain by smooth beach cobbles and shingle, just inland from the existing beaches. They are caused by the unloading of sediment from the glaciers as they retreated. Further inland from the raised beaches, there are areas of fluvio-glacial material which range in extent from several hundred square metres to several square kilometres. These outwash fans contain meltwater streams, often braided, travelling over pavements of water-worn gravels and through areas usually devoid of vegetation cover.

Soils

The soils of South Georgia are mainly acidic podsols and other leached forms resulting from the high precipitation and low temperatures. Four types of soil can be identified:

1) organic soils, mainly peat deposits ranging from 25 cm to 3 m deep, occur where vegetation is well developed in rock basins, valley floors and coastal plains; on slopes; and at lake and pool margins; these soils are strongly acidic with a pH range of 3.5 to 4.5. Peat formation has proceeded at a constant rate for about 10,000 years since the retreat of an ice cap which extended off-shore during the last glacial maximum;

2) meadow tundra soils usually have a shallow upper layer of peat over a wet, brown to grey band of fine clay on a sandy or stony base; they occur on seepage slopes and to a lesser extent in marshy areas on more level ground;

3) brown soils occur on well-drained slopes or level ground beneath dry grassland; their profile comprises a layer of litter overlying a layer of peat of five to 10 cm depth; this in turn overlies a reddish-brown loamy soil which varies in depth from 30 cm to one metre. The basal layers comprise sandy debris and stones; and,

4) mineral soils are mainly derived by weathering and past glacial action and are of recent origin deposited at the margins of retreating glaciers and the lower end of scree slopes; they vary from fine clays, silt and sands to coarse gravels, pebbles and boulders. Where these soils are present as raw debris, vegetation is sparse or absent.

Soils near colonies of birds or seals are enriched with nutrients such as nitrogen and phosphorus, and usually support dense stands of vegetation, particularly tussac grassland.

Low rates of decomposition in these areas can lead to rapid humus accumulation, and further build up of organic soils.

There is no evidence of permafrost at present in South Georgia; however, there is some evidence that permafrost occurred in the past. For example, ridge and trough systems on slopes, and networks of vegetated hummock and hollows on level ground. There is evidence of continuing periglacial activity in the active sorting of polygons and stone stripes.

Water resources

There is little detailed information on the island's water resources. The South Georgia Ecological Atlas (Trathan *et al*. 1996) shows about 20 freshwater lakes distributed along the north-east side, some of which are pro-glacial lakes formed when ridges of fluvio-glacial material dam back the meltwaters from the glacier, for example at the snout of the Elephant Cove glacier. In addition there are many other small tarns and ponds. Many of these freshwater bodies may be covered with ice for more than six months of the year. Rivers and streams are also common throughout the island, at least in the summer when there is abundant meltwater and high rainfall; some of these are permanent meltwater streams from the glaciers.

2.4 Glaciology

The configuration of the mountain chains divides the island into three areas of glaciation:

i. North-east of the Allardyce and Salvesen Ranges, the snow accumulation areas are generally large cirques carved out of the mountains with high and very steep back walls; the glaciers are generally separated high ridges and they descend into the fjords of the north east coast; for example, Lyell Glacier which terminates at the coast and the Neumayer Glacier which enters the sea;

ii. South-west of the Allardyce and Salvesen Ranges, the glaciers flow from the crests of the main ranges in a series of ice falls to the sea. Unlike the north-east area, many of the dividing ridges are ice-covered, leading to complex glacier systems with several outlets to the sea; for example part of the snout of the Helland Glacier terminates at the coast and the other part protrudes into the sea.

iii. North-west of the Allardyce Range, there are scattered low peaks linked by long ice-covered ridges. The glaciers are wide and the surfaces have fewer crevasses than observed on glaciers elsewhere on the island. Ice flows out of large snow fields and there is little or no cirque development. For example, the König Glacier, which is the largest on the island to terminate on land, flows gently down a broad valley before ending on a flat plain about 800m from the sea.

Following the retreat of an ice cap which extended off-shore during the last glacial maximum about 10,000 years ago, glaciers withdrew to their present limits. Since then there have been at least two main Holocene advances when most fjord and land-terminating glaciers advanced only several hundred metres, whilst certain fjord glaciers, such as those entering Possession Bay on the north coast, advanced up to 6.5 km (Clapperton et al 1989). In the more recent past, of the 38 glaciers for which multiple observations have been made, 13 show no significant change during the present century. The remainder have undergone oscillations which are, however, small compared with changes to glaciers in the Northern Hemisphere.

2.5 Bathymetry and oceanography

South Georgia is situated in the Scotia Sea, which forms part of the Southern Ocean. The bathymetry of the Scotia Sea is dominated by the steep submarine ridge of the Scotia Arc which runs as a continuous feature from the Patagonian Shelf to the Antarctic Peninsula, broken intermittently by a number of deep fissures. The Scotia Arc rises above the sea-surface at Shag Rocks, South Georgia, Clerke Rocks, the South Sandwich Islands, the South Orkney Islands, and at the South Shetland Islands.

The continental shelf around South Georgia is generally less than 200 m deep, except for the deep submarine canyons which are off-shore extensions of the many glaciated fjords on the island. The shelf is relatively wide and extends for 50 to 150 km from the island. Beyond the shelf edge water depth increases rapidly to over 3000 m. This creates physical oceanographic conditions that generate high biological productivity.

The oceanography of the Southern Ocean is dominated by the continuous eastward-flowing Antarctic Circumpolar Current (ACC) which is a deep current driven by strong prevailing westerly winds. The ACC contains a number of prominent features including narrow, high velocity frontal jets embedded in wider, slower moving zones. The fronts from north to south, include the Sub-Antarctic Front, the Polar Front and the Continental Water Boundary.

The Sub-Antarctic Front crosses the Scotia Sea to the north of the Falkland Plateau and does not directly affect South Georgia. However, south of the Sub-Antarctic Front lies the Polar Frontal Zone (PFZ) which has an important influence on the ecosystem of the island and surrounding seas. The PFZ is a slower moving region, where

northward and eastward-flowing Antarctic surface water sinks beneath warmer, less dense sub-Antarctic water. Across this Zone there is a drop in temperature of between 2 to 3 ^{o}C, as well as changes in salinity and dissolved oxygen content. There is also a marked change in marine life, for example Antarctic krill (*Euphausia superba*) does not occur north of this Zone. The southern edge of the Polar Frontal Zone is the Polar Front. South Georgia lies south of the Polar Front and is therefore within the Antarctic Zone, with the result that the island is heavily influenced by Antarctic surface waters.

The Continental Water Boundary is also important for South Georgia, carrying cold waters from the polar regions to the south and south-east of the island. This cold water flows to the north of South Georgia where it meets water from the Antarctic Zone to the north east of the island. The area where these two flows meet is thought to be of major biological significance, playing a key role in the South Georgia marine ecosystem.

The tides in the enclosed bays of South Georgia have a typical range of about 1 m, but can be irregular. For example, tidal surges occur occasionally; some of these have swept up to 100m inland.

Sea ice covers a large part of the Antarctic Ocean for much of the year. During winter the ice becomes much more extensive, although the amount of winter sea ice cover varies from year to year. Usually the limit of the winter pack-ice is to the south of South Georgia, although occasionally it reaches as far north as the island. For example, in September 1980 pack-ice extended to approximately 200 km to the north of South Georgia, rendering it ice-bound.

Some sheltered bays at South Georgia regularly become frozen over and covered with drifting ice during winters. However, this is usually short-lived as the ice is thin and broken up by the ocean swells and frequent storms. Each spring the sea ice breaks up and drifts away from the island.

Icebergs in the vicinity of South Georgia may be derived from glaciers on the island, or from the glaciers and ice shelves of the Antarctic continent. The largest icebergs come from the Antarctic. For example, a large tabular iceberg passed close by South Georgia in 1978 and was 65 by 35 km, almost half the size of the island. Small icebergs are common and are produced from the calving of local glaciers, particularly in the spring.

2.6 Marine communities

2.6.1. General

In biological oceanographic terms, being to the south of the PFZ, South Georgia is considered to be within the Antarctic Zone. Even though it is at the northern limit of this zone the species composition of the region has closer affinity with the high

Antarctic than regions to the north of the ACC. The deep water separation of the islands of the Scotia chain has resulted in floral and faunal communities which show trends in composition from South Georgia in the north through the South Orkneys and South Shetlands to the Antarctic Peninsular that are of major significance. The South Georgia Maritime Zone includes the area of shelf around South Georgia and Shag Rocks as well as a large area of deep ocean, north to the APFZ and south to close to the South Orkneys.

2.6.2. Bottom dwelling fauna

Bottom-dwelling invertebrate communities in the seas 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; slow growth rates; delayed maturation; and an incomplete range of invertebrate groups.

Recent studies have shown that pelagic dispersal of larval invertebrate stages is more common than previously recognised, and this has led to research into the genetic affinities of such species and the influence of the polar environment on their population relationships and adaptations.

The bottom-dwelling invertebrate community is dominated by sessile, particle feeding organisms such as sponges, tubeworms and molluscs with associated mobile predatory groups such as echinoderms (such as starfish, brittle-stars and sea urchins) and crustaceans. 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 spinossissima* 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.

2.6.3. Demersal fish fauna

The demersal fish fauna, as with other Antarctic regions, is dominated by one group the Notothenioidei a group of perch-type fishes which occupy many of the ecological niches typically available on the shelf of islands. This high degree of adaptive radiation by a single group, whilst typical for the Antarctic, is unusual elsewhere in the world.

One group of Notothenioidei, the Channichthyidae or icefishes, are characterised by having no haemoglobin, the oxygen carrying substance present in the red blood cells of vertebrates, in their blood. They absorb oxygen by simple diffusion from the water and carry it around their bodies in physical solution in the blood plasma. Such an adaptation is possible because of the continuous low temperature, close to the freezing point of seawater, of their environment combined with a generally high oxygen saturation in the water. Several species have been fished commercially although only one, the mackerel icefish *Champsocephalus gunnari*, has been a major target species.

The Nototheniidae, the nominate group of the Notothenioidei, are the most diversified family with regard to structure, habits and distribution. Typically these fish look similar to the sculpins of the northern hemisphere although they are frequently referred to as Rockcods. Several species have been fished commercially. *Notothenia rossii*, the marbled rockcod, grows to about 70cm and was the first species to be heavily fished in the Antarctic. Large catches, which proved to be unsustainable, were made at South Georgia and Kerguelen in the early 1970's. The Patagonian rockcod, *Patagonotothen brevicauda guntheri*, rarely exceeds 25cm and is restricted to the Shag Rocks area of the SG-MZ; a fishery for this species was present in the early 1980's but was closed by CCAMLR due to problems arising from catch reports. The bumphead rockcod, *Gobionotothen gibberifrons*, was taken as a significant bycatch in bottom trawl fisheries but has not been caught in large quantity following the prohibition by CCAMLR of the use of bottom trawls.

The largest Nototheniid species is the Patagonian toothfish, *Dissostichus eleginoides*, which grows up to two metres in length, and is likely to be found throughout the SGSSI-MZ. Juvenile fish are found on the shelf of Shag Rocks and South Georgia whilst adult fish appear to be restricted to the deeper waters of the continental slope and deep ocean. The same species is found off southern South America and around many peri-Antarctic islands. The amount of interaction between the fish populations of the different regions is unknown. Initially the species was taken as bycatch in the trawl fishery for icefish, but since 1990 a significant single species fishery has developed using longlines.

Both bottom trawl and long line fisheries frequently include rays in their bycatch. The biology of the species in this group is poorly known although it is likely that, as in other parts of the world, quite low catches have had a significant impact on the stocks.

2.6.4. Pelagic fauna

Antarctic krill ,*Euphausia superba*, dominate the planktonic invertebrate community in the seas around South Georgia, accounting for about half of the biomass. These small shrimp-like crustaceans up to 6 cm long when fully grown, and feed on the abundant phytoplankton. They form the diet of many of South Georgia's other marine organisms, including some squid, fish, seals, sea birds and some whales. They tend to be concentrated around the island's shelf and near to the shelf-slope.

The abundance of krill around South Georgia varies between years, and availability was much reduced at least in four of the last 20 years. Krill population dynamics operate over ocean basin scales. The variation in krill abundance observed around South Georgia is thought to be linked to fluctuations in average annual temperature, and the dynamics of the ocean currents in the Scotia Sea. Warmer winters result in less sea-ice development and this is linked to years with low krill abundance. Such variation reflects the open nature of the marine ecosystem around South Georgia which is influenced by and dependent on the large scale biological and physical processes of the Scotia Sea, and more broadly, the Southern Ocean. South Georgia's stock of krill is thought to be part of a large scale population, and not self-sustaining; krill may be spawned much further south, possibly in the Bellinghausen Sea.

Since the mid 1970's a fishery for krill has developed in the vicinity of South Georgia. Typically this is concentrated in the winter months from May to August with the fleets beginning fishing to the north of Cumberland Bay and moving to the west along the shelf break.

Periods of low krill biomass may have deleterious impacts on various parts of the marine community, such as reducing the reproductive success of some of South Georgia's albatrosses, petrels, penguins and fur seals.

There are about 13 species of squid and one species of pelagic octopodid in South Georgia waters. Of these, the seven star flying squid, *Martialia hyadesi*, belongs to the same family as other squid that support high value fisheries elsewhere in the world. It is important in the diet of some albratross species, southern elephant seals and probably of smaller toothed whales such as the southern bottlenose whale and the long-finned pilot whale. Exploratory fishing expeditions by east Asian commercial squid jigging vessels and RRS James Clark Ross have demonstrated that exploitable stocks are present in the seas around South Georgia.

The pelagic fish community is dominated by lantern fish with 13 species recorded. The dominant species *Electrona antarctica* did support a major fishery in the 1980's but the low value of the resource means that it is currently uneconomic.

The pelagic fauna also contains the early life stages of a large number of fish species which, in adult life, are demersal. These very young fish may be taken incidentally during trawling operations for krill.

2.6.5. Commercial Fisheries

Interest in commercial fishing developed from exploratory studies on krill, marbled rockcod and mackerel icefish from 1956 onwards. Gross over-fishing on marbled rockcod around 1970 reduced the stock to uneconomic level very quickly. This result along with concerns over exploratory fishing for krill was central to the negotiation of CCAMLR. Subsequently all fisheries around South Georgia have been subject to

conservation measures enacted by CCAMLR. These conservation measures are designed to protect the stocks by setting catch limits and closed seasons and the dependent species and the marine environment by controlling the fishing methods. The potential impacts of the different fishing methods are summarised below:

Bottom trawling: This is the simplest form of trawling and would be suitable for catching most of the Nototheniidei species. The method has the disadvantages that it is not very specific with the result that mixed catches are frequent resulting in a bycatch problem. Due to the very rough ground in the region, the method causes significant damage to benthic biota, particularly sponges and corals. Currently no fisheries around South Georgia are permitted by CCAMLR which use bottom trawls.

Pelagic trawling: With this method of trawling the net is targeted onto concentrations of fish or krill that have been 'seen' on an echosounder. The result of this is that catches tend to be quite monospecific. The nets can be fished very close to the seabed and thus target icefish as they rise off the bottom to feed on krill; this method produces a minimal bycatch of demersal species. Krill catches might contain significant amounts of early life history stages of fish; due to the small size and transparency of these fish they can go un-noticed.

Long-lining: This method is suitable for fishing on almost any seabed, particularly in regions where the ground is unsuitable for trawling. Catches of fish tend to be almost all of the target species although there is a bycatch of some species, particularly rays, which might have a large effect on the population. The most serious drawback with the method is the incidental catch of seabirds which, if appropriate measures are not taken, can be unacceptably high.

Crab pots: These were used for the experimental fishery for crabs. Some bycatch of fish, such as toothfish, is inevitable. Adverse effects are thought to be small.

Jigging: this method has been used successfully for catching squid. Although the method relies on bright lights at night there have been no adverse interactions reported involving birds and seals.

The greatest problem with managing the fisheries, particularly that for toothfish due to its high value, is that of illegal fishing. This was significant in the early 1990's but, following some arrests and high profile fines, appears to be under control at present.

2.6.6. Littoral invertebrate species

In contrast with the rich invertebrate fauna off-shore, 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 (Headland 1984). 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 (Platinigera) concinna*; and annelid worms, such as *Lumbricillus* spp. Sixteen species of prostigmate mites have also been recorded on South Georgia's foreshores and coastal waters.

2.6.7. Marine flora

South Georgia's inshore ecosystem has a diverse marine algal flora (seaweeds), with 103 species recorded from a limited number of sites in sheltered and rocky shores on the north-eastern coast (John *et al.* 1994). Of these, nine are green algae, 35 brown algae and 47 red algae. It is likely that additional species would be recorded if visits were made to shores elsewhere on the island. The high diversity and biomass of the subtidal algal vegetation is in marked contrast to the low diversity and relative barrenness of the littoral zone. Some of the deeper water brown algae are exceptionally large, e.g. the giant kelp *Macrocystis pyrifera*, and *Lessonia fuscescens* reach at least 40 m in length. The subtidal vegetation provides a favourable habitat for many species of juvenile fish and invertebrates.

There are four endemic species: one green alga (*Entonema subcorticale*), two brown algae (*Melastictis desmarestiae*, *Stegastrum porphyrae*), and one red alga (*Plectoderma minus*). Twelve of the 103 species are known only from South Georgia and Tierra del Fuego, which lies about 2150 km to the west. Just under one quarter of the species also occur in the Northern Hemisphere. About half are known from other sub-Antarctic islands at similar or more northerly latitudes, and from mainland South America. The remainder are confined to Antarctic coastal waters, with a few reaching their northernmost limit at South Georgia, for example the brown alga *Desmarestia antarctica*.

Many species of microalgae occur in the seas around South Georgia, including diatoms, dinoflagellates and other unicellular forms. This phytoplankton community is abundant and is the basis of the marine food chain of the Southern Ocean.

2.7 Terrestrial communities

2.7.1 Vegetation

Terrestrial plant life on South Georgia is limited in terms of species diversity and community types as a consequence of the island's isolation from vegetated land masses and its cool summers. Other sub-Antarctic islands also have limited plant life. South Georgia's native flora is closely related to that in the Falkland Islands, Tierra del Fuego and southern Patagonia. However, there are no trees or shrubs, and there is no development of the dwarf shrub-dominated maritime heath which is characteristic

of the Falkland Islands and elsewhere in the southern cold temperate zone. The only shrub-like plants belong to the genus *Acaena*, a woody-stemmed herb. Whilst some species on South Georgia occur only in the Southern Hemisphere, a few others have bi-polar (e.g. alpine cat's tail, *Phleum alpinum)* or world-wide (e.g. water blinks, *Montia fontana,* and brittle bladder-fern *Cystopteris fragilis*) distributions. With the exception of the hybrid, *Acaena magellanica* x *tenera*, no endemic higher plants are known, although there are a few endemic bryophytes (mosses and liverworts) and lichens.

