

Management Plan for

Antarctic Specially Protected Area (ASP) No. 149

CAPE SHIRREFF AND SAN TELMO ISLAND, LIVINGSTON ISLAND, SOUTH SHETLAND ISLANDS

Introduction

The Cape Shirreff Antarctic Specially Protected Area (ASP) is situated on the northern coast of Livingston Island, South Shetland Islands, at 62°27'30"S, 60°47'17"W, and is approximately 9.7 km² in area. The primary reason for designation of the Area is to protect the biota present within the Area, in particular the large and diverse seabird and pinniped populations which are the subject of long term scientific monitoring. Krill fishing is carried out within the foraging range of these species. Cape Shirreff is thus a key site for ecosystem monitoring, which helps to meet the objectives of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). The Area contains the largest Antarctic fur seal (*Arctocephalus gazella*) breeding colony in the Antarctic Peninsula region and is the most southerly colony where fur seal reproduction, demography and diet can be monitored. Palynoflora discovered within the Area are of significant scientific interest. The Area also contains numerous items of historical and archaeological value, mostly associated with sealing activities in the 19th Century. The Area was originally designated following proposals by Chile and the United States of America and adopted through Recommendation IV-11 [1966, Specially Protected Area (SPA) No. 11]. The Area was re-designated as Site of Special Scientific Interest (SSSI) No. 32 through Recommendation XV-7 (1989). The Area was designated as CCAMLR Ecosystem Monitoring Program (CEMP) Site No. 2 through CCAMLR Conservation Measure 82/XIII (1994); protection was continued by Conservation Measure (CM) 91/02 (2004) and boundaries were extended through Measure 2 (2005) to include a larger marine component and to incorporate plant fossil sites. Conservation Measure 91-02 was lapsed in November 2009 and protection of Cape Shirreff continues as ASPA No. 149 (SC-CCAMLR-XXVIII, Annex 4, para 5.29).

1. Description of values to be protected

Cape Shirreff (62°27'30" S, 60°47'17" W, a peninsula of approximately 3.1 km²), Livingston Island, South Shetland Islands, was originally designated as Specially Protected Area (SPA) No. 11 through Recommendation IV-11 (1966). In the light of results from the first census of Pinnipedia carried out in the South Shetland Islands (Aguayo and Torres, 1966), Chile considered special protection for the site was needed. Formal proposal of the SPA was made by the United States (US). The Area included the ice-free ground of the Cape Shirreff peninsula north of the Livingston Island ice cap margin. Values protected under the original designation included the diversity of plant and animal life, many invertebrates, a substantial population of southern elephant seals (*Mirounga leonina*) and a small colony of Antarctic fur seals (*Arctocephalus gazella*).

Following designation, the size of the Cape Shirreff Antarctic fur seal colony increased to a level at which biological research could be undertaken without threatening continued colony growth. A survey of the South Shetland Islands and the Antarctic Peninsula identified Cape Shirreff – San Telmo Island as the most suitable site to monitor Antarctic fur seal colonies potentially affected by fisheries around the South Shetland Islands. In order to accommodate the monitoring program, the SPA was redesignated as Site of Special Scientific Interest (SSSI) No. 32 through Recommendation XV-7 (1989) following a joint proposal by Chile, the United Kingdom and the US. Designation was on the grounds that the “presence of both Antarctic fur seal and penguin colonies, and of krill fisheries within the foraging range of these species, make this a critical site for inclusion in the ecosystem monitoring network being established to help meet the objectives of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). The purpose of the designation is to allow planned research and monitoring to proceed, while avoiding or reducing, to the greatest extent possible, other activities which could interfere with or affect the results of the research and monitoring program or alter the natural features of the Site”. The boundaries were enlarged to include San

Telmo Island and associated nearby islets. Following a proposal prepared by Chile and the US, the Area was subsequently designated as CCAMLR Ecosystem Monitoring Program (CEMP) Site No. 2 through CCAMLR Conservation Measure 82/XIII (1994), with boundaries identical to SSSI No. 32. Protection of Cape Shirreff as a CCAMLR Ecosystem Monitoring Program (CEMP) was continued by Conservation Measure (CM) 91/02 (2004).