Only 25 species of indigenous vascular (higher) plants have been recorded on the island comprising one lycopod (clubmoss), six ferns, five grasses, three rushes, one sedge, and nine forbs (non-grass-like herbs). Of these species, only six develop extensive stands and dominate distinct communities: greater burnet (*Acaena magellanica)*; Antarctic hairgrass (*Deschampsia antarctica)*; tufted fescue grass (*Festuca contracta*); greater rush (*Juncus scheuchzerioides*); tussac grass (*Parodiochloa flabellata*); and brown rush (*Rostkovia magellanica*). The introduced annual meadow grass, *Poa annua*, also dominates some coastal areas grazed by introduced reindeer.

In addition to, and often less conspicuous than the higher plants, are large numbers of cryptogamic (lower) plant species. These are represented mainly by mosses (around 125 species), liverworts (around 80 species) and lichens (around 150 species). At least 50 species of macro-fungi (toadstools) and about ten macro-algae are known. However little is known about the microflora (soil fungi, algae, cyanobacteria or bacteria).

Introduced species. Many higher plants have been introduced, mostly accidentally, during the course of human occupation on the island. All have been associated with sealing, whaling stations and the settlement on King Edward Point. *Poa annua* was probably introduced at numerous sites during the sealing era in the19th century, and it is the only alien species widely distributed around the island. Most of the introductions have resulted from seed inadvertently imported from Europe with foodstuffs for poultry, sheep, cattle, pigs, etc. which were kept as a food supply at several of the stations; a few have been introduced accidentally from the Falkland Island. About 30 of the 70 introduced species which have been recorded, survived for only one or a few years. However, around 40 have survived several decades, and about 25 of these are now regarded as naturalised, reproducing successfully and enabling the species to spread within the environs of, and sometimes beyond the whaling stations. Since the mid-1980s many seedlings have appeared around several naturalised species indicating that fertile seeds are being produced more often. This may be a response to increasing summer temperatures on the island.

Plant communities

Five broad categories of plant communities are recognised and generally occupy habitats mostly in the coastal lowlands up to around 100 m altitude (200 m 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, *Parodiochloa 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 metre in diameter and may reach 2 metres 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 built up. 'Closed' tussac communities cover extensive areas of Bird Island and the north western 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 hairgrass *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 the plants are the preferred diet of the introduced reindeer, particularly during winter often resulting in severe overgrazing leading, in some places, to soil erosion. Rats also feed on the leaf bases and seeds.

Seal and penguin colonies are often found in tussac grassland wherever there is low-lying ground behind the shoreline. Physical damage to the tussocks may occur locally due to the movements of these animals and in extreme cases the plants can be killed; other plant species growing with the tussac plants can also be damaged. Burrowing petrels are common in tussac. Albatross colonies are also 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. For example, as the substratum becomes drier, *Acaena magellanica* increases in abundance as the community changes to herbfield, usually with increasing amounts of mosses (notably *Tortula robusta, Chorisodontium aciphyllum, Polytrichastrum alpinum*) and lichens (e.g. *Cladonia* spp,

Pseudocyphellaria spp.). Towards wetter habitats, for example adjacent to bog or mire, the rushes *Juncus scheuchzerioides* or *Rostkovia magellanica* become abundant, again with a variety of mosses.

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*. This can sometimes form extensive "lawns" (e.g. Dartmouth Point). There are usually 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, reflecting a change in hydrology at some time in the past, or a gradation from wet grassland to fellfield.

Introduced grasses. Meadow grassland occurs in certain areas as a consequence of long-term grazing by introduced reindeer of several indigenous herbaceous species, notably *Acaena magellanica* and *Parodiochloa flabellata*. In cases of excessive grazing of communities dominated by these two species, 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 considerable disturbance. Grazing aids the dispersal of tillers and seed and, being an opportunistic plant, it quickly becomes established in new sites.

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 3 m 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 understorey 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*. *Acaena magellanica* and Antarctic buttercup (*Ranunculus biternatus*) and occasionally water blinks (*Montia fontana*) are also usually sparsely associated. There is no peat development in these communities.

Mire communities also occur where springs issue from the ground, usually at the foot of scree, 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. There is often an understorey of the moss *Tortula robusta*. Towards the margins of these dense stands, especially where the community grades into dry grassland, *Festuca contracta, Phleum alpinum,* hybrid *Acaena* (*A. magellanica* x *tenera*), and various mosses and lichens become frequent associates.

Moss bank community

The moss bank community is very distinctive, being formed predominantly by *Polytrichum strictum*, usually with some *Chorisodontium aciphyllum*. These mosses build up a compact turf sometimes a metre or more thick. Large expanses may be entirely moss, but typically the short rush *Juncus scheuchzerioides* is also present, together with scattered plants of *Acaena magellanica, Festuca contracta* and *Parodiochloa flabellata*. There is usually a variety of lichens, especially *Cladonia* spp., 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 cryptogams (i.e. mosses, lichens) and various higher plants. There is seldom a dominant species, except in small patches. 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, A. 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. *Cladonia* spp., *Pseudocyphellaria* spp., *Stereocaulon* spp.) are usually present.

Lowland rock ledge communities often have ferns present; for example lowland ledges around Cumberland and Stromness Bays, where the commonest ferns are 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 due to the thick and prolonged ice cover in winter. 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 1-2 m often have mosses and liverworts growing on them, and a few mosses and algae grow at depths to 30 m (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.

2.7. 2 Invertebrates

The terrestrial and freshwater invertebrate fauna at South Georgia is limited in terms of numbers and species diversity; this is accounted for by the island's relatively severe environment and geographical isolation. However, the fauna is considerably more diverse and abundant than found further south in the Antarctic, but relatively poor in diversity and abundance compared to non-Antarctic continental areas or adjacent cool temperate islands such as the Falklands (Gressitt, 1970). South Georgia probably had a more extensive invertebrate fauna with major extinctions occurring during the Pleistocene ice age.

There is limited information on terrestrial and freshwater invertebrates at South Georgia. The terrestrial arthropod fauna dominates the published information, such as work by Gressitt (1970) on the numbers of arthropod species and their characteristics. Particular aspects of the arthropod fauna have been studied more recently, for example adaptation of insects to cold condition, and the ecology of mites, springtails and diving beetles. Little is known about other invertebrates, such as annelid worms and molluscs which have been recorded on the island; nor is there much information about nematodes, particularly those which are endoparasites of the resident birds, seals and reindeer. It is likely that there are several species awaiting discovery and identification.

Terrestrial arthropods. 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).

Several introduced insects have been recorded. For example, the cockroach *Blatella germanica* once inhabited the whaling station at Grytviken but died out after the station's closure. Occasional exotic insects arrive with cargo from ships, but they usually do not survive. Several species of non-indigenous mites have been recorded close to the whaling stations in Cumberland Bay and in Stromness Bay. Two carabid beetle species, probably introduced during the whaling era, have also survived in the north east, particularly in and around the abandoned whaling station at Husvik. One of the introduced carabids *Trechisibus antarcticus* preys on the endemic herbivorous beetle *Hydromedion sparsutum*. The endemic beetle has responded to this predation pressure by producing larger larvae which grow faster, thereby reducing the vulnerable period when small larvae can be predated by the introduced carabid.

Some of the native Collembola, in particular *Cryptopygus antarcticus*, may be at risk of displacement from certain habitats, as a result of successful competition from the two introduced species of Collembola recorded at South Georgia, *Hypogastura purpurescens* and *Hypogastura viatica*.

Some groups of insects are notable by their absence from South Georgia, in particular lepidopterans (butterflies and moths) and curculionid beetles (weevils) which are well represented on other sub-Antarctic islands such as Marion and Crozet. However the occasional visits have been recorded. 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, for example two staphallinids, 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 prostigmate 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 (for example *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 their capacity for extensive supercooling and 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.

Threats. The island's native arthropods are potentially at risk of displacement and/or predation as a result of alien invertebrate introductions by man.

Other terrestrial invertebrates include protozoa and amoeba 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 invertebrate communities of the limited number of South Georgia's lakes and rivers which have been studied to date, 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 north east coastal lowlands at South Georgia (Hansson *et al*, 1996), including five species of cladocera, three species of copepods, 54 species of rotifers, and several species of annelids and nematodes. Many species of protozoans, amoeba 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.

Most of the invertebrates, in terms of diversity and abundance, are found in association with the sediment surface or with the vegetation. Only a few species are found in the water column.

Many of the recorded freshwater invertebrate species are widespread and have probably colonised the island from South America. Some species are also found in the lakes of Signy Island, South Orkney Islands and on the Antarctic Peninsula.

2.8 Bird communities

Birds dominate the vertebrate fauna of South Georgia, both in terms of diversity and numbers. A total of 81 species has been recorded (Prince and Croxall, 1996 and South Georgia Checklist, 1997) at the island, including the Maritime Zone which extends approximately 200 nautical miles from the island. Thirty-one species (27 of which are seabirds) breed at the island, including one endemic species. Of the remaining 50 species, 33 are vagrants; 11 are visitors or migrants; one is an introduced species (the upland goose *Chloephaga picta*) which is now extinct; two were ship-assisted species and three species need confirmation.

South Georgia is a key sub-Antarctic breeding location for birds and is typical of other sub-Antarctic islands in having abundant numbers but low species diversity (in comparison to tropical islands which have many different species). Prince and Croxall (1996) reported that the total numbers of breeding bird species at South Georgia are similar to other sub-Antarctic islands. However, South Georgia has more vagrants recorded than any other sub-Antarctic island, probably reflecting its proximity to the species-rich South American land mass and its location in the path of the prevailing westerly winds.

South Georgia contains important populations of most sub-Antarctic bird species. It probably contains half or more of the world population of macaroni penguins; grey-headed albatrosses; northern giant petrels and Antarctic prions; the last is the most numerous seabird species at South Georgia.

Breeding birds

Penguins are abundant and are represented by nine species, four of which breed regularly at South Georgia, two breed occasionally and the remaining three species are vagrants. The penguins mostly colonise the tussac grassland of the coastal fringe. They feed on fish, squid and krill and can forage well out to sea. The macaroni penguin (*Eudyptes chrysolophus*) is the most numerous species with more than two million breeding pairs and a fairly localised distribution mainly at north-west South Georgia where it occurs in several large colonies, particularly at the Willis Islands. There are around 400,000 king penguin (*Aptenodytes patagonicus*) breeding pairs, with large colonies accounting for some three-quarters of the pairs at St. Andrews Bay and the Bay of Isles. Gentoo penguins (*Pygoscelis papua*) with about 100,000 breeding pairs are widely distributed around the island in small colonies. Chinstrap penguins *(Pygoscelis antarctica)* with 6,000 breeding pairs are mainly found in the south-east of the island. The rockhopper penguin (*Eudyptes chrysocome*) breeds irregularly in very small numbers usually in association with the main macaroni penguin colonies. A pair of Adélie penguin (*Pygoscelis adeliae*) was discovered breeding for the first time in 1997.

King penguin populations have increased on average by at least 5% per year over the last 80 years (Croxall *et al.* 1988). Macaroni penguin populations have probably decreased by 50% over the last 25 years (Trathan *et al.* 1998), and the species is now classified by the IUCN as globally near-threatened (Ellis *et al.* 1998). Gentoo penguin populations have decreased by about 10% over the same period.

Albatrosses. Seven species of albatross have been recorded at South Georgia. Four breed in globally-important populations and three are vagrants. Albatross nest on rocky crags or cliffs and hillsides on islands or headlands, and feed mainly on fish and squid, but some species also take krill and carrion. The black-browed albatross (*Diomedea melanophrys*) with 100,000 breeding pairs is mainly found at the north-west and south-east of South Georgia. The largest concentrations are at Willis Islands (34,000), Annenkov Island (17,500), Bird Island (15,000) and Cooper Island (12,000). South Georgia is the main site for the grey-headed albatross (*Diomedea chrysostoma*), with 80,000 pairs (46% of the world annual breeding population) breeding biennially. It is confined to five areas in the north west with the largest numbers at and around Cape Paryadin (52,000), Willis Islands (25,000) and Bird Island (11,500). The largest seabird in the world, the wandering albatross (*Diomedea exulans*) breeds biennially and has an annual breeding population of 4,000 pairs (15% of the world population), mainly on Bird Island (1,200), at the Bay of Isles and on Annenkov Island. The light-mantled sooty albatross (*Phoebetria palpebrata*) breeds biennially, has an annual breeding population of some 5000 to 8000 pairs, and is widely distributed.

The populations of albatross species which breed at South Georgia, except the light-mantled sooty albatross (whose status is unknown), have been in decline over the last 10 to 20 years. The next IUCN World List (due to be formally published in 2000, but electronic version available during 1999) will present the grey-headed albatross as 'Vulnerable' (indicating a 10% chance of the species becoming extinct in 100 years) on the basis of the decline at South Georgia (the main site in the world for this species) and the black-browed albatross as 'Near-threatened' because of decline at most breeding sites except the Falkland Islands, which has 85% of the world population (Croxall and Gales 1998).

The population of wandering albatrosses has declined by more than 50% over 20 years; the cause is thought to be the drowning of birds caught by longline fishing gear used for catching tuna, toothfish and other demersal fish in the Southern Ocean and adjacent waters. This marked and rapid decline has led to the classification of the wandering albatross as a 'Vulnerable' species according to IUCN criteria (Croxall and Gale 1998).

Petrels and shearwaters. Twenty-one of the world's 66 species of petrels and shearwaters have been recorded at South Georgia, including six petrel and two prion species which breed at the island. White-chinned petrel (*Procellaria aequinoctialis*) in two million pairs and Antarctic prion (*Pachyptila desolata*) with 22 million pairs are widely distributed throughout the island, breeding in burrows in tussac grassland. The

southern giant petrel (*Macronectes giganteus*) and the northern giant petrel (*Macronectes halli*) have populations of 5,000 and 3,000 breeding pairs respectively, comprising significant proportions of the world population for these species. Unlike populations elsewhere, these two species are stable or increasing at South Georgia, probably because of the abundance of carrion from penguin and seal colonies.

The population of blue petrel (*Halobaena caerulea*) with 70,000 breeding pairs, has decreased recently due to destruction of part of their tussac grassland breeding habitat by Antarctic fur seals (*Arctocephalus gazella*); for example at Bird Island. The population of cape petrel (*Daption capense*) increased greatly during the whaling era, and the present population of 10,000 breeding pairs has a widespread distribution, mainly on ledges of steep cliffs. The snow petrel (*Pagodroma nivea*) with 3,000 breeding pairs is at the northern limit of its breeding range, and usually nests on rock ledges over 1,000 m above sea level. The fairy prion (*Pachyptila turtur*) with around 1,000 breeding pairs, breeds locally, and mainly at the northwest of the island, in rocky debris at the base of cliffs and in caves.

Storm-petrels and diving-petrels Storm-petrels are represented by three species which breed on South Georgia: Wilson's storm petrel (*Oceanites oceanicus*) which is abundant (600,000 breeding pairs) and widespread mainly in scree and rock debris habitats; the black-bellied storm petrel (*Fregetta tropica*) with 10,000 breeding pairs mainly in burrows or steep sea cliffs; and, the grey-backed storm petrel (*Garrodia nereis*) which is a very rare breeder with only a few confirmed records.

Two species of diving-petrels breed at South Georgia: the South Georgia diving petrel (*Pelecanoides georgicus)* with 50,000 breeding pairs mainly in scree habitats and mountains, and the common (sub-Antarctic) diving petrel (*Pelecanoides (urinatrix) exsul*) with just under four million breeding pairs in coastal tussac habitats, normally on steep slopes.

Other bird species which breed at South Georgia include four seabirds: the South Georgia shag (*Phalacrocorax georgianus)* with 7,500 pairs; the brown (sub-Antarctic) skua (*Catharacta löennbergi*) with 2,000 pairs; the kelp gull (*Larus dominicanus*) with 2,000 pairs; and, the Antarctic (South Georgia) tern (*Sterna (vittata) georgiae*) with 10,000 pairs. There are also around 2,000 breeding pairs of the yellow-billed sheathbill (*Chionis alba*), an important scavenger, which along with the brown skua and the kelp gull, feeds on such items as seal placentae, penguin eggs and chicks.

Two species of duck breed at South Georgia: the South Georgia (yellow-billed) pintail (*Anas georgica georgica*), which is endemic to the island, with a population of 1,000 pairs nesting mainly in tussac grassland and areas without rats; and, the yellow-billed (speckled) teal (*Anas flavirostris*) of which there are about 10 pairs breeding very locally in the Cumberland Bay area.

The South Georgia pipit (*Anthus antarcticus*) is the most important land-bird on the island as it is endemic. Its population of 3,000 to 4,000 breeding pairs is almost exclusively confined to the rat-free offshore islands, notably Bird Island.

Visiting birds

South Georgia is visited by other seabirds and some landbirds, including:

- occasional visits by emperor penguins (*Aptenodytes forsteri*), royal penguins (*Eudyptes schlegeli*) and magellanic penguins (*Spheniscus magellanicus*);

- occasional visits by royal albatrosses (*Diomedea epomophora epomophora*); shy albatrosses (*Diomedea cauta salvini*); and the sooty albatrosses (*Phoebetria fusca*). Visits from the royal albatross and the sooty albatross have been associated with the presence of warm surface waters, for example in 1986, bringing a number of seabirds, characteristic of cool temperate waters, south to South Georgian waters;

- regular visits by six species of petrels and shearwaters such as the Antarctic fulmar (*Fulmarus glacialoides*), the Antarctic petrel (*Thalassoica antarctica*) which breed further south in the Scotia Sea, the soft-plumaged petrel (*Pterodroma mollis*) and great shearwater *(Puffinus gravis*) which breed at Tristan da Cunha/ Gough, and the thin-billed prion (*Pachyptila belcheri*) which breeds at the Falkland Islands;

- occasional visits by seven other species of petrels and shearwaters, such as the great-winged petrel (*Pterodroma macroptera*) and the broad-billed prion (*Pachyptila vittata*) which breed at Tristan da Cunha and Gough Island, and the sooty shearwater (*Puffinus griseus*) which breeds at the Falkland Islands and South America;

- regular visits by land birds such as the cattle egret (*Bubulcus ibis*) and the white-rumped sandpiper (*Calidris fuscicollis*).

There are also numerous vagrant species, mainly waders and ducks but also some passerine species from South America (Prince and Croxall, 1996).

Threats to birds on South Georgia

Seabirds at South Georgia are generally subject to fewer serious threats than those in most other areas of the world. However, there are several reasons for concern, in particular the rapid decline of albatross populations (especially wandering and grey headed albatrosses) and macaroni penguins. The Government's management and conservation measures in response to this and other threats to the fauna and flora of South Georgia are described in Section 3.

The main threats to birdlife at South Georgia are incidental takes from entanglement and/or capture in fishing gear; potential competition with commercial fisheries particularly the possible development of a large-scale krill fishery; habitat disturbance and destruction; introduced predators.

Incidental takes are an increasing problem for albatrosses. Wandering albatrosses have been in decline over the last 20 years much as a result of fishing by long-lining for tuna in temperate regions of the Southern Ocean. Grey-headed albatrosses have been affected by similar fisheries; black-browed albatrosses to a lesser extent. All three species, but mainly black-browed albatross, are being affected by long-lining for toothfish around South Georgia (and at other temperate and sub-Antarctic areas), despite CCAMLR regulations which prescribe how fishing vessels should avoid entanglement or capture of seabirds in their gear.

Potential competition with commercial fisheries CCAMLR seeks to manage living resources in the Southern Ocean, including around South Georgia and sets conservative total allowable catches for commercial species in order to ensure that the ecology of marine predators, and the wider ecosystem are not comprised. This works well when fishing vessels follow the CCAMLR rules, but in recent years there have been substantial increases in illegal and/or unregulated fishing of commercial stocks which could lead to problems for the wider ecosystem.

Habitat disturbance and destruction Introduced reindeer have considerably over-grazed most of their relatively restricted range and the resulting destruction or reduction of tussac grassland has made it much less suitable for burrowing petrels. More serious habitat destruction, mainly at north west South Georgia, is resulting from the activities of Antarctic fur seals (*Arctocephalus gazella*) which have recovered from virtual extermination in the 19th century, to over three million individuals today. The tussac grassland is trampled and flattened by the activity of pups, and immature and sub-adult males. Where there is severe damage, there are few if any occupied petrel burrows, for example on Bird Island.

In addition to destroying breeding burrows, the opening up of the previously dense tussac grassland has given access to skuas, whose population at Bird Island doubled between 1958 and 1983 (Prince and Croxall 1983), resulting in increased predation on storm petrels, Antarctic prions and blue petrels.

Natural predators such as the skuas and sheathbills take some seabird species: skuas take petrel chicks (often excavating burrows to do so) and adults of the smaller common nocturnal burrow-dwelling species; sheathbills take eggs, mainly of penguin species. There are also predators at sea such as leopard seals and Antarctic fur seals. There is no evidence that any of these predators is having a serious adverse effect on the breeding populations of their prey.

Introduced predators Brown rats (*Rattus norvegicus*) were accidentally introduced in the early 1800s as the sealing industry became established on South Georgia. They are now widespread and take eggs and young chicks of most small petrels which nest in burrows, although storm petrels and the South Georgia diving petrels breed in habitats unsuitable for rats. Rats are absent from offshore islands and much of the south-west coast and burrowing petrels flourish there. The South Georgia pipit nests on the ground and is highly vulnerable to predation from rats.

2.9 Mammal communities

Seals

Six species of seal have been recorded at South Georgia. The Antarctic fur seal (*Arctocephalus gazella)* and the southern elephant seal (*Mirounga leonina*) are abundant and breed at South Georgia. The leopard seal (*Hydrurga leptonyx*) and the Weddell seal (*Leptonychotes weddellii*) occur in fewer numbers and are regular visitors, although there is a small breeding population of Weddell seals at South Georgia, and leopard seals may breed in the area. The crabeater seal (*Lobodon carcinophagus*) and the sub-Antarctic fur seal (*Arctocephalus tropicalis*) are occasional visitors.

Antarctic fur seals

Antarctic fur seals (*Arctocephalus gazella*) are active, agile animals which are polygamous and gregarious during the breeding season from November to April when they congregate on coastal beaches in rookeries for pupping, mating and lactation. Bulls of about seven to 13 years old defend territories in areas where females give birth. Pups are produced in early December, having been conceived the previous season. Outside the breeding season females are mainly pelagic, whilst males are found ashore at the island throughout the winter. Adult bulls may be up to 2 m long and weigh 200 kg; cows are up to 1.5m long and 50 kg. Pups at birth are about 66 cm and only 5 to 6 kg, and by weaning 4 months later are typically 14 to 16 kg. Their diet is mainly krill, but fish, squid and birds are occasionally consumed. Female fur seals continue to feed during the breeding season, but bulls probably do not. They have grey to brown fur which was much sought after during the sealing era from the late 18th century to 1913 at South Georgia.

Fur seals were hunted close to extinction during the sealing era, but after many years of protection they are once again abundant. South Georgia now holds the largest breeding population of Antarctic fur seals in the world, accounting for 96% of the pup production in this species; the population is increasing at 10% per year. Fur seals also breed on neighbouring islands such as the South Shetland Islands, South Orkney, and further afield, for example at Iles Kerguelen and Heard Island. The latest fur seal population census at South Georgia (Boyd, 1993) showed that during the 1990/91 pupping season, the total number of breeding females ashore was 380,000. This was

fewer than the estimates of female fur seals ashore in the previous three seasons, illustrating the fluctuations in the reproductive rate probably in response to variation in environmental factors. The total population size in 1990/91 season was estimated at 1,550,000.

The main fur seal colonies are on beaches at the north-western part of the island. The greatest numbers tend to be in and around the shallow, sheltered bays at Undine, where 90,000 breeding females were recorded in 1990/91. Small groups of breeding females are also observed at the southeast end of the island, particularly at Cooper Bay and Cooper Island where 4500 breeding females were recorded in 1990/91. Expansion of the population is taking place rapidly along the north coast, especially around Stromness and Cumberland West Bays.

Southern elephant seals

The southern elephant seal (*Mirounga leonina*) is the largest of all seal species. For most of the year they feed on squid and fish; they do not feed during the breeding season. The bull may be up to 6m in length and weigh 4.5 tonnes, and is characterised by a large proboscis. Cows are less than one quarter of the bull's size. Their breeding season commences in August and continues until November/December when, after a brief lactation of around 23 days, the cows and bulls return to sea, leaving their pups to moult before entering the sea by the end of the year. Adult bulls each may defend a harem of up to 100 cows during the breeding season. Frequent fights occur between breeding bulls and bachelor bulls. The adults come ashore again in the late summer to moult when they spend much time in wallows usually located in peaty soils above the high tide mark.

The sealing industry at South Georgia took elephant seals for their oil, from the late 18th century until the 1960s. Although fewer elephant seals were taken than fur seals, their numbers were depleted by the time the industry was regulated in 1909 to avoid excessive population loss. The latest survey of the population at South Georgia in 1995 (Boyd, *et al.* 1996) recorded around 110,000 breeding females which is comparable to the numbers recorded in previous surveys in 1951 and 1985, suggesting a stable breeding population. It has been estimated (Laws, 1994) that the breeding population at South Georgia produced around 54% of the annual world pup production. Elephant seals also breed on other sub-Antarctic islands such as Heard and Macquarie, and in small numbers on the Falkland Islands.

Elephant seal colonies are found at many sites around the coastline of South Georgia, particularly at long, tussac-backed beaches and long, open beaches. Almost half the population in 1995 was recorded in the south east of South Georgia from Larsen Point to Cape Disappointment.

Leopard seals

The leopard seal (*Hydrurga leptonyx*) is essentially a solitary species. The female can be up to 4m in length and is considerably larger than the male. Their diet includes fish, krill, birds and seals. It is one of the most widespread of the Antarctic seals and is a significant predator of seabirds (in particular penguins) and other seals. It has a circumpolar distribution, and can be found on Antarctic pack ice during the breeding season, from November to late December. It tends to move northwards to South Georgia and other sub-Antarctic islands during the winter (April to November) to feed and occasionally to breed. The largest numbers occur on South Georgia in August or September. They start to move south in October and then are generally absent until April. They have been regularly observed in the north west of South Georgia, close to fur seal and penguin colonies such as those on Bird Island. There is some evidence of an increase in the numbers of leopard seals visiting South Georgia (Walker *et al.* 1998), possibly attracted by increasingly abundant fur seal prey.

Weddell seals

The Weddell seal *(Leptonychotes weddellii*) is peri-Antarctic in its distribution and is at the northern limit of its range at South Georgia. It is a regular visitor and there is one long-established breeding colony, of around 100 seals, in the coves in the vicinity of Larsen Harbour at the southern end of the island. Although breeding mainly occurs in this region, the seals appear to disperse out from there to other parts of the island, particularly along the southwest coast. It feeds mainly on fish supplemented by squid and other invertebrates. Very little is known about this breeding colony, but it is probably a relatively isolated population, maintained partly by immigration from further south.

Trends and threats

Fur seals. The fur seal population is increasing at 10% per annum, and there appears to be no limit to population size at present. Breeding sites are unlimited at the island, and although some evidence may be emerging to suggest that food supply may be limiting, this may be a local effect where population density is high, rather than an effect which applies to the whole population.

The current population of fur seals is possibly causing deleterious effects on stocks of krill and commercially important fish species, such as icefish; on population sizes of some competitors, such as macaroni penguin; on plant communities, such as trampling of tussac grass; and on visitor access to certain wildlife sites. As fur seal populations continue to increase, further pressures on the local ecosystem are likely to arise.

Elephant seals. Elephant seals are declining in numbers throughout their range, except at South Georgia. If this trend continues, South Georgia will become of increasing importance as a breeding location for these seals.

Whales and dolphins

Until the advent of whaling in the early 1900s, the Southern Ocean contained more Great Whales than oceans elsewhere in the World. Waters around South Georgia, in particular, contained large numbers of blue (*Balaenoptera musculus*), fin (*B. physalus*), sei (*B. borealis*), humpback (*Megaptera novaeangliae*) and southern right (*Eubalaena australis*) whales during the austral summer. All of these animals were sustained by the huge production of krill in the region. Large-scale exploitation of whales began in the early 1900s, when developments in whaling techniques permitted the capture of the fast and profitable balaenopterid species (listed in this paragraph) for the first time. Very quickly, South Georgia became the whaling capital of the world, providing secure harbours for both land-based and floating factory operations. Hundreds of thousands of whales were taken in a few decades of intensive hunting. Whale populations were unable to withstand such depredation and were depleted to low levels. All of the species mentioned above were reduced to less than 10% of their original numbers, some to less than about 1%.

These whale species eventually received protection under the International Whaling Convention in the 1950s and 1960s, but this came too late to prevent the near-collapse of the whale populations and subsequently the cessation of the South Georgia whaling industry. The final shore stations were closed in the 1960s. Today commercial whaling is prohibited and the Southern Ocean, including the area around SGSSI, was designated as a whale sanctuary in 1994 by the International Whaling Commission.

No reliable estimates of current population size exists for any large whale in the area around South Georgia, but there is evidence that both right and humpback whales are increasing in the region. Right whales are once again regularly encountered near the coast of the island and over the shelf. Their calving ground has recently been established as Peninsula Valdes in Argentina following the observation of recognisable individuals at both locations. Blue and fin whales are known to be much reduced in number compared with a century ago, but the cost of counting pelagic whales over such a large area of sea is prohibitive; it is not known whether they too are increasing. Recovery to pre-exploitation numbers, if it occurs at all, will likely take a century or more for the slower-reproducing species.

In addition to the baleen whales, several species of toothed whale or Odontocete also occur around South Georgia. The largest of these is the sperm whale (*Physeter catodon*) males of which were taken occasionally during the whaling era but without significant impacts on the population. A major factor here was that only males reach the high latitudes of the Southern Ocean, so reproductive females never came within range of South Georgia whaling operations. Today pods of sperm whales and killer whales (*Orcinus orca*) are often encountered in the Maritime Zone, and commonly associate with long-lining fishery operations for Patagonian toothfish (*Dissostichus eleginoides*). Both species take toothfish off the lines with possible impacts on fishery operations.

Several species of squid-feeding beaked whale (Ziphiidae) probably occur around South Georgia, but they are notoriously difficult to identify. Only the southern bottlenose whale (*Hyperoodon planifrons*) is relatively common in the area. Small cetaceans recorded near the island include long-finned pilot whales (*Globicephala melas*), hourglass dolphin (*Lagenorhynchus cruciger*) and the very rare spectacled porpoise (*Australophocaena dioptrica*).

2.10 Introduced animals

South Georgia, in common with other sub-Antarctic islands, has no indigenous terrestrial mammals. During the sealing and whaling eras, several attempts were made to introduce and maintain animals and birds to serve the needs of the sealers and whalers (Leader-Williams, 1988). Rabbits were the first introduced mammals to South Georgia in 1872 and at various times since then, there have been introductions of domestic stock such as horses, cattle, sheep, goats, pigs, reindeer, poultry and of upland geese. None of these animals has become established on the island, apart from the reindeer (*Rangifer tarandus*). In addition brown rats have been introduced accidentally to South Georgia by sealers living in camps around the island. There is also an isolated population of house mice on the north-west side of the island, where rats are not present. Dogs and cats have been introduced as pets in the past, but have not become established on the island.

Reindeer (*Rangifer tarandus*).

On three occasions between 1911 and 1925, small numbers of reindeer were introduced by Norwegian whalers as a source of meat:

- in 1911 around 10 reindeer were introduced into Ocean Harbour on the Barff Peninsula. Their numbers increased rapidly and by 1958 there were 3,000 animals, but since the 1950s there numbers have declined, and in 1972 there were 1300 in the Barff herd. In the early 1960s part of the Barff herd moved across the Cook Glacier to Royal Bay where 600 reindeer were recorded in 1972;

- in 1911/12 five reindeer were introduced into Leith Harbour in Stromness bay, but after increasing to around 20 animals, all perished in a snow-slide during the late 1920s;

- in 1925, seven reindeer were introduced into Husvik Harbour in Stromness Bay, and spread out around Busen Point; by 1972 there were 800 reindeer in the Busen herd.

Since these introductions, there has been no contact between the Barff/Royal Bay herds and the Busen herd, because the Barff Peninsula and the Stromness Bay area are separated by glaciers stretching down to the sea and acting as a barrier to movement.

They are therefore two genetically distinct stocks of reindeer which form two separate herds. They are the largest terrestrial animals at South Georgia, and have no natural predators, and abundant supply of food, and unlike their northern cousins, are largely free from parasites and disease.

The two herds occupy 313 km ^{2}, which is about 20% of the snow-free area of South Georgia. Whilst the Barff/Royal Bay herd occupies and grazes all accessible areas within its range, the Busen herd has recently expanded its range and approximately 88% of the snow-free vegetated area is now grazed; there is still scope for the herd to occupy the remaining area, if the population continues to increase.

Threats to native plants from grazing by reindeer. The reindeer occupy the most extensive and species-rich vegetated areas of South Georgia, and there is concern about their impact on the native vegetation, in particular over-grazing (Leader-Williams *et al*., 1981 and 1987). In the summer they graze on herbfields and meadows, and in some areas the herbfield communities are no longer present in grazed areas. In the winter the only accessible vegetation type during snow-cover is tussac grassland, upon which the reindeer depend although they also eat seaweed on the beaches. Grazing has caused degradation of the tussac grassland, leading to loss of the plants in some areas and also erosion of the bare ground which is left; loss of lichens has also occurred. However, no species of native plant is threatened with extinction in grazed areas (Leader-Williams 1988). The current retreat of glaciers potentially opening up new areas (eg. west of Fortuna Glacier) to the reindeer, could lead to further degradation of plant communities (Moen and MacAlister, 1994).

Management of the reindeer. Reindeer are protected by the 1975 Conservation Ordinance. However, the Ordinance provides for the issue of permits to kill reindeer. Since the cessation of the whaling industry in the late 1960s, reindeer have occasionally been killed for research purposes, particularly in the 1970s as part of an extensive study. In recent years management policies to control the effects of mammals have been introduced successfully to some sub-Antarctic and other islands in the Southern Ocean; for grazing animals the concern is the protection of the native vegetation (Leader-Williams et al 1989). The Government's policy on the management of the reindeer at South Georgia is presented in Section 3.4.12.

Brown rats (*Rattus norvegicus*)

Brown rats were introduced to South Georgia by sealers and whalers during the 18th and 19th century. They are now widespread and abundant, and distributed in the north west of the island and along the north-east coast of the island, where the dense stands of tussac grass and the few glaciers provide favourable habitats. Evidence of rat activity, such as burrows, nests and runs can be found up to one km from the shore. Large numbers are found in and around abandoned whaling stations. They are mainly absent from off-shore islands. There are no naturally-occurring predators of rats in

South Georgia, with the possible exception of brown skuas which have occasionally been observed taking rats.

The rats have adapted successfully to the South Georgia climate. The main component of their diet is tussac grass. In addition they consume beetles and forage on the seashore for a variety of food, such as kelp and insects and their larvae. Carrion is eaten where available, such as seal and reindeer carcases. Ground-nesting birds are preyed on by rats, and this is having a severe impact on the population of the South Georgia pipit which nests beneath rocks or in tussac clumps near the ground. Breeding populations of South Georgia pintails and burrow-nesting petrels, such as prions and blue petrels, are also vulnerable to predation by rats. White-chinned petrels can co-exist with rats but smaller petrels are unable to do so in areas where rats can survive well in winter. Penguin rookeries also provide rats with a source of food in the form of carrion or chicks.

Management of the brown rat. The abundance and widespread distribution of the existing rat population makes it difficult to reduce or control. However, it is possible that they may extend their range through natural causes, such as retreating glaciers opening up new areas, and/or human intervention (e.g. accidental transport by inshore boat trips). The Government's policy on the management of the brown rat is presented in Section 3.4.12.

House mice (*Mus musculus*)

House mice have been recorded in the north-west of South Georgia at Shallop Cove in Queen Maud Bay. This localised population is cut off from the main part of the island by branches of the Esmark Glacier. The mice live in tussac grass which provides shelter, nesting opportunities and food. They have a large body mass for the species, but not as large as those on some north Atlantic islands, and have large amounts of brown fat indicating their adaptation to the island's low temperatures. The Government's policy on the management of house mice is presented in Section 3.4.12.

2.11 Infrastructure

2.11.1 King Edward Point

The settlement at King Edward Point was established in 1912 by the civil administration. Its 10 buildings, as well as the various stores and outhouses, have been used for many purposes over the years. Some of the buildings pose health and safety risks and are no longer in use. It is the location of the island's Post Office which has been in operation since the early days of the settlement. Access to King Edward Point is by jetty and by a track from nearby Grytviken. The settlement provides the island's administrative centre; since April 1982 it has been the base for UK military forces.

The Government has commissioned the construction of new research facilities at King Edward Point for scientists from British Antarctic Survey which is expected to operate at this site from 2001.

2.11.2 Bird Island Research Station

The British Antarctic Survey maintains a research station at Bird Island off the north-west tip of South Georgia. The current base at Jordan Cove comprises three principal buildings and two smaller structures. Wooden duckboarding connects the buildings. Access to the sea is provided by a 21 metre long plank- and- scaffolding jetty. The base provides living accommodation and office/laboratory space for up to eight people. Six to eight people are usually working at the station in the summer and three in the winter.

In addition to the main station, there are several field facilities at Bird Island to aid research programmes, including two field huts (Hibitane House near Payne Creek, Macaroni hut near the end of Fairy Point), and hides at Wander Ridge (2), colony J, Johnson Cove and Molly Hill.

In the summer of 1958/59 and 1960/61 and from 1962 through 1964, studies of albatrosses, funded by USARP (and supported by FIDS) were carried out. Research activities resumed at Bird Island during the summers of 1970/71 to 1973/74 with studies of fur seals, albatrosses and petrels. These studies continued in every summer from 1975/76 until 1981/82. From late 1982 the station has been occupied continuously by personnel from the British Antarctic Survey. The main research programmes are on seabird and seal population dynamics, feeding ecology and reproductive performance with long-term monitoring studies contributing to environmental conservation objectives, including under the CCAMLR Ecosystem Monitoring Programme (CEMP).

Field huts. In addition to the stations at King Edward Point and at Bird Island, around the island there are a number of field huts established in the 1970s for scientific research work, whose future is under review.