The boundaries of the Area were further enlarged through Measure 2 (2005) to include a larger marine component and to incorporate two new sites where plant fossils were discovered in 2001 (Maps 1 and 2). The designated Area (9.7 km²) comprises the entire Cape Shirreff peninsula north of the Livingston Island permanent ice cap, the adjacent part of the Livingston Island permanent ice cap where the fossil discoveries were made in 2001, the San Telmo Island group, and the surrounding and intervening marine area enclosed within 100 m of the coast of the Cape Shirreff peninsula and of the outer islets of the San Telmo Island group. The boundary extends from the San Telmo Island group to the south of Mercury Bluff.

Conservation Measure 91-02 lapsed in November 2009, with the protection of Cape Shirreff continuing under the management plan for ASPA No. 149 (SC-CCAMLR-XXVIII, Annex 4, para 5.29). The change was made with the aim of harmonizing protection under both CCAMLR and the Protocol on Environmental Protection to the Antarctic Treaty (The Protocol) and to eliminate any potential duplication in management requirements and procedures.

The current Management Plan reaffirms the exceptional scientific and monitoring values associated with the large and diverse populations of seabirds and pinnipeds which breed within the Area, and in particular those of the Antarctic fur seal colony. The Antarctic fur seal colony is the largest in the Antarctic Peninsula region and is the most southerly that is large enough to study growth, survival, diet, and reproduction parameters: it numbered around 21,000 individuals in 2002 (Hucke-Gaete *et al.* 2004). Monitoring of the Antarctic fur seal colony began in 1965 (Aguayo and Torres 1966, 1967) and seasonal data are available from 1991, making this one of the longest continuous Antarctic fur seal monitoring programs. As part of the CCAMLR Ecosystem Monitoring Program (CEMP), monitoring was established to detect and avoid possible adverse effects of fisheries on dependant species such as pinnipeds and seabirds, as well as target species such as Antarctic krill (*Euphausia superba*). Long-term studies are assessing and monitoring the survival, feeding ecology, growth, condition, reproduction, behavior, vital rates, and abundance of pinnipeds and seabirds that breed within the Area. Data from these studies will be evaluated in context with environmental and other biological data and fisheries statistics to help identify possible cause-effect relationships between fisheries and pinniped and seabird populations.

In 2001-02 imprints of megafloora were discovered in rocks incorporated within moraines of the Livingston Island glacier (Palma-Heldt *et al.* 2004, 2007) (Map 2). The fossiliferous rocks were found to contain two distinct palynological assemblages, indicative of different time periods and climatic conditions, and formed part of a study into the geological history of Antarctica and Gondwana. Studies of microbial research were carried out within the Area in 2009-10, to assess the influence of microhabitats on microbial diversity and metabolic capacity (INACH 2010).

The original values of the protected area associated with the plant and invertebrate communities cannot be confirmed as primary reasons for special protection of the Area because there is a lack of data available describing the communities.

The Area contains a number of pre -1958 human artifacts. HSM No.59, a rock cairn commemorating those who died when the Spanish ship San Telmo sank in the Drake Passage in 1819, lies within the Area. Remnants of a 19th Century sealing community also can be found within the Area.

2. Aims and objectives

Management at Cape Shirreff aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance;
- avoid activities that would harm or interfere with CEMP research and monitoring activities;
- allow scientific research on the ecosystem and physical environment in the Area associated with the CEMP;

- allow other scientific research within the Area provided it is for compelling reasons which cannot be served elsewhere and provided it will not compromise the values for which the Area is protected;
- allow archaeological and historical research and measures for artifact protection, while protecting the historic artifacts present within the Area from unnecessary destruction, disturbance, or removal;
- minimize the possibility of introduction of alien plants, animals and microbes to the Area; and
- allow visits for management purposes in support of the aims of the management plan.

3. Management activities

The following management activities shall be undertaken to protect the values of the Area:

- Copies of this management plan, including maps of the Area, shall be made available at the following locations:
 1. accommodation facilities at Cape Shirreff;
 2. Saint Kliment Ohridski Station (Bulgaria), Hurd Peninsula, Livingston Island;
 3. Arturo Prat Station (Chile), Discovery Bay/Chile Bay, Greenwich Island; and
 4. Base Juan Carlos I (Spain), Hurd Peninsula, Livingston Island.
- A sign showing the location and boundaries of the Area with clear statements of entry restrictions should be placed at Módulo Beach, Cape Shirreff, to help avoid inadvertent entry;
- Markers, signs or other structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition;
- National Antarctic programs operating within the Area should maintain a record of all new markers, signs and structures erected within the Area;
- Visits shall be made as necessary (no less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate;
- National Antarctic programs operating in the region shall consult together for the purpose of ensuring that the above provisions are implemented.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