2.11.3 South Georgia Museum

The South Georgia Museum was established and opened to visitors in 1992. It is located at Grytviken in the station manager's villa at the abandoned whaling station. Displays provide information on the island's wildlife; on the history of its whaling industry; and on exploration and expeditions, including Shackleton's journey across the island. It also contains artifacts, photographs and paintings relating to these themes. There is a continuous programme of repair and maintenance of the Museum building.

The Museum is managed by two curators and a board of trustees. The Museum's remit also covers the management and maintenance of the Heritage Trail (the signposted walk around Grytviken) and the whalers' cemeteries, including Shackleton's grave, at Grytviken. In more recent years the remit has been extended to the repair and restoration of the church which originally stood at Strømmen in Norway, but was dismantled and taken to Grytviken where it was re-erected in late 1913 on behalf of Norwegian whalers.

Access to the Museum and the other historic sites at Grytviken for ship-borne visitors is by the nearby Harpon jetty which is currently closed for a major refurbishment, and is expected to reopen in 2000/2001.

2.11.4 Abandoned whaling stations

Six abandoned whaling stations occupy harbours along the north east coast of South Georgia. The station at Ocean Harbour was the first to be closed in 1920 and there are few industrial remnants at the site, as most of its equipment was removed to nearby Stromness station shortly after closure. The station at Prince Olav Harbour was closed in 1931, and it is now almost entirely in ruins.

The four other stations at Husvik, Grytviken, Stromness, and Leith Harbour were in operation until the 1960s. When the latter three ceased operation by 1965, they were left substantially intact and ready for use again, should whaling resume. There are substantial remains at these four sites, particularly at Grytviken which was the largest station at the island. However, nearly all of the buildings at these sites are now in a poor, and often dangerous state of repair, as a result of weather and human interference.

In addition, there was a shore-based facility at Godthul which supported whaling vessels and factory ships. There are some limited remains at this site.

All the major stations have cemeteries, containing almost two hundred graves in total.

A partial clean-up operation of the abandoned stations at Husvik, Grytviken, Stromness and Leith was undertaken in 1990-91, funded jointly by the British Government and the station leaseholders Christian Salvesen of Leith (UK).

There has been recent interest in the preservation of certain aspects of the sites by industrial archaeologists documenting the history of whaling.

2.11.5 Other historic sites

Relics from the sealers who stayed on the island for extended periods, and occasionally overwintered, are widespread. They are found in some of the island's caves which had provided shelter; for example at Fortuna Bay and at Will Point in

Royal Bay. Relics are also found at the sites of several ruined huts scattered around the island, for example at Hestesletten, near Cape Vakop, Hope River and at Diaz Cove. Marked graves are also found close to these sites.

Try-pots are the most widespread relics, for example, they are found at Elsehul, Undine Harbour South, Elephant Cove and elsewhere. Several have been removed from South Georgia to museums around the world. Wooden implements and relics from ships are commonly found on the island's beaches.

Relics from scientific expeditions occur at a limited number of sites at the island. The German International Polar Year expedition of 1882-83 established a station at Royal Bay. There is little left of the station, but it is still possible to see where the various buildings were located. Relics at the site include cast iron stoves, and a large number of glass and earthenware bottles.

There are approximately 50 recorded shipwrecks, and other abandoned vessels, around the island, in particular along the north-west coast. They include supply vessels, shallops (locally built small sealing vessels), large sealing vessels, whale catchers, launches and a submarine. The earliest is the sealing vessel *Sally* wrecked in1796; the most recent is the launch *Albatros* wrecked in 1983.

A list of South Georgia's historic sites is found at Annex 2.

3. MANAGEMENT POLICIES

3.1 Management objectives

These proposed objectives, and the detailed management prescriptions in the plan, would provide the framework for Government decision making and aim to influence and direct change towards desired goals.

1. To conserve the indigenous flora and fauna, ecological associations, and natural environment of South Georgia.

2. To remove introduced flora and fauna as far as practicable, and to prevent their further establishment.

3. To manage and preserve, as far as practicable, historic and archaeological features.

4. To manage human activities so that they do not cause deleterious impacts on the fauna and flora and natural features of the island; and to encourage activities aimed at restoring and rehabilitating damage due to local human activities.

5. To manage sustainable tourism to the extent compatible with objective (1) to (3) above, whilst ensuring that the provisions of the South Georgia Visitor Code are met.

6. To manage fishery activities in the Maritime Zone in a sustainable manner so that they do not cause deleterious impacts on the marine environment and its biota; and to ensure that obligations to, and the provisions of CCAMLR are met.

7. To allow development of the island to the extent compatible with objectives (1) to (3) above, and within a framework of planning consent following satisfactory completion of an environmental impact assessment, and minimising the effects of operational management through appropriate waste disposal and pollution prevention.

8. To encourage research especially where the results will contribute directly to the effectiveness of the protection and management of South Georgia.

9. To seek cooperation on matters of relevance to the conservation management of South Georgia with parties interested in the conservation of the Southern Ocean and its islands.

10. To manage South Georgia to ensure that the UK's international conservation obligations are met, as appropriate.

11. To keep under review the matter of South Georgia's nomination for World Heritage Status, to ensure nomination is achieved in a timely manner.

The Government would welcome your views on the proposed objectives as the basis for the long term management of South Georgia

3.2 Administration

3.2.1 Administrative Authority

Legal, financial and administrative arrangements for the governance of SGSSI are vested in the Commissioner at Stanley in the Falkland Islands. Local administration is the responsibility of the Marine Officer at King Edward Point. At present the Marine Officer's duties include those of Harbour Master, Customs and Immigration Officer, Fisheries Officer and sub-Postmaster. Since 1982 the Magistrate has been the officer in command of the military at King Edward Point. When the military leave South

Georgia, the magistrate will then be the station commander of the British Antarctic Survey's research station at King Edward Point.

3.2.2 Fees and charges

This section describes the various activities in South Georgia and/or inside its Maritime Zone for which the Government currently levies fees and charges. The legislative basis for these fees and charges is described in Section 1.4 of this Plan. A list of the current level of fees and charges (at time of going to press) is at Annex 3.

Fees may be paid in pounds sterling (cash, cheque or travellers' cheque) or in United States dollars (cash or traveller's cheque) to the Marine Officer at King Edward Point upon arrival, or by the vessel's agent directly to the Government in Stanley.

A passenger landing fee is charged to every visitor over the age of 16 years to South Georgia. However, the following are excluded from payment: civil servants on official duty from the UK, the Falkland Islands or South Georgia and the South Sandwich Islands; contractors and subcontractors to the Government; serving members of the British Forces on official duty, and their spouses and children; staff and trustees of the South Georgia Museum; employees and subcontractors of British Antarctic Survey; other scientists visiting to undertake approved research projects; and crew and/or tour guides from ships, charter vessels and yachts.

Charges for ships include fees for harbour entry and exit; harbour clearance; customs clearance; and daily harbour dues determined by the vessel's tonnage and number of passengers.

These charges apply to all visiting ships apart from UK military vessels, BAS and other scientific ships, fishing vessels collecting licences or dropping off log books, vessels carrying out Government work, and vessels coming in for medical assistance or *force majeure*.

Yachts are currently charged a flat rate fee to cover harbour fees, entry, clearance and customs.

Additional charges which may apply to vessels include purchase of water; use of buoys per 30 day period or part thereof at Grytviken and at Stromness; transhipment fees to be paid by reefer ships for each vessel from which they receive fish or fish products.

Fishing licences issued by the Government are charged at various rates depending on the target species.

3.2.3 Permits and licences

The legislative basis for permits and licensing at South Georgia is described in Section 1.4 of this Plan.

All prospective visitors to South Georgia and the South Sandwich Islands are required to seek permission from the Commissioner. Applications should be made in writing using the appropriate form available from the Commissioner. Permits are issued in a number of categories: per cruise ship, per yacht, per expedition, per group or per individual. Travel to the island should not be undertaken without having first obtained official approval.

Prospective visitors wishing to visit in order to undertake research or other academic work are required to complete a separate form, which is also available on request from the Commissioner.

Approval to visit is given on the basis that the visitors will abide by the relevant legislation in force at South Georgia and the South Sandwich Islands, and any other instructions given by the Commissioner on the visitor permit.

All fishing vessels wishing to fish within the Maritime Zone must obtain a licence in advance from the Director of Fisheries for SGSSI, based at Stanley in the Falkland Islands. Applications for licences should in the first instance be made to the Licensing Officer at Stanley.

Transhipment of fish and other target species within the Maritime Zone is prohibited without the authority of a licence which may be obtained from the Marine Officer at King Edward Point.

3.2.4 Post Office

The Post Office is situated at King Edward Point and is open upon request to sell stamps, postcards, first day covers and other philatelic items. The South Georgia Museum at Grytviken also sells these items. The Postmaster may also sell these items on board cruise ships visiting Cumberland Bay East. Mail can be posted from the island if South Georgia stamps of appropriate value are used, but it may take up to two months or more for items to reach their destination, via the Falkland Islands.

3.2.5 Search and rescue

There are no hospital facilities or search and rescue services on South Georgia. The research stations at Bird Island and King Edward Point will not be able to provide any medical or search and rescue facilities. Government advises strongly that all visitors should be self sufficient with their own medical backup and/or rescue vessel. The Government requires applications for visitor permits to include evidence of the applicant’s insurance cover for the proposed trip: adequate insurance cover is a pre-requisite of granting a permit. Risks are reduced by sound planning, well rehearsed

procedures, good quality equipment and experienced personnel. The Government may require additional information on a case by case basis about personnel and safety procedures on applications for visitor permits.

3.2.6 Maps and charts

Topographic maps of South Georgia are based on the1:200,000 map first produced in 1958. Hydrographic charts comprise 'Harbours and anchorages of South Georgia' and 'Approaches to South Georgia', produced by the Admiralty Hydrographic Office which is currently undertaking a metrication programme for South Georgia's charts, and reviewing the charts to assess whether to improve the coverage of anchorages for tourist vessels. HM survey vessels continue to improve the detailed hydrography around the island. The Admiralty Pilot for Antarctica provides current details for mariners.

The latest place-name gazetteer for South Georgia was published by HMSO in 1977; South Georgia place names approved since 1997 by the Antarctic Place-names Committee (APC) are featured in maps produced in the APC map series.

The Government has available a Geographical Information System for the island, which provides a geographical overview of much of the available environmental and biological data. Recognising that the existing topographic maps of South Georgia are based on surveys made in the 1950s, the Government is aiming to produce an updated topographic map for South Georgia, to improve its usefulness as a management tool.

The Government would welcome your views on the arrangements for the administration of the island

3.3 Fisheries management

3.3.1 Development of conservation measures

Distant water fishing fleets, mainly from eastern block countries and the far-east, began large-scale fishing around South Georgia in the late 1960s, attracted by the rich stocks of fish. By the early 1970s stocks of one target species, marbled rockcod, had completely collapsed as a result of heavy fishing pressure; today this species is still in low abundance. In the 1970s catches were dominated by icefish, whilst in the 1980s icefish and krill were the main target species. During the 1990s the main target species have been Patagonian toothfish and krill; there has been little interest in icefish. In the last few years there have been experimental fisheries for crab and squid.

Scientific concerns that overfishing of krill would adversely effect dependent species led to negotiation, by Antarctic Treaty Parties, of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) to which the UK is a signatory. The Convention came into force in 1982. CCAMLR regulates fisheries activities in Antarctic waters including waters around South Georgia and the South Sandwich Islands, by means of conservation measures agreed by all Member States, including:

- prohibitions on fishing certain species;
- prohibitions on the use of certain types of gear (such as banning commercial bottom trawling);
- regulations on catch levels (Total Allowable Catches (TACs)) and fishing seasons (eg. for krill, crab, and fin fish); and
- measures to protect by-catch species.

CCAMLR's framework also includes requirements for Contracting Parties to report on catch and effort to the CCAMLR Commission; inspection and observation activities; and from 1 March 1999, compulsory use of vessel monitoring systems on licensed vessels to improve surveillance of fishing activities.

The CCAMLR Commission reviews most of these measures on an annual basis.

One of the key conservation measures is the setting of TACs for each of the target species found in the Southern Ocean; the TACs are set annually by the CCAMLR Commission for each of the CCAMLR designated blocks of ocean. The relevant block for South Georgia is Subarea 48.3, a large proportion of which is the Maritime Zone of South Georgia and the South Sandwich Islands. TACs for the main target species in Subarea 48.3 for 1998/99 are given in Annex 4. TACs are cautious for several reasons: there is incomplete knowledge of Southern Ocean ecosystem dynamics; in order to conserve fish stocks in the region; and to minimise impacts on dependent species, such as seabirds, seals and whales.

The Government implements TACs for the target species by determining the number of vessel months, on the basis of historic catch rates and taking into account different fishing methods and efficiencies, required to achieve the TAC. The numbers of fishing licences issued by the Government under the current licensing regime (see Section 3.3.3) are commensurate with the TAC-limited vessel months.

The conservation and management aims of the Fisheries (Conservation and Management) Ordinance, enacted by the Government in 1993, give effect to the requirements of CCAMLR, amongst other things.

3.3.2 Objectives for fisheries management

The Government's objectives for fisheries management, as given in Section 3.1 of this Plan, are:

To manage fishery activities in the Maritime Zone in a sustainable manner so that they do not cause deleterious impacts on the marine environment and its biota; and to ensure that obligations to, and the provisions of CCAMLR are met.

3.3.3 Licensing

The Fisheries (Transhipment and Export) Regulations (1990) provide for the issue of licences for the transhipment of fish or transportation of fish from internal waters and the territorial sea of South Georgia and the South Sandwich Islands. The recognised harbour for such activities is Cumberland Bay East.

The 1993 Fisheries Ordinance provides the framework for licensing and enforcement of fishing, and the penalties for illegal fishing and non-compliance with conservation measures in the SGSSI Maritime Zone, part of which falls within CCAMLR Subarea 48.3. Vessels can only fish within the Maritime Zone with the authority of a licence issued by the Government. The Ordinance provides scope for the licence fee to be expressed or varied, as required, in relation to certain factors such as the size of the vessel, on-board processing facilities, specific fishing areas and periods. Under the conditions of the licence, vessels are required to submit reports to the Marine Officer at King Edward Point, about their daily operations in the Maritime Zone, including catch and effort data; these reports are submitted to CCAMLR for monitoring purposes. Licence fees need to cover the costs of monitoring and research control and surveillance, administration and analysis of data from the fishery.

The Government is currently reviewing fishery licensing policy and depending on the outcome of the review will amend the 1993 Ordinance as necessary. Any amendments to licensing policy will continue to conform with CCAMLR requirements.

3.3.4 Surveillance and enforcement

Regular surveillance of the South Georgia Maritime Zone is undertaken by fisheries protection vessels which the Government sub-charters from the Falkland Islands Government. These voyages aim to deter illegal fishing activities and to take any necessary legal action, under the 1993 Ordinance, if vessels are caught. They also seek to reinforce conservation measures. Military flights also undertake fisheries surveillance for the Government.

The 1993 Ordinance provides for the levying of unlimited fines to fishing operators if vessels are caught fishing without the appropriate licence, and for seizure of vessel, catch and fishing gear if the fishing operator is found to have committed an offence under the Ordinance. Fines of up to but not exceeding £100,000 may be levied for other contraventions under the Ordinance, such as failing to notify the Marine Officer about vessel movements.

3.3.5 Research and science support

The Government commissions research and scientific support to underpin the management of the fisheries, including advice on implementation of the licensing regime, proposals on catch limits for negotiation at CCAMLR, strategic research on key target species, stock modelling, regular surveys of fish stocks, identifying new fisheries, evaluating impact on the ecosystem, and organisation and storage of commercial and research survey data on the fisheries. The British Antarctic Survey and Marine Resources Assessment Group are currently the main sources of research and science support.

3.3.6 Administration

The Falkland Islands Fisheries Department (FIFD) undertakes the day-to-day administration of fisheries management on behalf of the Government, in particular processing licence applications, securing payment of fees and liaison with fishing operators. The Marine Officer/Harbour Master stationed in South Georgia is responsible for local administration of the requirements of the Fisheries Ordinance (amongst other things).

The Government would welcome your views on fisheries management policy

3.4 Conservation

3.4.1 Conservation value

South Georgia is of global conservation significance because of its importance as a breeding site for large and diverse populations of seabirds and seals, its simple terrestrial and freshwater communities, its remarkable landscape and its historical remains from the whaling era. The island is also of growing importance as a key tourist destination for the rapidly expanding Antarctic tourism industry.

The island has a long history of statutory conservation policy starting in1908 with legislation to protect fur seals, following significant population decline during the 1800s as a result of exploitation. The Falkland Islands administration also enacted legislation for the sustainable management of the elephant seals and whales at the island. The legislation was successful in sustaining the population of elephant seals, and in controlling shore based whaling. The growth of pelagic whaling, inadequately controlled despite the efforts of the International Whaling Commission, resulted in overexploitation; reduced numbers of whales and competition from petrochemical products led to the demise of the industry. As discussed in Section 3.3, commercial

fishing started in the Southern Ocean in the late 1960s; since 1982 this activity has been managed within the conservation framework provided by CCAMLR.

There is a continuing need for a conservation policy at South Georgia as long as humans are present at the island, and living resources are exploited. Potential impacts from human activities at South Georgia could include unsustainable exploitation, habitat and species disturbance, loss and destruction, introduction of alien species and pollution. During the sealing and whaling industries such impacts were observed. Since cessation of the whaling industry in the mid 1960s there has been a reduced impact on the island's terrestrial ecosystems, but an increasing impact on marine systems due to fisheries development. A modern conservation framework is therefore required to ensure the sustainable management of the island and its resources, including natural resources, wildlife, biodiversity, amenity value, human history and archaeology.

3.4.2 Current conservation policy - protected areas

Designation of protected areas and regulations to protect fauna and flora are the two main measures currently in place at South Georgia to achieve both the conservation objectives and the protection of scientifically important sites on land. Entry to protected areas requires a permit issued by the Government. These measures have their statutory basis in the Falkland Islands Dependencies Conservation Ordinance 1975, which applies to South Georgia.

The 1975 Ordinance provided for the designation of Cooper Island as a Specially Protected Area (SPA) with the aim of preserving representative or unique ecological systems or habitats; Annenkov Island and Bird Island have been designated as Sites of Special Scientific Interest (SSSIs) in order to prevent interference with scientific investigations. Two Areas of Special Tourist Interest (ASTIs) have been designated under the Ordinance; the first is the coastal area between Cape Buller and Cape Wilson, including all offshore islands in the Bay of Isles; and the second is the area bounded by Moraine Fjord, Hamberg Glacier, Mount Sugartop, Thatcher Peninsula and Lyell Glacier, including Grytviken and King Edward Point.

Although under the present policy all other parts of South Georgia are in effect closed to human access and use, the Government has demonstrated flexibility in implementing this policy. In particular, the Government has issued permits to tour operators for visits to sites both outside, and inside the designated ASTIs. Whilst the present policy has worked well in the past, the Government recognises some shortcomings. In particular the legislation provides no basis for monitoring and management of the areas visited. In addition, new scientific information on the island's flora and fauna suggests that the present two protected area designations (SPA and SSSIs) and the existing areas protected by these may no longer be adequate to meet the Government's proposed management objectives as described in Section 3.1.