Map 1: Cape Shirreff and San Telmo Island, ASPA No. 149, in relation to Livingston Island, showing the location of Base Juan Carlos I (Spain) and Saint Kliment Ohridski Station (Bulgaria), and the location of the closest protected area, Byers Peninsula (ASPA No. 126), also on Livingston Island. Map specifications: Projection: Lambert Conformal Conic; Standard parallels: 1st 60°00' S; 2nd 64°00' S; Central Meridian: 60°45' W; Latitude of Origin: 62°00' S; Spheroid: WGS84; Horizontal accuracy: < ±200 m. Bathymetric contour interval 50 m and 500 m; vertical accuracy unknown. Data sources: land features from SCAR Antarctic Digital Database v. 4.1 (2007); bathymetry supplied by the Antarctic Marine Living Resources (AMLR) Program, NOAA, US (2002).

Inset: the location of Map 1 in relation to the South Shetland Islands and the Antarctic Peninsula.

Map 2: Cape Shirreff and San Telmo Island, ASPA No. 149, protected area boundary and access guidelines. Map specifications as per Map 1, except the vertical contour interval is 10 m and the horizontal accuracy is expected to be greater than ±5 m. Data source: from digital data supplied by Instituto Antártico Chileno (INACH) (2002) (Torres *et al.* 2001).

Map 3: Cape Shirreff, ASPA No. 149: breeding wildlife and human features. Map specifications and data source as per Map 2 with the exception of the vertical contour interval, which is 5 m.

6. Description of the Area

6(i) Geographical coordinates, boundary markers and natural features

Boundaries and coordinates

Cape Shirreff (62°27'30" S, 60°47'17" W) is situated on the northern coast of Livingston Island, the second largest of the South Shetland Islands, between Barclay Bay and Hero Bay (Map 1). The cape lies at the northern extremity of an ice-free peninsula of low-lying, hilly relief. To the west of the peninsula lies Shirreff Cove, to the east Black Point, and to the south lies the permanent ice cap of Livingston Island. The peninsula has an area of approximately 3.1 km², being 2.6 km from north to south and ranging from 0.5 to 1.5 km from east to west. The interior of the peninsula comprises a series of raised beaches and both rounded and steep-sided hills, rising to a high point at Toqui Hill (82 m) in the central northern part of the peninsula. The western coast is formed by almost continuous cliffs 10 to 15 m high, while the eastern coast has extensive sand and gravel beaches.

A small group of low-lying, rocky islets lie approximately 1200 m west of the Cape Shirreff peninsula, forming the western enclosure of Shirreff Cove. San Telmo Island, the largest of the group, is 950 m in length, up to 200 m in width, and of approximately 0.1 km² in area. There is a sand and pebble beach on the southeastern coast of San Telmo Island, separated from a sand beach to the north by two irregular cliffs and narrow pebble beaches.

The designated Area comprises the entire Cape Shirreff peninsula north of the permanent Livingston Island ice cap, the San Telmo Island group, and the surrounding and intervening marine area (Map 2). The marine boundary encloses an area that extends 100 m from, and parallel to, the outer coastline of the Cape Shirreff peninsula and the San Telmo Island group. In the north, the marine boundary extends from the northwestern extremity of the Cape Shirreff peninsula to the southwest for 1.4 km to the San Telmo Island group, enclosing the intervening sea within Shirreff Cove. The western boundary extends southwards for 1.8 km from 62°28' S to a small island near 62°29' S, passing around the western shore of this small island and proceeding a further 1.2 km south-east to the shore of Livingston Island at 62°29'30" S, which is approximately 300 m south of Mercury Bluff. From this point on the coast, the southern boundary extends approximately 300 m due east to 60°49' W, from where it proceeds in a northeasterly direction parallel to the coast for approximately 2 km to the ice sheet margin at 60°47' W. The southern boundary then extends due east for 600 m to the eastern coast. The eastern boundary is marine, following the eastern coastline 100 m from the shore. The boundary encompasses an area of 9.7 km² (Map 2).

Climate

Meteorological records for Cape Shirreff have been collected for a number of years by Chilean and US scientists and are currently recorded by instruments mounted on the Cape Shirreff Field Station buildings. During recent summer seasons (Nov – Feb inclusive, 2005-06 to 2009-10) the mean air temperature recorded at Cape Shirreff was 1.84°C (AMLR Program data, 2005-2010). The maximum air temperature recorded during this period was 19.9°C and the minimum was -8.1°C. Wind speed averaged 5.36 m/s and the maximum recorded wind speed reached 20.1 m/s. Wind direction over the data collection period was predominantly from the west, followed by WNW and ENE. Meteorological data are available for two recent winters, with mean daily temperature for Jun-Aug 2007 of -6.7°C with a minimum of -20.6°C and a maximum of +0.9°C, and a mean daily temperature for Jun-Sep 2009 of -5.8°C with a minimum of -15.2°C and a maximum of +1.9°C.

Precipitation recorded in summer seasons (21 Dec – 24 Feb, 1998-2001) ranged from 56.0 mm (recorded on 36 days in 2000-01) to 59.6 mm (recorded on 43 days in 1998-99) (Goebel *et al.* 2000; 2001). The peninsula is snow-covered for much of the year, but is mostly snow-free by the end of the summer.

Geology, geomorphology and soils

Cape Shirreff is composed of porphyritic basaltic lavas and minor volcanic breccias of approximately 450 m in thickness (Smellie *et al.* 1996). The rocks at Cape Shirreff are deformed into open folds, which trend in a NW-SE direction, and subvertical axial surfaces that are intruded by numerous dykes. A rock sample obtained from the southern side of Cape Shirreff was identified as fresh olivine basalt and was composed of approximately 4% olivine and 10% plagioclase phenocrysts in a groundmass of plagioclase, clinopyroxene and opaque oxide. Rock samples at Cape Shirreff have been K-Ar dated as of late Cretaceous age with a minimum age of 90.2 ± 5.6 million years old (Smellie *et al.* 1996). The volcanic sequences at Cape Shirreff

form part of a broader group of relatively fresh basalt and andesite lavas covering eastern-central Livingston Island that are similar to basalts found on Byers Peninsula.

The Cape Shirreff peninsula is predominantly a raised marine platform, 46 to 53 m above sea level, (Bonner and Smith 1985). The bedrock is largely covered by weathered rock and glacial deposits. Two lower platforms, covered with rounded water-worn pebbles, occur at elevations of approximately 7-9 m and 12-15 m above Mean Sea Level (MSL) (Hobbs 1968).

There is little information on the soils of Cape Shirreff. They are mainly fine, highly porous, ash and scoria. The soils support a sparse vegetation and are enriched by bird and seal colonies which inhabit the Area.

Palaeobotany

A fossilized wood specimen belonging to the Araucariaceae family (*Araucarioxylon* sp.) was recorded from Cape Shirreff (Torres, 1993). It is similar to fossils found at Byers Peninsula (ASPA No. 126), a site with rich fossil flora and fauna 20 km to the southwest. Several fossil specimens have also been found at the northern extremity of the Cape Shirreff peninsula. In 2001-02 fossiliferous rocks of two different ages were discovered incorporated within frontal and lateral moraines of the Livingston Island permanent ice cap (Map 2). Study of the palynomorphs found within the moraines identified two distinct palynological assemblages, arbitrarily named 'Type A' and 'B' (Palma-Heldt *et al.* 2004, 2007). The 'Type A' association was dominated by Pteridophyta, mainly Cyatheaceae and Gleicheniaceae, and by *Podocarpidites* spp. and also contained *Myrtacidites eugenoides* and epiphyllous fungal spores. The assemblage is believed to be indicative of warm and humid conditions of Early Cretaceous in age (Palma-Heldt *et al.* 2007). The 'Type B' assemblage was characterized by a subantarctic flora with *Nothofagidites*, *Araucariacites australis*, *Podocarpidites otagoensis*, *P. marwickii*, *Proteacidites parvus* and also epiphyllous fungal spores, which indicate a cold and humid temperate climate (Palma-Heldt *et al.* 2007). The age of the assemblage is estimated to be Late Cretaceous-Paleogene (Palma-Heldt *et al.* 2004; Leppé *et al.* 2003). Palynological investigations were undertaken at Cape Shirreff in order to investigate the evolution of the southern Pacific margin of Gondwana and to develop a model of the Mesozoic-Cenozoic evolution of the Antarctic Peninsula. It has been noted that other fossils may be revealed by further recession of the Livingston Island permanent ice cap (D. Torres, A. Aguayo and J. Acevedo, pers. comm. 2010).