Moreover, South Georgia is expected to benefit from the predicted increase in visitors to Antarctica. As visitor numbers grow, and their activities ashore diversify, there are increased concerns about potential damage from tourism on the island's wildlife, and about whether there are adequate measures in place to reduce the risk of cumulative and significant impacts.

3.4.3 Proposals on future management policy for terrestrial and marine areas

Conservation policy at South Georgia seeks to protect indigenous wildlife and ecosystems, and the natural environment as described in the management objectives in Section 3.1.

The Government proposes to bring its area management policies in line with modern conservation objectives and in so doing seeks to provide a sound and transparent basis for management. In reviewing the policy the Government considered several options, including approaches adopted at other sub-Antarctic islands, Antarctica and other remote Southern Ocean islands. The Government recognises that future reviews of area management policy will need to consider new approaches to identifying candidates for protected area status (such as Important Bird Areas), and new approaches to conservation management, especially those developed in international fora.

The proposal favoured by the Government is for South Georgia, including off-shore islands, stacks and territorial waters, to be categorised into three different areas, as follows.

Protected areas (terrestrial)

This category would replace the present SSSI and SPA categories. The Government proposes eight candidate protected areas (terrestrial) which are described in Annex 5. In identifying protected areas the Government aims to preserve representative or unique ecological systems or habitats, and to prevent interference with scientific investigations and sites designated for monitoring, such as land-based sites in CCAMLR's Ecosystem Monitoring Programme (CEMP).

The methodology for identifying protected areas is based on habitat and species criteria and is discussed in Section 3.4.5 and summarised in Annex 7. These terrestrial protected areas are similar in description to 'strict nature reserves' under the IUCN Protected Area Management Categories (IUCN (1994)).

Entry into protected areas would be prohibited except under permit issued at the Government's discretion for scientific and management activities. Permit conditions would describe activities which are prohibited, restricted or managed. In the longer term, the Government would develop management plans, particularly for those protected areas where there are long-term scientific and associated logistic activities or monitoring programmes. The plans would set out, amongst other things, the objectives

to be achieved by protection, and measures necessary to ensure preservation of the area's unique or representative ecological systems or habitats. The plans may need to include special conditions to protect sites designated for regional and/or global environmental monitoring, such as CEMP sites.

Protected areas (marine)

At present there are no proposed areas for designation under this category. However, the Government recognises that such areas might be needed in the future as part of a comprehensive area management framework and that further scientific research will be needed before such areas can be identified. The aim would be to designate areas, as necessary, inside South Georgia's territorial waters, to protect the habitat of important species of marine life, including for the benefit of land-breeding species dependent on marine prey. Specific measures may be required in these areas to protect particular species and/or promote recovery and maintenance of ecosystems.

It is likely to be impracticable at present to enforce prohibitions on entry into marine protected areas. However, in issuing permits for visitors to the island, the Government would set out specific conditions in the permit describing activities which are prohibited, restricted or managed to ensure that the area fulfils the purpose for which it was designated; for example, specifying permissible anchorages for vessels and controls on small craft activity (such as zodiacs).

Open areas

Open areas would cover most of the island; in effect most of South Georgia will be open to visitors. Nevertheless, prospective visitors will be required to apply to the Government for a permit identifying, amongst other things, which sites they plan to visit. The Government recognises that this proposed policy might lead to high visitor pressure at certain sites, with the risk of deleterious impacts on the environment. It would therefore implement appropriate monitoring at the most frequently visited sites which would be identified from analysis of visitor permits and post-visit reports. If the monitoring produces evidence of significant impacts the Government would implement appropriate mitigating measures which may include restrictions on visitor numbers to the site; and closure of the site on a temporary or, if necessary, a permanent basis;

Additional level of protection in open areas. The Government recognises that an additional level of protection may be required in open areas, particularly where human activities and conservation objectives are known to be in conflict with one another requiring specific measures to minimise potential impacts. It therefore proposes to identify such areas as environmentally sensitive areas. There are two environmentally sensitive open area candidates at present (see map and descriptions at Annex 5). The methodology for their identification is discussed in Section 3.4.5 and summarised in Annex 8. However, the Government recognises that there might be a need for additional areas in the future if other areas where potential conflict might arise.

Entry into environmentally sensitive open areas would be allowed under permit describing activities which are prohibited, restricted or managed with the aim of minimising conflicts and potential impacts. In the longer term, the Government would develop management plans for environmentally sensitive open areas. The plans would set out, amongst other things, measures to minimise conflicts and potential impacts.

3.4.4 Rat-free islands/groups

There are 22 rat-free islands/groups (see preliminary list at Annex 6), some of which are already included in the candidate protected areas. Permits to undertake research and/or visit any of these 22 islands/groups would only be issued by the Government for compelling purposes which could not be served elsewhere. Any permits issued would specify detailed measures to minimise risks of introducing any alien biota, with stringent precautions relating to rats.

3.4.5 Proposed methodology for identifying protected areas

The Government's proposed methodology for identifying protected areas on land is described at Annex 7. The methodology is based on selection principles developed by the UK's Joint Nature Conservation Committee to identify and recommend to the UK Government, a list of high quality conservation sites for designation as Special Areas of Conservation under the European Community Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

In essence the methodology seeks first to identify areas with high biodiversity, in terms of high abundance and large numbers of plant and animal species. The methodology also aims to identify areas where the island's main plant communities are represented, and which contain bird species which are: endemic; rare; of restricted range; globally threatened or near-threatened; and/or for which South Georgia is one of the main global sites.

As far as possible the candidate protected areas on land have been delimited by using appropriate criteria in order to enhance their integrity and security. This means that boundaries have been defined by natural features and the size and extent of areas is sufficient to satisfy ecological (such as seasonal or year-round habitat requirements) and management needs.

Environmentally sensitive open areas. The proposed methodology for identifying environmentally sensitive open areas aims to identify areas of conservation interest, in terms of particular features, such as endangered species, and where there is evidence of, or potential risk of disturbance from human activities, such as high visitor pressure. Annex 8 shows the proposed methodology in more detail.

3.4.6 Monitoring impacts.

A key feature of the proposed management policy is to implement appropriate monitoring programmes to assess whether there are significant impacts on the environment. In the short term the Government is aiming to focus on visitor sites in open areas. Monitoring will be at two levels. First, there would be a new requirement for cruise ships to carry Government-appointed observers who would be responsible for, amongst other things, monitoring visitor behaviour and impacts ashore, and reporting back to the Government. Second, the Government would implement appropriate environmental monitoring programmes at the most frequently visited sites.

If the monitoring programmes produce evidence of significant impacts the Government would implement appropriate mitigating measures.

Monitoring described in this section is in addition to the monitoring and reporting of the South Georgia fisheries which is undertaken for the Government and/or for CCAMLR (see Section 3.3)

The Government would welcome your views on the proposed area management policy; in particular on the candidate protected areas, environmentally sensitive open areas, the proposed methodologies and the proposed monitoring programmes.

3.4.7 Current conservation policy - controls to protect fauna and flora

The 1975 Conservation Ordinance provides for the protection of native mammals, birds and plants. In principle this means that native mammals and birds are not allowed to be disturbed, killed, captured or exported, and native plants are not allowed to be collected or destroyed. However, the Ordinance also provides for the Commissioner to have discretion to issue permits for the collection, killing or export of mammals, birds and plants for the purposes of research and as specimens for zoos, and wildlife parks. There is also provision for animals and plants to be removed in order to regulate the management and use of living resources. The Ordinance emphasises that permits will be limited in number to ensure that the variety of species and the ecosystems from which the specimens are taken, are maintained. In practice the Ordinance has been largely effective in protecting native animals and plants from direct human impacts on land.

Under the Wild Mammals and Birds (Export) Regulations 1975, export fees are payable to the Government for animal export. For example, fees for elephant seals are £150 each, and for King Penguins are £50 each.

Conservation measures related to fisheries management are provided for in the 1993 Fisheries Ordinance, which, amongst other things implements conservation measures agreed by the UK under the international Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), as discussed in Section 3.3. These measures include prevention of deleterious impacts on seabirds from fisheries harvesting. Because CCAMLR sets the framework, this consultation paper does not offer any policy proposals on conservation management related to fisheries at South Georgia.

3.4.8 Proposals on collection and export of animals and plants

The Government proposes to continue with the general policy, as given in the 1975 Ordinance, on the prohibition of disturbance, killing, capture or export of native mammals and bird, and of collection or destruction of native plants, except under permit. This would be extended to prohibit removal or destruction by divers of animals and plants in the subtidal environment. Appropriate regulations would be included in the new conservation legislation and would also be highlighted in the visitor code of conduct.

However, the Government proposes to amend the current policy in the 1975 Ordinance which allows licensed collection and export of animals and plants, in the light of recent international discussions and developments, and advice from leading scientists (eg. in reports of workshops on penguins in 1992 and 1996 held by the World Conservation Union (IUCN) Conservation Breeding Specialist Group (Ellis *et al.* 1998)). In particular, the Government proposes to prohibit the export of animals, except under permit which the Government would have discretion to issue only if the following circumstances apply:

a) the species (or possibly subspecies if appropriate/relevant) has been evaluated as Globally Threatened (possibly including 'near-threatened', depending upon species and circumstance), according to the most recent IUCN Criteria, by a group with the appropriate expertise for undertaking such an evaluation (eg. IUCN Specialist Group, Birdlife International);

b) a captive breeding programme has been recommended as an appropriate mechanism for improving the conservation status of the species concerned. This recommendation should have been approved by the IUCN Conservation Breeding Specialist Group, ideally at a Conservation and Management Plan meeting/workshop of the species-group concerned; and

c) an appropriate captive-breeding programme has been developed by one or more institutions appropriately experienced in such work for the species/ species-group concerned.

The Government also proposes to prohibit the export of plants and invertebrates, except by permit which the Government would consider issuing for compelling scientific purposes which cannot be served by other means.

3.4.9 Proposal on export fees and conditions

The Government proposes revoking the Wild Mammals and Birds (Export) Regulations 1975, which set export fees. However, if an export licence is issued under the prescribed circumstances, the licence conditions would include specific provisions for animal welfare during capture and transport of the animals.

3.4.10 Proposals on threatened species

Recent IUCN investigations have identified wandering and grey-headed albatrosses as globally threatened species. There is therefore an international obligation on the Government to implement conservation measures at South Georgia to halt the decline in these species at the island. As IUCN continues this work, other species may be identified as globally and regionally 'threatened' or 'near threatened'. Other species at South Georgia known to be at risk from population decline include macaroni penguins (globally near-threatened), black-browed albatross (near-threatened) and possibly some burrowing petrels and the endemic South Georgia pipit as a result of predation from rats. In revising the conservation legislation the Government would highlight the threatened species at South Georgia, and provide, as necessary, a framework for their management and recovery. Any species management plans would be linked to appropriate legislation for such species in adjoining areas and would be well publicised.

3.4.11 Indigenous species.

There has been rapid recovery of fur seals at the island since the 1970s leading to damage to breeding habitats of some other species, and current evidence suggests that South Georgia could support a fur seal population significantly higher than the current population size.

The Government recognises that the characteristics of the island and the dynamics of ecological processes will probably act as natural controls on such expanding population. However, it will be important to continue monitoring expanding populations and their impacts and to review the need for additional controls as required.

The Government would welcome your views on the proposed controls to protect fauna and flora; in particular on the collection and export of animals and plants, on threatened species and on indigenous species.

3.4.12 Control of introduced animals and plants

South Georgia currently supports a considerable range of introduced species, in particular reindeer, rats, mice, plants and invertebrates. On the one hand, introduced species usually have undesirable effects on native flora and/or fauna and there are worldwide initiatives to eradicate such species. On the other hand, there is scientific interest in genetic variation and mutation rates of introduced species which are successful in their new environment, particularly the reasons for their success and how they have become established. Many of the introduced species, particularly plants, at South Georgia are at the limits of their distribution, and have a limited ability to spread further than the area where they were introduced. The Government's present policy has focussed on assessing the distribution and abundance of introduced species at the island and their impact on local ecosystems. The Government has taken no action to eradicate or reduce the established introductions.

The Government has reviewed policy on introduced reindeer, rats, mice, plants and invertebrates, with the aim of being consistent with the proposed management objective to eradicate of non-indigenous flora and fauna, as far as is practicable. The Government's proposed priorities for action are discussed in the rest of this section.

Reindeer were first introduced to the island in the early 1900s by Norwegian whalers. There are believed to be around 2000 reindeer making up two herds which occur in two areas at the island (Barff/Royal Bay and Busen herds). These areas include almost all the areas of the island with the highest plant biodiversity. The main impact from reindeer is over-grazing of the native vegetation leading to soil erosion at some sites, major changes in community structure at others, and more widespread distribution of introduced grass species. Even though this has not led to extinction of any native plant species in grazed areas, there are concerns that retreating glaciers might open up new areas to the reindeer, leading to further degradation and loss of native plant communities.

In view of the damage to vegetation and the risks of further spread, the Government considers management of the reindeer to be the first priority for action. There are various options for the future management of the reindeer, including status quo, eradication, partial eradication, population reduction in all three herds, population reduction in one or two herds, controlled hunting and export. Of these possible options the Government at present favours eradication of all or a major part of the reindeer populations which would allow recovery of the native plant communities.

Before proceeding with this proposed policy, the Government would consider the scientific value of the herds, assess what further scientific data would be useful, and investigate options for minimising management costs. The Government may also consider the option of exporting some animals to maintain and/or exploit their genetic value.

Brown rats were introduced accidentally during the late 1700s and 1800s when humans started to visit the island. They are widespread and abundant throughout much of the island, although they are mainly absent from off-shore islands. They have no naturally-occurring predators, with the possible exception of brown skuas. The main effect of rats is predation of ground-nesting and burrowing birds and this is having a severe impact on populations of the endemic South Georgia pipit, pintail and burrowing petrel species. Rats also cause some damage to vegetation.

Due to their abundance and widespread distribution at the island, rats would be the next priority, after reindeer, for eradication; this would pose a considerable challenge. However, there have been successes in eradicating rats from islands up to 2000 ha, and more than 80 islands have been cleared around the world. New Zealand is currently developing plans to eradicate rats from Campbell Island which is 11,000 ha. The Government proposes therefore to investigate the feasibility of eradicating the rat population, at least at some discrete areas bounded by glaciers and other natural features or at any islands where they are found.

Feasibility studies would consist of investigating existing operational prescriptions (for example, eradication methods used at New Zealand islands); selecting trial sites at South Georgia; preparing costings for eradication; and seeking sponsors for collaborative funding of the programme. If eradication in certain areas is judged to be feasible, the Government would consider initiating a pilot programme in a limited number of areas, including monitoring to assess effectiveness.

House mice were accidentally introduced to the island by sealers. They have been recorded in the north-west of South Georgia at Shallop Cove in Queen Maud Bay. This is a localised population cut off from the main part of the island by branches of the Esmark Glacier. The mice live in tussac grass which provides shelter, nesting opportunities and food. The population is small and, on limited observations, appears to have no significant impact on the local ecosystem. The Government considers the mice population to be of low priority for eradication, and therefore proposes taking no action at present; however occasional monitoring of abundance and distribution would be undertaken to allow regular review of the policy.

Introduced plants are found at the island close to abandoned whaling stations, and several species have become more widespread as a result of reindeer grazing and dispersal; for example in a few places ‘lawns’ of annual meadow grass have replaced the native herbfield. However, there have been no extinctions of any native plant species as a result of the introductions. The Government considers that these introduced plants to be of low priority for eradication, and proposes taking no action at present; however occasional monitoring of abundance and distribution would be undertaken to allow regular review of the policy.

Introduced invertebrates have been recorded at the island close to, or at abandoned whaling stations. The island’s native arthropods are potentially at risk of displacement and/or predation as a result. However, there have been no extinctions of any native

species as a result of the introductions. The Government considers that introduced invertebrates to be of low priority for eradication, and proposes taking no action at present; however occasional monitoring of abundance and distribution would be undertaken to allow regular review of the policy.

The Government would welcome your views on the proposed controls on introduced species; in particular the proposals on controlling or eradicating the reindeer and on investigating the feasibility of eradicating the rats.

3.4.13 Preventing further introductions of alien biota and diseases

Accidental introductions of rodents to South Georgia from visiting vessels, and the introduction of rodents to the rodent-free islands offshore, are the main concerns about alien biota. It is critical that all vessels visiting South Georgia, whether tied up at jetties or at anchor in bays, adhere to established de-ratting protocols in order to minimise the risk of rodent introductions, particularly to sites which are currently rat-free. It is also essential that shipping containers used to move stores and/or equipment ashore must be de-ratted before putting ashore. The Government proposes reinforcing these messages in visitor guidelines and entry permit requirements and making additional efforts to secure the cooperation of private yachts and sea kayaking expeditions. The Government also intends to seek the cooperation of the UK Hydrographic Office to circulate advisory information with relevant Admiralty Charts.

The Government is also concerned about potential problems from introduced insects and other invertebrates in the light of problems from an introduced moth at Marion Island (part of the Prince Edward Islands) which has damaged native vegetation. The Government therefore proposes taking additional steps to minimise the introduction of invertebrates as well as alien plants and diseases, such as asking visitors to ensure their clothing, footwear, camping and other leisure equipment is free from seeds and insects. Again, these messages would be reinforced in visitor guidelines, entry permit requirements, with particular effort directed at private yachts.

There is also a risk of introducing alien species into South Georgia's Maritime Zone from vessels which take on ballast water, and any accompanying marine organisms, outside the Zone and discharge it inside the Zone. The Government intends to advise fishing and other vessels that ballast pumping should take place before entering the Zone; this advice would be reinforced as a condition of fishing licences and other entry permits.

The Government has also considered the need for quarantine arrangements for those animals and plants imported under licence. The Government proposes that any relevant quarantine arrangements are given as a condition of the import licences.

The Government would welcome your views on the proposed policies for preventing further introductions of alien biota and diseases; in particular ideas on how to communicate policy effectively to private yachts.

3.4.14 Controls on use of vehicles

Inappropriate use of vehicles at the island can lead to disturbance of wildlife and damage to plant communities; for example there is anecdotal evidence of helicopter overflights of penguin breeding colonies leading to birds abandoning their nests. The Government proposes:

- to continue to permit vehicle use inside the designated perimeter of research stations and at King Edward Point; vehicle use would be prohibited elsewhere at the island, except at the discretion of the Government when a permit would be issued;

- to prohibit helicopter use at the island, except under permits at the discretion of the Government which would take into account designated no-fly areas;

- to specify rules for tourist zodiac/small boat cruising (including divers), such as: whales and seals at sea may not be deliberately approached closer than 50m by small boats or divers.

The Government would welcome your views on the proposed policies on the use of vehicles, and in particular your proposals on no-fly areas at the island.

3.4.15 Historic sites and artefacts

Historic sites and artefacts at South Georgia comprise whaling stations, sealers' camps, shipwrecks, and items from the 'heroic' era of exploration.

The whaling stations have been closed for many years. Buildings and other structures at the stations have deteriorated and are in poor condition. Consequently, the Government proposes prohibiting access to all visitors to the stations at Leith, Stromness, Husvik and Prince Olav Harbour. Special arrangements will apply to Grytviken.

Guidelines on visitor behaviour at the island's other historic sites would be provided in the visitors code. In essence, visitors should not disturb or remove any artefacts at these sites, except if the items are in danger of damage or loss from natural causes, such as flooding or high tides, when they should be moved nearby out of danger. If

visitors move any items for these reasons, they should report their actions to the curators at the South Georgia Museum.

The Government proposes demolishing all buildings at King Edward Point, apart from those with a designated purpose. This would take place as part of the programme to build new research facilities this site for scientists from British Antarctic Survey to use from 2001.

A list of historic sites on South Georgia is given at Annex 2, included relevant guidelines for incorporation in the visitors code.

The Government would welcome your views on the proposed policies on historic sites and artefacts

3.5 Research

3.5.1 Scientific

South Georgia has a long history of scientific research as described in Section 1.2 and offers remarkable opportunities for a wide variety of research in sub-Antarctic terrestrial and marine ecosystems. Since 1967 there has been a continuous scientific research programme on the island conducted by, or in collaboration with the British Antarctic Survey, using its stations at King Edward Point (until 1982) and Bird Island for year round work, and Husvik and other sites for summer field camps. As a result there are significant improvements in understanding the geology, glaciology, meteorology and biology of the island and its surrounding seas.

Research will continue at Bird Island into population biology, ecosystem dynamics and behaviour of seabirds and seals, and the pelagic ecosystems around the island as part of British Antarctic Survey's core marine science programme.

The Government is also considering developing a research programme to provide information and data to support the sustainable management of the fisheries, and other management and monitoring activities as required.

All research undertaken on the island and inside the Maritime Zone by the British Antarctic Survey and other external organisations would require a permit issued by the Government. Proponents would be required to submit their research proposals to the Government, and might be required to undertake an environmental impact assessment as part of their application for a permit.

3.5.2 Historic

South Georgia offers opportunities for research into the history of human occupation including sealing, whaling, exploration and scientific activities. Recent historical research has focussed on industrial archaeology of the whaling stations; for example Basberg (1996).

All research into historical aspects would require a permit issued by the Government. Proponents would be required to submit their research proposals to the Government, and might be required to undertake an environmental impact assessment as part of their application for a permit.

The Government would welcome your views on the proposed policies on research

3.6 Visitor management

3.6.1 Background

Visitors to South Georgia include tourists, scientists, military personnel, administrators, contractors, journalists, film crews and fishermen. In developing visitor management policy at the island, the Government is seeking to ensure that visitor activities are compatible with the proposed conservation objectives (Section 3.1).

The main focus of the Government's proposed policies is towards tourism management because over recent years around 1600 tourists have visited South Georgia each year, and numbers are expected to increase. Visitors are relatively few in number compared with further south; for example Port Lockroy on the Antarctic Peninsula receives about 4,500 visitors each year. At present tourists are mainly ship-based, but occasionally small groups stay overnight. As numbers grow, and their activities ashore diversify, there are increased concerns about potential adverse impacts from tourism on the island's ecosystems, and about whether there are adequate measures in place to reduce the risk of impacts.

Polar tourism is expected to show strong growth, at least in the short term. In 1997, the International Association of Antarctic Tour Operators (IAATO) predicted that over the next five years, tourists visiting Antarctica will continue to increase from current levels of around 8,000 to 14,000 in 2001. South Georgia is very likely to attract more tourists as a result.

Other tourism trends in the Southern Ocean include larger cruise ships with more passengers; more visits by privately owned yachts; and a possible increase in demand for active adventure tours (for example skiing, walking, kayaking, sub-aqua diving).

Potential impacts from visitors include:

- direct disturbance and damage, such as trampling of vegetation and burrowing nests, disturbance of breeding sites, and damage to built heritage (such as souvenir removal);

- pollution by local activities or accidents, such as fuel spills, litter, inadequate waste and sewage disposal; and

- introductions of plant and bird diseases, and of non-native fauna and flora.

There is very limited scientific evidence so far of significant deleterious effects caused by visitors to South Georgia, apart from damage to built heritage and introductions of alien fauna and flora.

3.6.2 Existing visitor management policy

Existing visitor management measures at South Georgia include:

- designation of two tourist sites (Areas of Special Tourist Interest) under the 1975 Conservation Ordinance;

- permitting arrangements, whereby all visitors are required to apply in advance to the Government for a visitor's permit; tourist applicants are required, amongst other things, to list the sites they are expecting to visit;

- post-visit report submitted by tour companies to the Government, describing the itinerary, passengers numbers, sites where tour members disembarked at the island, activities and time spent ashore, and comments on any observed impacts;

- visitor management ashore, whereby there is a general requirement for tour operators and visitors to abide by provisions in the Government's booklet 'Information for Visitors to South Georgia' and in the code of practice in the tourist welcome pack;

- official supervision, whereby the South Georgia Marine Officer briefs each tour ship on arrival at King Edward Point, about the standard of behaviour expected ashore;

- charges and fees for visiting, currently a flat rate fee per head.

The current visitor management policy has worked well in practice and visitor activities have not, so far, led to any observed impacts on wildlife. However, the Government is concerned about the expected increases in visitor numbers and the risk

of cumulative impacts particularly at the most popular sites. Therefore the Government has reviewed the policy with the aim of developing an effective framework which could be made more stringent in future if there is objective evidence of damaging impacts from visitors.

3.6.3 Proposed visitor management policy

The Government's proposals on visitor management are as follows.

Measures to address visitor impacts in open areas. As described in Section 3.4 in this consultation paper on conservation management, the Government proposes that most of South Georgia will be open to visitors. The Government is prepared to implement controls on visitors in these open areas. Control measures may be triggered as necessary on a precautionary basis in particularly sensitive areas, and/or if monitoring produces evidence of deleterious impacts from visitor activities. Controls could include building boardwalks to prevent trampling of vegetation, setting limits on the numbers of visitors to the island and/or to various popular sites; and closure of damaged sites on a temporary or, as necessary, a permanent basis. Baseline data would need to be acquired for the most frequently visited sites to provide the basis for establishing whether any visitor impacts are occurring.

In order to determine whether there are visitor impacts the Government would implement monitoring programmes at two levels. First, there would be a new requirement for the cruise ships to carry Government-appointed observers who would be responsible for, amongst other things, monitoring visitor behaviour and impacts ashore, and reporting back to the Government. Second, the Government would implement appropriate monitoring programmes at the most frequently visited sites.

Permitting arrangements. Visitors would continue to be required to apply in advance to the Government for a visitor's permit, and applicants would be required, amongst other things, to list the sites they wish to visit. The Government is keen to ensure a minimum standard of visitor behaviour on the island and therefore would only issue permits to tour operators if they are members of the International Association of Antarctic Tour Operators (IAATO). When processing applications, the Government might decline to issue a visitor permit:

- if there is any evidence of inappropriate behaviour and activities by the tour operators and/or their passengers on previous visits to the island, as provided in observers' reports; and

- if the applicant has made previous visits to the island, but has not complied with all conditions in the permit, including submission to the Government of a post-visit report.

Visitors applying to enter South Georgia for the purpose of undertaking more active pursuits, for example mountaineering, kayaking, diving or skiing, might be required to provide additional information on their application. In particular, to demonstrate their competence in the requested activity and their preparations for the trip, including insurance cover, safety procedures, medical backup. Permits issued for such activities might contain specific additional conditions to reduce potential significant environmental impacts from the activity, such as measures to minimise damage to, or loss of inshore marine life from diving activities.

Post-visit reports. The Government would continue with the requirement for tour companies to submit post-visit reports, and is considering extending this requirement to chartered and private yachts.

Visitor management. The general requirement would remain for tour operators and visitors to abide by provisions in the Government's booklet 'Information for visitors to South Georgia' and in the code of practice in the tourist welcome pack. These publications would be updated in line with best practice. However, the Government would be prepared to consider additional controls on visitor management, which would be stipulated in the visitor permit, if there is evidence of deleterious effects given in observer reports and from monitoring. For example, additional controls could include limits on the numbers of visitors per site per visit; limits on the frequency of visits over a season; limits on the time of year, or season, or day when visits can take place; limits on the size of parties ashore; on the ratio of tourists to guides/leaders; and on the permitted landing sites for the parties.

Visitors undertaking more active pursuits, for example mountaineering, kayaking, skiing, diving might be subject to additional control measures if deemed by the Government to be necessary to reduce the risk of potential deleterious effects from the activity. For example, limits on the time of year when kayaking expeditions could take place and/or limits on beaches for landing ashore or closure of bays to vessels, in order to avoid seal and penguin breeding activities.

Official supervision. In addition to the present measure of briefings by the South Georgia Marine Officer to cruise ships on arrival at King Edward Point, there would be a new requirement for cruise ships to carry Government-appointed observers paid for by the tour operators. The observers would be responsible for monitoring visitor behaviour and impacts ashore; ensuring that visitors and tour operators abide by the permit conditions; and reporting back to the Government.

Another aspect of official supervision is the current practice of requiring all tourist ships to visit King Edward Point, as the port of entry, before proceeding to visit the island. The Government recognises that this requirement is unpopular with some tour operators because it wastes fuel and misses limited good weather opportunities as the ships pass sites of interest en route to King Edward Point. The Government therefore

proposes dropping the requirement of cruise ships registering at King Edward Point before visiting, but only on condition that the ship:

1) has on board a Government-appointed observer and an expedition leader who has visited South Georgia before;

2) advises the Marine Officer of its planned route when it enters South Georgia waters; and

3) visits King Edward Point at some time during the visit.

Charges and fees. The Government would continue to levy charges to visitors for the purpose of raising funds towards the sustainable management of the island. Fees would be regularly reviewed and the next review is expected to take place in 2000.

The Government would welcome your views on the proposed visitor management policy.

3.7 Education and culture

3.7.1 South Georgia Museum

The Government established the Museum in 1992 as a whaling museum, but in recent years the Museum Trust and the Curators have started to re-develop it as a more visitor-focussed information centre with displays on the island's wildlife and research activities by the British Antarctic Survey and others. It is located in the station manager's villa at Grytviken. The Museum is open as required all year round and there is no entrance fee. Access to the Museum and the other historic sites at Grytviken will be by the nearby Harpon Jetty which is being refurbished at present and is due to reopen in 2000/2001.

3.7.2 Public information and education

Current sources of information include the Government's booklets 'Information about South Georgia' (1998) and 'South Georgia' (1998), and various maps of the islands and its coastal waters. The Antarctic Pilot produced by the British Navy Hydrographic Office also provides information for mariners about South Georgia and its coastal waters. Non-governmental sources of information include Headland (1982) and (1984), and Carr and Carr (1998). In addition British Antarctic Survey, and its predecessor, the Falkland Islands Dependencies Survey, have published many scientific papers and articles about the island. This present document also provides

detailed information on the island and its management and is available to all interested persons and organisations.

The Government intends to make efforts to increase awareness amongst visitors and others, of the need for environmental management of the island. One approach which the Government is considering is the development of an Internet website. Another approach being considered is the production of the visitors code and other information in different languages focussing on nationalities of the most frequent visitors to the island.

3.7.3 Culture and media interests

The Government welcomes proposals from media organisations and from individuals to utilise the unique cultural, landscape and wildlife aspects of the island in order to develop films, paintings, poetry and other cultural products. Media and cultural visitors would be required to comply with the policies in this plan.

The Government would welcome views on the development of Museum facilities for consideration by the Museum Trust and the Curators, and the wider provisions for information and cultural access.

3.8 Environmental management

3.8.1 Environmental Impact Assessment and planning procedures

Environmental Impact Assessment (EIA) and planning procedures are key elements in the Government decision making process concerning human activities, and are therefore essential tools which the Government proposes adding to the package of environmental management measures at South Georgia.

Proposed policy on Environmental Impact Assessment. Proponents of a proposed activity which is expected by Government to have a significant environmental impact will be required to undertake an EIA. The Government may request that the EIA is carried out by an independent organisation, as necessary. The EIA would be submitted to the Government for a decision on whether the activity can proceed, and if so, in its original or in a modified form. The purpose of the assessment would be to evaluate the direct, indirect and cumulative effects which the proposed activity could have on humans, fauna, flora, soil, water, air, atmosphere, landscape, scientific research, cultural heritage and resource management.

Activities expected to have a less than minor or transitory impact would be unlikely to need EIA, although cumulative impacts on particular sites might require special consideration.

Proposed activities for which the Government might require an EIA include construction or extension of buildings and structures; scientific research programmes; tourism developments and expeditions; visits by the media; and demolition of building and facilities.

If the Government requires an EIA, the proponent of the proposed activity would prepare an assessment covering the following four issues:

1) a description or assessment of activity under consideration and of the environment/location in which it is to take place;

2) a description of other options for the activity, including the option of not proceeding;

3) predictions of the impact on the environment/location and the consequences of the impact, based on the best available evidence;

4) any measures which would be taken to minimise or mitigate impacts and for monitoring.

Guidance on the required format and content of the EIA report would be provided by Government on a case by case basis. The guidance would be based on the approach to EIA applied in the Antarctic Treaty System. Proponents would need to give adequate advance notice of proposed activities to the Government to allow for any appropriate level of EIA to be considered.

Proposed policy on planning procedures. Proponents wishing to construct or extend buildings and other structures would be required to discuss their proposals with the Government to determine the Government's general policy on the location and design of the proposed building or structure.

If the Government is willing to consider the proposal in more detail, the proponent would be required to make an application to the Government for a permit to construct/extend the building or structure. The applicant would need to demonstrate how the construction and associated activities will avoid disturbance or harm to fauna and flora and to natural landforms; and how consideration has been given to the aesthetic and visual consequences of the design and placement of permanent structures, and to any impact on cultural heritage.

On receiving the application the Government would have discretion about whether or not to give permission and if so, whether an EIA for the proposed construction or extension would be required.

The Government would welcome your views on the proposed policies on environmental impact assessment and on planning procedures.

3.8.2 Management of hazardous substances

A comprehensive policy on the use of hazardous or toxic materials/products is an essential item in the Government's package of environmental management policies. Inappropriate use of such substances could lead to adverse effects on human health and the environment. The Government's proposed policy framework is consistent with the requirements under the1991 Protocol on Environmental Protection to the Antarctic Treaty. The main focus of the policy is on asbestos, radioactive substances, pesticides, refrigerants, fire fighting products, aerosols, detergents and disinfectants.

Practical aspects of the proposed policy

Prohibited substances at South Georgia. The following substances would be prohibited at South Georgia: polychlorinated biphenyls, non-sterile soil, polystyrene beads, chips or similar forms of packaging, and pesticides (other than those required for scientific, medical or hygiene purposes). In addition, the Government would discourage the use of poly-vinyl chloride (PVC) products in South Georgia.

Asbestos is found in various buildings and storage tanks at the abandoned whaling stations. The 1990/91 clean-up of the whaling stations cleared some of the asbestos into soil pits or storage tanks which were then welded shut. In autumn 1998, the Government commissioned a survey of the abandoned whaling stations which is examining, amongst other things, whether remaining asbestos poses a problem. When the survey results are available in March 1999, the Government will consider how to address any remaining asbestos problems in the context of the future of the abandoned whaling stations. Asbestos is also found in some old buildings at King Edward Point which are scheduled to be removed.

Radioactive substances. The Government would only permit the use of radioactive substances for scientific research purposes. Radioactive wastes would be removed from the island as soon as possible after completion of the research activity. The Government would prohibit long-term storage and disposal of radioactive waste on the island.

Hazardous chemicals. All heavy metals and other potentially hazardous chemicals, including waste laboratory chemicals, would be removed from the island for safe disposal elsewhere.

Other products. Use of refrigerants, fire fighting products, aerosols, detergents and disinfectants would be discouraged to minimise adverse environmental impacts. Used refrigerants would be collected and removed for recycling or disposal outside South Georgia. Refrigerants, fire fighting foams and aerosols used on the island should be ozone "friendly", and biodegradable detergents and disinfectant agents should be used.

Firearms and explosives. The use of firearms and explosives anywhere on the island and within the 200 miles Maritime Zone, will be prohibited, except under permit from the Government for specific activities, such as culling reindeer, darting seals for research purposes and geophysical research. A general exception would be the use of safety and rescue flares in emergencies.

The Government would welcome your views on the proposed policy on the use of hazardous substances.

3.8.3 Prevention of marine pollution

Policy on prevention of marine pollution is an essential item in the package of environmental management policies at South Georgia. Problems which could arise from shipping and shore-based activities include entanglement of wildlife from marine litter, such as plastic packaging bands, and pollution of marine ecosystems from oil spills. Entanglement of seals in marine debris followed by death has been observed at Bird Island. The Government's proposed policy framework is consistent with international marine pollution legislation, in particular the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) and policy on prevention of marine pollution set out in the1991 Protocol on Environmental Protection to the Antarctic Treaty. CCAMLR conservation measures also include regulations to prohibit use of plastic packaging bands on fishing vessels.

Practical aspects of the proposed policy

Discharge of oil and other noxious substances. The policy would prohibit vessels and shore-based facilities from deliberately discharging oil, oily mixtures (except as permitted under Annex 1 of MARPOL 73/78) and other hazardous, radioactive or toxic material, plastics or non-biodegradable refuse inside South Georgia's 200 mile Maritime Zone. In addition vessels would be required to carry a shipboard oil pollution emergency plan.

Disposal of sewage and food waste from vessels. Discharge of untreated sewage and food waste would prohibited from within 12 miles of the shore of South Georgia. Ships would be expected to pass sewage through a treatment plant before discharge; such treatment plants should meet the standards laid down by the International Maritime Organisation. Ships would be expected to pass food waste through a waste disposal unit before discharge. All comminuted food waste would have to be capable of passing through a screen with a mesh size of less than 25 mm.

Vessels and small crafts carrying not more than 10 people would be allowed to discharge untreated sewage within 12 miles of the shore, but should aim to do so in deep water to aid rapid dispersal.

Ship-generated refuse. Vessels would keep on board ship-generated garbage such as plastics, paper products, rags, glass, metal, bottles, crockery, incineration ash, lining and packing materials, for later disposal at port reception facilities outside of South Georgia.

Fishing vessels would be required to be fitted with grills to prevent small pieces of packaging and other plastic material from washing off the factory deck into the sea.

Promulgation and implementation of policy. The Government would include a requirement to comply with the policy as a condition of licences issued to fishing vessels and of permits issued to cruise ships.

The Government would welcome your views on the proposed policy on the prevention of marine pollution.

3.8.4 Waste management

Waste management is an essential item in the package of environmental management policies at South Georgia. The Government's proposed waste management framework is broadly in line with the waste management procedures set out in the 1991 Protocol on Environmental Protection to the Antarctic Treaty. The policy aims to reduce waste produced or disposed of at South Georgia in order to minimise the impact on the environment, and for all waste from human activities, apart from sewage and domestic waste, to be removed from South Georgia. The proposed policy would apply to all activities undertaken at South Georgia including scientific research, tourism, fishing and other governmental and non-governmental activities.