Streams and lakes

There is one permanent lake on Cape Shirreff, located north and at the base of Toqui Hill (Map 3). The lake is approximately 2-3 m deep and 12 m long at full capacity, diminishing in size after February (Torres 1995). Moss banks grow on surrounding slopes. There are also several ephemeral ponds and streams on the peninsula, fed by snow-melt, especially in January and February. The largest of the streams is found draining southwestern slopes toward the coast at Yamana Beach.

Vegetation and invertebrates

Although a comprehensive survey of the vegetation communities at Cape Shirreff has not been undertaken, Cape Shirreff appears to be less well vegetated than many other sites in the South Shetland Islands. Observations to date have recorded one grass, five species of moss, six of lichen, one fungi and one nitrophilous macroalgae (Torres 1995).

Patches of Antarctic hairgrass (*Deschampsia antarctica*) can be found in some valleys, often growing with mosses. Mosses are predominantly found inland from the coast. In a valley running northwest from Half Moon Beach, there is a moderately well-developed wet moss carpet of *Warnstorfia laculosa* (= *Calliergidium austro-stramineum*, also = *Calliergon sarmentosum*) (Bonner 1989, in Heap 1994). In areas with better drainage, *Sanionia uncinata* (= *Drepanocladus uncinatus*) and *Polytrichastrum alpinum* (= *Polytrichum alpinum*) are found. The raised beach areas and some higher plateaus have extensive stands of the foliose nitrophilous macroalga *Prasiola crispa*, which is characteristic of areas enriched by animal excreta and has been observed to replace moss-lichen associations damaged by fur seals (Bonner 1989, in Heap 1994).

The six lichen species thus far described at Cape Shirreff are *Caloplaca* spp, *Umbilicaria antarctica*, *Usnea antarctica*, *U. fasciata*, *Xanthoria candelaria* and *X. elegans*. The fruticose species *Umbilicaria antarctica*, *Usnea antarctica* and *U. fasciata* form dense growths on cliff faces and on the tops of steep rocks (Bonner 1989, in Heap 1994). The bright yellow and orange crustose lichens *Caloplaca* spp, *Xanthoria candelaria*

and *X. elegans* are common beneath bird colonies and are also present with the fruticose species. The identity of the single recorded fungal species is unknown.

The invertebrate fauna at Cape Shirreff has not been described.

Microbial ecology

Field studies of the microbial ecology at Cape Shirreff were carried out 11-21 January 2010 and results were compared with the bacterial communities present at Fildes Peninsula, King George Island. The study aimed to evaluate the influence of the different microhabitats on the biodiversity and metabolic capacities of bacterial communities found at Cape Shirreff and Fildes Peninsula (INACH, 2010).

Breeding birds

The avifauna of Cape Shirreff is diverse, with ten species known to breed within the Area, and several non-breeding species present. Chinstrap (*Pygoscelis antarctica*) and Gentoo (*P. papua*) penguins breed within the Area; Adélie penguins (*P. adeliae*) have not been observed to breed on Cape Shirreff or San Telmo Island, although are widely distributed throughout the region. Both Chinstrap and Gentoo penguins are found in small colonies on the northeastern and northwestern coasts of Cape Shirreff peninsula (Map 3). Data have been collected on the Chinstrap and Gentoo penguin colonies every summer season since 1996-97, including reproductive success, demography, diet, foraging and diving behaviour (e.g. Hinke *et al.* 2007; Pietrzak *et al.* 2009). During the 2009-10 summer season, Chinstrap and Gentoo penguins at Cape Shirreff were tagged with satellite transmitters, in order to study their over-winter behaviour.

In 2008-09 there were 19 active breeding sub-colonies at Cape Shirreff, with a total of 879 Gentoo and 4026 Chinstrap penguin nests (Pietrzak *et al.* 2009), although the number of the sub-colonies and their composition show some inter-annual variation. From the late 1990's to 2004, the numbers of Chinstrap penguins at Cape Shirreff declined significantly, whilst Gentoo populations showed no discernible trend. (Hinke *et al.* 2007). The negative trend in Chinstrap numbers has continued and nest counts for both penguin species reached their lowest for 11 years in 2007-08, due to poor weather conditions (Chisholm *et al.* 2008; Miller and Trivelpiece 2008). In 2008-09 the population and reproductive success of both Gentoos and Chinstraps at Cape Shirreff increased significantly in comparison to the previous season but numbers of Chinstrap nests remained 30% below average for the site (Pietrzak *et al.* 2009). The differing trends in Chinstrap and Gentoo populations at Cape Shirreff have been attributed to the higher winter juvenile mortality rate experienced by Chinstraps (Hinke *et al.* 2007) and a greater flexibility in feeding patterns exhibited by Gentoos (Miller *et al.* 2009).

In general, the Chinstrap penguins nest on higher escarpments at Cape Shirreff, although they are also found breeding on small promontories near the shore. Gentoo penguins tend to breed on more gentle slopes and rounded promontories. During the period of chick rearing, foraging by both species of penguin is confined to the shelf region, approximately 20 to 30km offshore of Cape Shirreff (Miller and Trivelpiece 2007). Data available on penguin numbers are presented in Table 1.

Several other species breed within the Area (Map 3), although data on numbers are patchy. Kelp gulls (*Larus dominicanus*) and Brown skuas (*Catharacta loennbergi*) nest in abundance along the entire coastline of the Area. In 2000 there were 25 and 22 breeding pairs of these species respectively (AMLR, pers. comm. 2000). In 2007-08, 24 pairs of skuas were identified at Cape Shirreff and Punta Oeste, of which 23 were Brown skuas (*Catharacta loennbergi*) and one pair was a hybrid of Brown-South Polar skuas (*C. maccormicki*). Fifty-six Kelp gull nests were observed at Cape Shirreff during the 2006-07 season. Reproductive success of skuas and kelp gulls has been regularly monitored during recent summer seasons at nesting sites around Cape Shirreff (Chisholm *et al.* 2008; Pietrzak *et al.* 2009).

Sheathbills (*Chionis alba*) nest in two places: one pair has been recorded nesting on the western coast of the Cape Shirreff peninsula; a second pair has been observed breeding among rocks at the northern beach on San Telmo Island, near an Antarctic fur seal breeding site (Torres, pers. comm. 2002). Antarctic terns (*Sterna vittata*) breed in several locations, which have been observed to vary from year to year. Since 1990-91 a small colony of approximately 11 pairs of Antarctic shag (*Phalacrocorax [atriceps] bransfieldensis*) has been observed breeding on Yeco Rocks, on the western coast of the peninsula (Torres, 1995). Cape petrels (*Daption capense*) breed on cliffs on the western coast of the Area; 14 pairs were recorded in January 1993, nine in January 1994, three in January 1995 and eight in 1999. Wilson's storm petrel (*Oceanites oceanicus*) also breed on the western coast of the Area. Black-bellied storm petrel (*Fregatta tropica*) have been observed

to breed near the field camp on the eastern coast. A large number of non-breeding Southern Giant petrels (*Macronectes giganteus*) frequent the Area in the summer, and a report of a breeding colony on the peninsula (Bonner 1989, in Heap 1994) is incorrect (Torres, pers. comm. 2002). Other bird species recorded but not breeding within the Area include Macaroni penguin (*Eudyptes chrysolophus*), King penguin (*Aptenodytes patagonicus*), Emperor penguin (*Aptenodytes forsteri*), Snow petrel (*Pagodroma nivea*), White-rumped sandpiper (*Calidris fuscicollis*), Black-necked swan (*Cygnus melanocoryphus*), and the Cattle egret *Bubulcus ibis* (Torres 1995; Olavarría *et al.* 1999). Additional bird species recorded as foraging close to Cape Shirreff include the Black-browed albatross (*Thalassarche melanophris*) and Gray-headed albatross (*T. chrysostoma*), although neither species has yet been recorded within the Area (Cox *et al.* 2009).