Practical aspects of the proposed policy

Equipment. The Government would initiate a programme of upgrading facilities and procedures as part of the redevelopment of King Edward Point, to ensure widespread implementation of the policy. This would require research stations, the South Georgia Museum, and other buildings in use at the island to have the right tools, equipment and facilities to ensure waste is packaged and stored properly with the aim of preventing their dispersal into the environment. Particular care would be required for the storage of food waste to prevent its accessibility to rats.

Waste management protocols. The Government would require all personnel planning and implementing activities at South Georgia to incorporate protocols on waste storage, removal, disposal and audit, as well as recycling and source reduction. Temporary visitors to the island, including tourists, would also be required to comply with waste management procedures. In particular, wastes generated at field camps should to the maximum extent possible be removed by the generator of such wastes.

In addition, the Government would require the island's management authority to establish a waste disposal classification system as a basis for recording wastes.

Disposal routes . Sewage, food wastes and grey water would be disposed of, after initial maceration, by pumping to sea when and where conditions exist for initial dilution and rapid dispersal. All combustible non-hazardous wastes (eg. paper, wood) and non-combustible non-hazardous wastes (eg. metal) would be stored and packaged in suitable on-board facilities for export to land fill sites outside South Georgia. Hazardous (including medical waste) and radioactive wastes would be removed from South Georgia for disposal. Recycling would be developed for those items for which it is cost-effective to do so.

In addition, the Government would undertake the preparation of an inventory of locations of past activities and the wastes left there, such as landfill and burial sites at abandoned whaling stations, before the information is lost, so that such locations could be taken into account, as necessary, in planning future activities.

Incineration. All open burning of wastes would be prohibited.

The Government would welcome your views on the proposed waste management policy.

3.8.5 Fuel supply, storage and use

A comprehensive policy on fuel supply, storage and use is an essential item in the Government's package of environmental management policies. Inappropriate management of fuel could lead to adverse environmental effects from oil spillage. Problems which could arise include pollution of soils and aquatic systems and

contamination of wildlife. Whilst there is as yet little evidence of significant and long term adverse effects arising from fuels used at the island, there have been some small-scale problems of sediment and soil pollution because of accidental spills and poor maintenance of storage and pumping equipment.

The proposed policy is based on good practice guidelines for fuel management which have been developed and implemented in many parts of the world, including Antarctica.

Practical aspects of the proposed policy

Contingency plans to respond to spills. The Government would require contingency plans to be in place at fuel storage locations to cover the response procedure in the event of a spill including training of staff, emergency communications, and the location, availability and maintenance of response equipment. The Government would also require a full report to be submitted by the management authority on any spills and the clean-up response undertaken.

Vessels would be required to carry shipboard oil pollution emergency plans which will be checked by the Marine Officer as part of the clearing duties into Grytviken.

Preventative measures. The Government would require containment bunds and spill trays to be constructed under diesel storage tanks and taps, and for regular maintenance checks on storage and pumping equipment. In addition, pumps must have automatic cut-offs, must not be left unattended when in use, and all leakages must be reported to the management authority.

Re-supply of fuel. Pumping of fuel ashore from supply vessels would only be permitted in daylight and during good sea and weather conditions to reduce risk of accidental spillage. Refuelling must take precedence over all other ship and shore activities.

Ship to ship transfer of fuel oil between fishing vessels and reefers. Cumberland East Bay is recognised by the Government as suitable (sheltered) for this activity; at present the activity is prohibited at all other locations. Oil spill response equipment would be available at King Edward Point to deal with any spills from this and other activities in Cumberland East Bay.

Choice of fuel oil. The Government would only permit vessels based at the island to use light and non-persistent fuels inside the island's 12 mile limit.

The Government would welcome your comments on the proposed policy on fuel supply, storage and use.

3.9 Mineral exploration and excavation

At present the Government has no plans to develop or exploit any mineral resources at South Georgia.

3.10 Monitoring and revision of Management Plan

The Government intends to review the Management Plan every five years, commencing five years after it is first published. Any revised plan arising from the review would be publicised and available to the public.

Notwithstanding the above, the Government may decide to review the Plan in a period of less than five years, as required by policy developments and/or evidence from the Government's monitoring programme of deleterious impacts on the environment.

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Annex 1

List of legislation for South Georgia and the South Sandwich Islands

South Georgia legislation currently in force

1. Falkland Islands Dependencies Conservation Ordinance (1975) provides for the designation of protected areas on South Georgia and the South Sandwich Islands and for regulations to protect fauna and flora.

2. Wild Mammals and Birds (Export) Regulations (1975) provides for the export, under licence, and the charging of fees for the export of wild animals and birds.

3. South Georgia and South Sandwich Islands Order (1985) abolished the designation of the Falkland Island Dependencies, and replaced it by the designation of South Georgia and the South Sandwich Islands. The geographical effect of the 1985 Order was to define the territory as 'all islands and territories whatsoever situated between the 20th degree of west longitude and the 50th degree of west longitude which are situated between the 50th parallel of south latitude and the 60th parallel of south latitude.' Section 4 of the Order was revoked and replaced by the South Georgia and South Sandwich Islands (Amendment) Order 1995.

4. The South Georgia and South Sandwich Islands (Territorial Sea) Order(1989) extended the boundaries of the Territories of South Georgia and the South Sandwich Islands to include, as territorial sea, the sea situated within 12 nautical miles from the shore, together with the seabed of the territorial sea and its subsoil.

5. The Fisheries (Transhipment and Export) Regulations (1990) prohibit the transhipment of fish or transportation of fish from internal waters and the territorial sea of South Georgia and the South Sandwich Islands without the authority of a licence. They also provide for the grant of licences to tranship or transport fish and for the payment of fees to do so. In 1998 amended Regulations came into force to increase the transhipment fee from £1,000 to £1,100; the amended Regulations are the Fisheries (Transhipment and Export) (Amendment) Regulations 1998.

6. The Visitors Ordinance (1992) makes further and better provision in relation to sums to be paid by persons arriving in South Georgia. In 1998 subsidiary legislation came into force under Section 6(1) of the Ordinance, cited as the Visitor (Landing Fees) Regulations 1998, which increased the passenger landing fee from $50 to £50.

7. The South Georgia Museum Trust Ordinance (1992) established the South Georgia Museum Trust; provides for the transfer of certain lands and objects in South Georgia to the Trust; defines the functions of the Trust; and provides for certain operational activities.

8. The Customs (Fees) Regulations (1992) set fees for ships and yachts requiring the services of a customs officer for any purpose under the customs laws. In 1998 subsidiary legislation came into force, cited as the Custom (Fees) (Amendment) Regulations 1998, which increased the customs fees.

9. Proclamation (Maritime Zone) (1993) established for South Georgia and the South Sandwich Islands a maritime zone of 200 nautical miles around the island, together with the seabed and its subsoil, in order to regulate activity in the zone in accordance with relevant international laws.

10. The Fisheries (Conservation and Management) Ordinance (1993) provides for the regulation, conservation and management of the fishing waters of South Georgia and the South Sandwich Islands, comprising internal waters, the territorial sea and the Maritime Zone which extends to 200 nautical miles from the shore. The Ordinance gives effect to the Government's conservation and management obligations under CCAMLR. It also provides the framework for licensing and enforcement of fishing, and the penalties for illegal fishing in the South Georgia Maritime Zone. It requires that all vessels wanting to fish within the Maritime Zone must have a licence from the Government. It provides scope for the licence fee to be expressed or varied, as required, in relation to certain factors such as the size of the vessel, on-board processing facilities, specific fishing areas and periods.

11. The Harbour Fees Regulations (1994) set harbour dues for South Georgia and the South Sandwich Islands. In 1998 amended Regulations came into force to set revised harbour dues; the amended Regulations are the Harbour (Fees) (Amendment) Regulations 1998.

12. The Pensions (Amendment) Ordinance (1994) adopts as law of South Georgia and the South Sandwich Islands the Pensions (Amendment) Ordinance 1987 of the Falkland Islands.

13. The Antarctic Regulations (1997) were enacted under the UK's Antarctic Act 1994 (Overseas Territories) Order 1995. They prescribe, amongst other things, the procedure by which applications can be made for permits (to visit Antarctica) under the Act, including provisions relating to environmental evaluations, production of permits and their revocation or suspension.

14. The Export of Arms Proclamation (1997) gives effect in South Georgia and the South Sandwich Islands to various international arms embargoes which the UK Government agreed shall be applied to this territory.

15. The Export of Anti-Personnel Landmines Proclamation (1997) gives effect in South Georgia and the South Sandwich Islands to the UK Government's policy of prohibiting the export of anti-personnel landmines to all countries as part of its commitment to work actively towards a total global ban on the use of such mines.

16. Various Appropriation Ordinances have also been enacted by the Government.

Annex 2

South Georgia - list of historic sites, shipwrecks and other historic vessels

Historic sites

	Location	Historic site
1.	Elsehul	trypot and other sealing equipment
2.	Right Whale Bay	trypot and other sealing equipment
3.	Rosita harbour	trypot and other sealing equipment
4.	Prion Islet	trypot and other sealing equipment
5.	Cook Bay	sealers'cave; trypot and other sealing equipment
6.	Prince Olav Harbour	whaling station
7.	Fortuna Bay	sealers' cave
8.	Hercules Bay	ruined hut
9.	Leith Harbour	whaling station
10.	Stromness Harbour	whaling station; trypot and other sealing equipment
11.	Husvik Harbour	whaling station
12.	Carilita Bay	sealers' cave
13.	Maiviken	sealers' cave
14.	Grytviken	whaling station; trypot and other sealing equipment
15.	Discovery Point	sealing remains
16.	Godthul	whaling storage depot
17.	Ocean Harbour	whaling station and sealing remains
18.	Hound Bay	sealing remains and ruined hut
19.	Doris Bay	trypot and sealing remains
20.	Royal Bay(Moltke Harbour)	abandoned research station
21.	Will Point	sealing cave
22.	Diaz Cove	trypot and sealing remains; ruined hut
23.	Shallop Cove	hut
24.	Nilse Hullet	trypot and other sealing equipment
25.	Elephant Cove	trypot and other sealing equipment
26.	Wilson Habour	trypot and other remains

Shipwrecks and other historic vessels

	Location	Wrecks (date lost, if known) and vessels
1.	Bird Sound	*Fantome* (1961)
2.	Right Whale Bay	*Regulator* (1799)
3.	Welcome Islands	*Southern Sky* (1929)
4.	Sitka Bay	Wreck found in 1877
5.	Rosita Harbour	Some wreckage
6.	Bay of Isles	*Lovely Nancy* (1816)
7.	Cape Crew	Wreck found in 1927
8.	Prince Olav Harbour	*Brutus*

9.	Tornquist Bay	*Ernesto Tornquist* (1950)
10.	Leith Harbour	*James Turpie* (1946)
11.	Stromness Bay	*Horatio* (1916) and *Septa* (1936)
12.	Off Stromness Bay	*Southern Wave* (1953); *Southern Shore* (1954); *Stina* (1955); *Busen 6* (1955); *Busen 8* (1956); *Busen* 10 (1959); Southern *Spray* and *Southern Chief* (1961)
13.	Off Cape Saunders	*Stora* and *Southern Star* (1963)
14.	Husvik	*Karrakatta*
15.	Husvik Harbour	*Camana* (1911)
16.	Jason Island	*Southern Foster* (1964)
17.	Cumberland Bay East	*Fortuna* (1916)
18.	King Edward Point	Shallop
19.	Grytviken	*Dias* (1974); *Albatros* (1975); *Sante Fe* and *Fenix* (1982); *Albatros* (BAS) (1983); *Petrel* and *Louise*.
20.	Rookery Bay	*Shoma* (1934)
21.	Godthul	Jolle (wooden barges)
22.	Fridtjof Nansen Reef	*Fridtjof Nansen* (1906)
23.	Ocean Harbour	*Bayard* (1911) and *Montebello* (1916)
24.	Moltke Harbour	*Lyn* (1906)
25.	Cooper Bay	Shallop (1815)
26.	Diaz Cove	Wreck found in 1929
27.	Mouse Cove	Wreck
28.	Near Samuel Islands	*Don Samuel* (1951)
29.	Ice Fjord	*Granat* (1925)

(Wrecks from Headland, R.K. (1984) British Antarctic Survey Bulletin 65, 109-126)

<u>Code of practice for all visitors to historic sites and shipwrecks</u>

* pre-visit briefings provided by tour operators must emphasise the significance and fragility of the sites and artefacts, and reinforce the prohibition on souveniring or removal of artefacts.
- visitors must take great care when viewing Grytviken whaling stations and follow specified routes, paying particular attention to signage prohibiting entry to certain buildings.
- smoking is prohibited in the locality of these listed sites.
- visitors must not disturb or destroy any artefacts found at these sites, including wrecks and other vessels.
- visitors must not remove artefacts from these sites, unless there is immediate risk of damage or loss, for example, trampling by seals, erosion in stream beds, or wave action on shores.
- if under threat of damage or loss, large artefacts may be moved to a safer site nearby; if visitors move any artefacts the visitor must report the new location to the South Georgia Museum.
- if under threat of damage or loss, fragile artefacts such as glass, pottery and small metal objects may be collected and taken to the South Georgia Museum.

- if visitors discover remains and artefacts which do not appear to have been recorded, the Government requests that the visitors make a note of the location and contents of the site, including photographs and sketch maps showing distances to landmarks and send this information to the South Georgia Museum.
- visitors must not deface or vandalise any part of the listed sites.

Annex 3

Fees and charges (current at time of going to press)

		£
Passenger landing fee		50
Vessels		
Harbour entry and exit		30
Harbour clearance		30
Customs clearance		44 (minimum charge)
Daily harbour dues		53 to 3050 (determined by vessel tonnage and number of passengers)
Yachts (covering harbour fees, entry, clearance and customs)		50
Water		5.50 per tonne
Use of buoys (per 30 day period or part thereof)		195 (Grytviken) 265 (Stromness)
Transhipment		1,100
Fishing licences (1997/98 season)	icefish	28,000
	toothfish	70,000
	krill	10,500 (monthly) or 31,300 (six months)
	lantern fish	5,000 (monthly)
	squid	4,000
	crab	11,000 (monthly)

Annex 4

TACs set by CCAMLR for main target species in Subarea 48.3 for 1998/99

	Tonnes
Toothfish	3,500
Icefish	4,840
Krill	620,000
Crab	1,600
Squid	2,500

Description of Candidate Protected Areas

Willis Islands

This is a small group of islands at the northwestern extremity of South Georgia comprising Main Island (largest), Trinity Island and several islets and stacks. Rising to 500 metres in height, they are mostly steeply-sided with limited access points. The islands are separated from nearby Bird Island by Stewart Strait. There is no permanent snow or ice on the islands. Summer rainfall is high.

Vegetation. The limited vegetation is predominantly tussac grassland with a moderate number of other plant species, in total around six species of native vascular (higher) plants and around 50 species of native cryptogamic (lower) plants. The vegetation is sparse above 100 m. Species diversity is relatively low in comparison with other sites on South Georgia due to the steep rocky nature of the terrain, and large colonies of penguins on less steep slopes.

Birds. The islands are an important location at South Georgia, in terms of high biodiversity, for breeding birds, with the occurrence of 21 species including species which are globally threatened or near-threatened; endemic or rare; and important populations globally or regionally.

Macaroni penguins (near-threatened) are particularly abundant with more than half of South Georgia's total of 2,000,000 pairs, which in turn represents more than half of the world population. Black-browed albatross (near-threatened) is abundant with 34,000 pairs or 34% of South Georgia's population. Grey-headed albatross (threatened) is abundant with 25,000 pairs and for which South Georgia, with a population of 80,000 pairs, is the main site in the world. The occurrence of the endemic South Georgia pipit and South Georgia pintail, and the rare snow petrel and fairy prion is important on these rat-free islands. The islands are also an important location for the white-chinned petrel for which the South Atlantic is its global headquarters.

Seals. There is a moderate abundance (in comparison with other sites on north west South Georgia) of Antarctic fur seals with 1,250 pups born annually.

Bird Island

This is a small island (around 500 ha) just off the north-west tip of South Georgia from which it is separated by Bird Sound. Rising to 365 metres, the island's northern coast consists mainly of sheer cliffs with few beaches; the southern coast is more accessible with numerous beaches. There is no permanent snow or ice on the island. Summer rainfall is high.

Vegetation. There is a moderate number of native plant species: around 11 vascular plants and 147 crytogamic plants. On the gentler slopes below 100 m the vegetation is dominated by

tussac grass; however, there are some examples of fellfield, bog and mire plant communities. Above 100 m here are sparsely vegetated gravels and cryptogam-dominated screes and rock faces.

Insects. Relatively rich insect fauna with one species of spider, 48 mite species, 30 feather lice (on the rich diversity of seabirds), eight springtails, four beetles, six flies, three fleas and a wasp.

Birds. The island is the most important location at South Georgia, in terms of high biodiversity, for breeding birds, with the occurrence of 27 species, including species which are globally threatened or near-threatened; endemic or rare; and important populations globally or regionally.

This is the most important location after Willis Islands for macaroni penguins (near-threatened) which are abundant with around 50,000 pairs. Black-browed albatross (near-threatened) are abundant with 15,000 pairs or 15% of South Georgia's population. Bird Island is the single most important site on South Georgia for southern giant petrel (near-threatened) with 500 pairs or 10% of South Georgia's total breeding population of 5000 pairs, which in turn represents around one quarter of the world population.

The main breeding site on South Georgia for wandering albatross (threatened) is on Bird Island where there are 1,200 pairs, accounting for just over one quarter of South Georgia's total breeding population of 4,000 pairs, which in turn represents about 15% of the world population. The island is also one of the main breeding sites for the grey-headed albatross (threatened) with 11,600 of the total 80,000 pairs occurring on South Georgia which is the world's main breeding ground for this species, accounting for 46% of the world's annual breeding population.

The occurrence of the endemic South Georgia pipit and South Georgia pintail, and the rare fairy prion is important on this rat-free island. Rockhopper penguin have also bred here. In addition Bird Island is an important breeding location for species for which the South Atlantic is the global headquarters, in particular the white-chinned petrel, Antarctic prion and around 1,500 northern giant petrels representing about half of South Georgia's population of 3,000 pairs, which is possibly half of the world population.

Seals. Bird Island is an important location at South Georgia for the Antarctic fur seal with around 65,000 pups born annually.

Scientific research. Protection of the island is important not only for conservation but also for research purposes in view of the location of the British Antarctic Survey's research station at Jordan Cove. Research has been undertaken on Bird Island since the late 1950s mainly into population biology, ecosystem dynamics and behaviour of seabirds and seals. Bird Island has been a CCAMLR Ecosystem Monitoring Programme (CEMP) site since 1985 and many indices of predator populations and performance have been recorded every year since 1976.

Management. This is the only candidate protected area for which there is an environmental assessment (Bonner and Croxall 1988) examining how the British Antarctic Survey's scientific activities affect the environment. The Government will undertake another assessment of these activities in due course.

Annenkov Island

This is a moderate sized island about 15 km off the south-west coast of South Georgia. It rises to just over 1000 m in height and is steeply-sided in some parts but has access points elsewhere. There is no permanent snow or ice on the island.

Vegetation. There are a moderate number of native plant species with around 14 species of vascular plants and 75 species of cryptogams. Most of South Georgia's plant communities are represented at the island, although tussac grass predominates. Vegetation is sparse above 100 m.

Birds. The island is an important location on South Georgia, in terms of high biodiversity, for breeding birds, with the occurrence of 25 species including species which are globally threatened or near-threatened; endemic or rare; and important populations globally or regionally.

Black-browed albatross (near-threatened) are abundant with 17,500 of the total 100,000 pairs which occur on South Georgia. The island is also an important breeding location for macaroni penguins with about 10,000 pairs. The southern giant petrel (near-threatened) also breeds here. The island is also one of the three main breeding sites on South Georgia for wandering albatross (threatened) with about 500 pairs. The occurrence of the endemic South Georgia pipit and South Georgia pintail, and the rare snow petrel and fairy prion is important on this rat-free island. The island is also an important breeding location for the white-chinned petrel, northern giant petrel and South Georgia diving petrel for which the South Atlantic is the global headquarters.

Seals. There is a moderate abundance (in comparison with other sites on South Georgia) of elephant seals with around 1,100 females.

Fossils. The island is one of the few locations on South Georgia where fossils occur. It has a varied fossil fauna and flora, including ammonites, bivalves, foraminifera, ciripedia, with fish scales, bones and spinal columns. Fronds of fossil cycads and fragments of fossil wood are also found.

Cooper Island

This is a small island just off the south-east of South Georgia from which it is separated by Cooper Sound. It rises to 500 metres in height, and is steeply-sided in some parts but has access points elsewhere. Snow occurs in all months of the year, and there is some permanent snow or ice on the highest land.

Vegetation. The predominant vegetation is tussac grassland with a limited number of other native plant species: in total around 10 vascular (higher) plants and 64 cryptogamic (lower) plants.

Birds. The island is an important location at South Georgia, in terms of high biodiversity, for breeding birds, with the occurrence of 21 species including species which are globally threatened or near-threatened; endemic or rare; and important populations globally or regionally.

Black-browed albatross (near-threatened) are abundant with 12,000 of the total 100,000 pairs which occur on South Georgia. The Island is also an important breeding location for macaroni penguins with about 20,000 pairs. The southern giant petrel (near-threatened) also occurs at the Island. The occurrence of the endemic South Georgia pipit and South Georgia pintail, and the rare snow petrel is important on this rat-free island. Chinstrap penguins (rare) also breed here. The island is also an important breeding location for the white-chinned petrel, Antarctic prion and northern giant petrel for which the South Atlantic is the global headquarters.

Seals. There is a moderate abundance (in comparison with other sites on South Georgia) of elephant seals with around 200 females and Antarctic fur seals with around 2,000 pups born annually.

Cape Paryadin Peninsula west of Elsehul and Undine Harbours

This area is in the extreme north-west of the mainland and comprises the peninsula due west of Elsehul and Undine Harbours. It is about eight km long (north-south) and about four to five km wide (east-west). Its main physical feature is the Paryadin Ridge which runs north-south and is up to 500 m above sea level. There is no permanent snow or ice on the Peninsula.

Vegetation. There are moderate numbers of native plant species: 13 vascular and 143 cryptogamic species, including some very rare species. The predominant vegetation is tussac grassland with some development of herbfield and moss bank communities. The vegetation is typical of wetter parts of South Georgia.

Birds. The Peninsula is an important location at South Georgia, in terms of high biodiversity, for breeding birds. The north eastern part of the Peninsula has 22 species including species which are globally threatened or near-threatened; endemic or rare; and important populations globally or regionally. There are fewer species (10) in the south western part of the Peninsula towards Cape Paryadin.

Black-browed albatross (near-threatened) are moderately abundant (in comparison to other locations on the island) with 6500 pairs. The Peninsula is also important for macaroni penguins with around 2,500 pairs. The southern giant petrel (near-threatened) also breeds here. The Peninsula is one of the key breeding sites on South Georgia for wandering albatross (threatened) with between 100 and 150 pairs making it the fourth most important site for this species on South Georgia. Grey-headed albatrosses (threatened) are also abundant with

50,000 of the total 80,000 pairs at South Georgia, thereby the most important area on South Georgia and in the world for this species. The occurrence of the endemic South Georgia pipit and South Georgia pintail, and the rare snow petrel is important even though this is not a rat-free area.

Seals. The Peninsula is an important breeding location for the Antarctic fur seal with up to 100,000 pups born annually. Elephant seals are also present with around 250 females.

Bomford Peak Peninsula (mainland south of Schrader Glacier and Peters Glacier, including Samuel Islands, Saddle Island, Anvil Stacks and the valley behind the shore at Wilson Harbour)

This is an area in the north-west of South Georgia between, and including part of Wilson Harbour and Cheapman Bay. It is delimited in the north by the Schrader Glacier and Peters Glacier, but also includes the valley behind Wilson Harbour, just to the north west of the Schrader Glacier. It also includes the Samuel Islands, Saddle Island and other offshore islets and stacks and varies between about 5 - 10 miles north to south and about 5 - 10 miles east to west. The area is dominated by Bomford Peak at 1140 m above sea level. Glaciers and/or permanent snow or ice are present; a notable glacial feature is the Catcher Icefall to the south -west of Bomford Peak.

Vegetation. There are a large number of native plant species with around 19 vascular plants and 139 cryptogams. Most of South Georgia's plant communities are represented in this area, although tussac grass predominates. There is extensive colonisation in the valley inland from the shore at Wilson Harbour. In addition there are kelp beds off the eastern coast.

Birds. The area is an important location at South Georgia, in terms of high biodiversity, for breeding birds with the occurrence of 22 species including species which are globally threatened or near-threatened; endemic or rare; and important populations globally or regionally. The area of highest biodiversity is in the south with 17 species.

There is a small colony of 850 pairs of black-browed albatross (near-threatened) at Klutschak Point. The southern giant petrel (near-threatened) also occurs here. Wandering albatross (threatened) occur on the Samuel Islands and on Saddle Island with around 70 and around 30 pairs respectively. The endemic South Georgia pipit and most of the South Georgia pintail in this area are confined to the rat-free Samuel Islands and Saddle Island. The rare snow petrel occurs in the upland areas of the mainland. The area is also an important location for several species for which the South Atlantic is the global headquarters: it is a major area for gentoo penguins with11,500 pairs; northern giant petrels and white-chinned petrels are also present, especially on islands and some headlands on the mainland.

Seals. The area is moderately important as a breeding location for the Antarctic fur seal with 2,500 pups born annually, and for elephant seals with around 2000 females.

Scope for eradication of rats. As a protected area, which for the most part is closed off from the rest of the mainland by the Schrader and Peters Glacier, there would be scope to assess the feasibility of eradicating rats.

Greene Peninsula (Dartmouth Point and hinterland)

This Peninsula is on the mid-eastern coast of South Georgia. To the west is Moraine Fjord and to the east is Cumberland Bay East. It is delimited in the south by Nordenskjöld Glacier, Paget Glacier and Harker Glacier. It also includes the small rat-free area between the Harker and the Hamberg glaciers. About eight km north to south, it varies between two and eight km east to west. The central ridge, with gently undulating eastern and western sides has numerous streams, tarns and small lakes. It rises to 500 m high in places. There are some limited areas of permanent ice and snow.

Vegetation. This is one of the most diverse areas for native vegetation on South Georgia with 24 species of vascular plants and 146 cryptogams. There are several rare species and there are deep peat deposits. The absence of reindeer enhance its value in relation to its plant species. The full range of South Georgia's plant communities is represented. Several flowering plant species are near the southern limit of their range yet form climax communities, amongst the most extensive on South Georgia.

Birds. The area is of moderate importance for breeding birds with the occurrence of 13 species. The area appears to be the only site where speckled teal still breeds on South Georgia.

The southern giant petrel (near-threatened) occurs here. The occurrence of the endemic South Georgia pintail is important even though this is, for the most part, not a rat-free area. The area has several species for which the South Atlantic is the global headquarters including gentoo penguins with 400 pairs, northern giant petrels and white-chinned petrels; Antarctic prions breed in the rat-free area between the Harker and the Hamberg glaciers.

Seals. The area is moderately important as a breeding location for elephant seals with1000 females. Extensive studies of this species were conducted here in the 1970s.

Scope for eradication of rats. As a protected area, which for the most part is closed off from the rest of the mainland by glaciers, there is scope to assess the feasibility of eradicating rats, especially as there is already a small area of rat-free habitat.

Nuñez Peninsula

This peninsula is in the north west of South Georgia between Queen Maud Bay and Jossac Bight. It is delimited by the Esmark Glacier and the glaciers to the south west of Mount Cunningham. The protected area also includes islets and stacks around the peninsula. Rising to about 760 km in height, it varies from three to six km east to west and is about 12 km north to south. There are some small areas of permanent ice.

Vegetation. This is an important area for native vegetation on South Georgia with 19 species of vascular plants and 153 species of cryptogams, including some rare species, for example at Shallop Cove. The full range of South Georgia's plant communities is represented although tussac grass predominates.

Birds. The area is of moderate importance for breeding birds with the occurrence of 20 species including species which globally near-threatened; endemic or rare; and important populations globally or regionally.

There is a small colony (around 1000 pairs) of black-browed albatross (near-threatened) in the west of the peninsula. The southern giant petrel (near-threatened) also breeds on the peninsula, as do wandering albatross (threatened) with around 40 pairs. The occurrence of the endemic South Georgia pipit and South Georgia pintail and the rare fairy prion is important in this rat-free area. The area has several species for which the South Atlantic is the global headquarters including gentoo penguins with 3,000 pairs, northern giant petrels, white-chinned petrels, Antarctic prion, blue petrel and common-diving petrel.

Seals. The area is an important breeding location for elephant seals with 4,500 females.

Description of Candidate Environmentally Sensitive Areas

Bay of Isles

This area comprises the 12 or so islands, islets and stacks enclosed within the Bay of Isles on the northern coast of South Georgia, between Cape Buller in the west and Cape Crewe in the east. The main islands are Albatross Island and Prion Island. Generally low-lying, the islands rise to about 500 m. There is no permanent snow or ice.

Vegetation. The predominant vegetation is tussac grassland with a moderate number of other plant species, in total around 8 species of native vascular (higher) plants and around 28 species of native cryptogamic (lower) plants.

Birds. The islands are an important location at South Georgia, in terms of high biodiversity, for breeding birds, with the occurrence of 17 species including species which are globally threatened or near-threatened; endemic or rare; and important populations globally or regionally.

The Bay of Isles is one of South Georgia's most important sites (after Bird Island) for wandering albatross (threatened) with 500 pairs, particularly on Albatross Island and on Prion Island. Southern giant petrels (near-threatened) and northern giant petrels also breed on the islands. Burrowing petrels are abundant, including white-chinned petrels, Antarctic prions, common diving petrels and blue petrels.

The occurrence of the endemic South Georgia pipit and South Georgia pintail, is important on these rat-free islands.

Seals. There is a moderate abundance of elephant seals (250 females) and there are1,500 Antarctic fur seal pups born annually.

Thatcher Peninsula

This peninsula is on South Georgia's northern coast between Cumberland Bay West and Cumberland Bay East. It is delimited in the south by the Lyell and the Hamberg Glaciers. About 10 km north to south and varying between five and 12 km east to west, it rises to about 1000 m in height. There are numerous streams, tarns and lakes, and some limited areas of permanent ice.

Vegetation. This is an important area for vegetation on South Georgia with 23 species of native vascular plants and 173 species of native cryptogams. The absence of reindeer enhances its value in relation to its plant species.

Birds. The peninsula is of moderate importance for breeding birds with the occurrence of 12 species, primarily burrowing petrels, including white-chinned petrels, South Georgia pipit and speckled teal. The presence of rats is a threat to the burrowing birds.

Seals. Elephant seals (1,250 females) and a small number of Antarctic fur seals (producing less than 100 pups per year) breed on the peninsula.

Freshwater habitats. This is the island's most important area for freshwater habitats ranging from streams to interconnected lake systems.

Research. This is one the main areas on South Georgia where scientific research has been undertaken by British Antarctic Survey over many years.

Historic. There are many sources of historical interest in this area, including Grytviken Whaling Station, Shackleton's grave and Memorial Cross, and remains of sealing activities.

South Georgia - analysis of Candidate Protected Areas against selection criteria

Criteria		**Candidate areas**							
		Willis Islands	Bird Island	Annenkov Island	Cooper Island	Cape Paryadin Peninsula	Bomford Peak Peninsula	Greene Peninsula	Nuñez Peninsula
HABITATS	Vegetation								
* identify sites where habitat is typical of other subAntarctic islands and/or internationally recognised habitat types or biogeographical regions.	tussac grassl.	✓	✓	✓	✓	✓	✓	✓	✓
	fellfield	✓	✓	✓	✓		✓	✓	✓
	bog & mire		✓	✓			✓	✓	✓
	dry grassland			✓			✓	✓	✓
	herbfield		✓	✓	✓	✓	✓	✓	✓
* identify sites which possess a wide range of habitats			✓	✓		✓	✓	✓	✓

Criteria		**Candidate areas**							
		Willis Islands	Bird Island	Annenkov Island	Cooper Island	Cape Paryadin Peninsula	Bomford Peak Peninsula	Greene Peninsula	Nuñez Peninsula
SPECIES		Key pt. = petrel pr.= prion rockh p.= rockhopper penguin SG = South Georgia t.= teal wan albt = wandering albatross GH albt= grey headed albatross BB albt= black browed albatross macor p. = macaroni penguin Sgiant pt = southern giant petrel wc pt= white chinned petrel Ngiant pt = northern giant petrel gentoo p = gentoo penguin							
* identify sites where more than a certain percentage of SG's total population of endemic, rare breeding or restricted range species occurs.		snow pt. fairy pr. SG pipit pintail	fairy pr. rockh p. SG pipit pintail	snow pt. fairy pr. SG pipit pintail.	snow pt. SG pipit pintail	snow pt. rockh p. SG pipit pintail	snow pt. SG pipit pintail	snow pt pintail speckled t.	fairy pr. SG pipit pintail
* identify sites where more than a certain percentage of SG's total breeding population of globally threatened or near-threatened species occurs.		 GH albt macor p. BB albt	wan albt GH albt macor p. BB albt Sgiant pt.	wan albt macor p. BB albt. Sgiant pt.	 macor p. BB albt. Sgiant pt.	wan albt GH albt. macor p. BB albt. Sgiant pt	wan albt BB albt. S giant pt.	 S giant pt.	wan albt BB albt S giant pt
* identify sites where more than a certain percentage of SG's total population occurs of species for which SG and/or the South Atlantic is the global headquarters.		wc pt. fur seals	wc pt Ngiant pt fur seals	wc pt. Ngiant pt elephant seals	wc pt. Ngiant pt fur seals	wc pt Ngiant pt gentoo p. fur and elephant seals	wc pt. Ngiant pt gentoo p. fur and elephant seals	wc pt Ngiant pt gentoo p. elephant seals	wc pt blue pt Ngiant pt gentoo p. elephant seals

Criteria		**Candidate areas**							
		Willis Islands	Bird Island	Annenkov Island	Cooper Island	Cape Paryadin Peninsula	Bomford Peak Peninsula	Greene Peninsula	Nuñez Peninsula
* identify sites with high biodiversity (high abundance and large numbers of species)	bb = breeding birds species high abundance of seals	22 bb	27 bb fur seals (65,000 pups per year)	25 bb	21bb	22 bb fur seals (up to 100,000 pups per year)	22 bb	13 bb	20 bb elephant seals (4500 females)
	Approx. numbers of native higher plant species Approx. numbers of native species of cryptogams	6 50	11 147	14 75	10 64	13 143	19 139	24 146	19 153
* identify sites which are free of introduced mammals		✓	✓	✓	✓	rats	rats	rats	✓
GENERAL									

Criteria		Candidate areas							
		Willis Islands	Bird Island	Annenkov Island	Cooper Island	Cape Paryadin Peninsula	Bomford Peak Peninsula	Greene Peninsula	Nuñez Peninsula
* identify sites where access is difficult (visitors are unlikely to want to come ashore)		✓	✓			✓			
* identify sites where protected status is important for conservation reasons		✓	✓	✓	✓	✓	✓	✓	✓
* identify sites where protected status is currently important for scientific reasons			✓						

Note

1) There are two additional criteria in the proposed methodology for identifying protected areas, but we were not able to use them because not enough is known about South Georgia to be able to apply them:

* identify habitat types which are unique to, or rare on SG

* identify sites which host more than a certain percentage of a particular habitat resource at SG .

Annex 6

Preliminary list of rat-free islands/groups (to be completed)

Willis Islands
Bird Island
Sörn and Bernt
Welcome Islets
The Guides
Jason Islet
Right Whale Rocks
East and West Skerry
The Wirik Bay Islands
Islet off Twitcher Glacier
Green Island
Kupriyanov Islands
Pickersgill Islands
Hauge Reef
Samuel Islands
Saddle Island

Annex 7

Proposed selection criteria for Protected Areas

Criteria	**How to use**
HABITATS	
Representative	* identify sites where the habitat is typical of other subAntarctic islands and/or internationally recognised habitat types or biogeographical regions. * identify habitat types which are unique to SG or rare habitat types
Area of habitat type	* identify sites which host more than a certain percentage of a particular habitat resource at SG.
SPECIES	
Proportion of SG population	* identify sites where more than a certain percentage of SG's total population of endemic, rare breeding or restricted range species (or taxa?) occurs. * identify sites where more than a certain percentage of SG's total breeding population of globally threatened or near-threatened species occurs. * identify sites where more than a certain percentage of SG's total population occurs of species for which SG and/or the South Atlantic is the global headquarters.
Rats and reindeer	* identify sites which are free of introduced mammals.
Biodiversity	* identify sites with high biodiversity - high abundance and large range of species.
GENERAL	
Geographical	* identify sites where access is difficult (visitors are unlikely to want to come ashore - so no conflict if designate as protected site)
Science	* identify sites where protected status might be important for scientific reasons
Combinations of criteria	* where possible combine criteria to identify sites

Annex 8

Proposed selection criteria for Environmentally Sensitive Open Areas

Environmentally sensitive areas will be identified in open areas and may require additional management measures to minimise potential impacts from human activities.

Areas will be identified as environmentally sensitive if they fulfill with the conservation criteria in the left hand column of the table below,

AND

are considered to be at risk of significant effects from human activities as described in the right hand column of the table.

Conservation features		Human activities
* identify sites with key conservation features, such as endangered species, unique plant associations.	A	* identify sites where there is evidence of, or a significant risk of high visitor pressure causing, or at risk of causing deleterious effects on the environment (High visitor pressure is defined in terms of high visitor numbers per year and/or high frequency of visits per year.)
AND/OR	N	AND/OR
* identify sites with habitat or other physical features which are unique to, or rare on South Georgia	D	* identify sites where diverse and regular human activities are taking place, for example, scientific investigations, land-based tourist visits, ship-based tourist visits, administration, and construction activities.