Table 1: Chinstrap (*Pygoscelis antarctica*) and Gentoo (*P. papua*) penguin numbers at Cape Shirreff.

| Year | Chinstrap (pairs) | Gentoo (pairs) | Source |
|---------|-------------------------|----------------------------|---|
| 1958 | 2000 (N3 ¹) | 200-500 (N1 ¹) | Croxall and Kirkwood, 1979 |
| 1981 | 2164 (A4) | 843 (A4) | Sallaberry and Schlatter, 1983 ² |
| 1987 | 5200 (A3) | 300 (N4) | Woehler, 1993 |
| 1997 | 6907 (N1) | 682 (N1) | Hucke-Gaete <i>et al.</i> 1997a |
| 1999-00 | 7744 (N1) | 922 (N1) | AMLR data, Carten <i>et al.</i> 2001 |
| 2000-01 | 7212 (N1) | 1043 (N1) | AMLR data, Taft <i>et al.</i> 2001 |
| 2001-02 | 6606 | 907 | AMLR data, Saxer <i>et al.</i> 2003 |
| 2002-03 | 5868 (A3) | 778 (A3) | AMLR data, Shill <i>et al.</i> 2003 |
| 2003-04 | 5636 (N1) | 751 (N1) | AMLR data, Antolos <i>et al.</i> 2004 |
| 2004-05 | 4907 (N1) | 818 (N1) | AMLR data, Miller <i>et al.</i> 2005 |
| 2005-06 | 4849 (N1) | 807 (N1) | AMLR data, Leung <i>et al.</i> 2006 |
| 2006-07 | 4544 (N1) | 781 (N1) | AMLR data, Orben <i>et al.</i> 2007 |
| 2007-08 | 3032 (N1) | 610 (N1) | AMLR data, Chisholm <i>et al.</i> 2008 |
| 2008-09 | 4026 (N1) | 879 (N1) | AMLR data, Pietrzak <i>et al.</i> 2009 |

1. Alphanumeric code refers to the type of count, as in Woehler (1993).

2. Reported data did not specify species. It has been assumed that the higher number referred to Chinstrap penguins. Data were reported as individuals, which have been halved to derive 'pairs' in the table.

Breeding mammals

Cape Shirreff (including San Telmo Island) is presently the site of the largest known breeding colony of the Antarctic fur seal in the Antarctic Peninsula region. Antarctic fur seals were once abundant throughout the South Shetland Islands but were hunted to local extinction between 1820 and 1824. The next observation of Antarctic fur seals at Cape Shirreff was on 14 January 1958, when 27 animals were recorded, including seven juveniles (Tufft 1958). The following season, on 31 January 1959, a group of seven adult males, one female and one male pup were recorded, along with one dead male pup (O'Gorman, 1961). A second female arrived three days later, and by mid-March 32 Antarctic fur seals were present. By 2002, the estimated Antarctic fur seal population at Cape Shirreff (excluding San Telmo Island) increased to 14,842 animals (including 6,453 pups), with the total population (including San Telmo Island) being 21,190 animals (including 8577 pups) (Hucke-Gaete *et al.* 2004). More recent data on Antarctic fur seal numbers have yet to be published. However, the present number of Antarctic fur seals at Cape Shirreff remain an order of magnitude lower than pre-exploitation populations, and it is unclear whether numbers will recover to their previous levels (Hucke-Gaete *et al.* 2004).

Antarctic fur seal breeding sites at Cape Shirreff are concentrated around the coastline of the northern half of the peninsula (Map 3). At San Telmo Island, breeding is concentrated at both ends of the island, with juveniles commonly found near the middle (Torres 1995). Long term monitoring of Antarctic fur seals has been carried at Cape Shirreff since 1991, with the primary objective of studying breeding success in relation

to prey availability, environmental variability and human impacts (Osman *et al.* 2004). Researchers have studied various aspects of the fur seal colony, including pup production, predation and growth, female attendance behavior, seal diet and diving and foraging. During the 2009-10 summer season, researchers tagged Antarctic fur seals, along with Weddell seals and Leopard seals, to monitor their behavior over the winter period.

During the 2008-09 season, the AMLR program reported a 13.3% reduction in pup production from the previous summer season (Goebel *et al.* 2009). Pup production at Cape Shirreff was particularly low during both the 2007-08 and 2008-09 seasons, most likely as a result unfavorable winter conditions (Goebel *et al.* 2008; 2009). During recent seasons, growth rates of fur seal pups within the Area have been studied in relation to sex, breeding season and maternal foraging and attendance (Vargas *et al.* 2009) and a number of extremely rare color patterns in fur seal pups have been recorded within the Area. Antarctic fur seals with pie-bald or light colorings were documented for the first time and an albino Weddell seal represented the first confirmed case of albinism in Weddell, Leopard, Ross or Crabeater seals (Acevedo *et al.* 2009a, 2009b).

A small number of Southern Elephant seals breed in October on several eastern beaches (AMLR, pers. comm. 2000; Torres, pers. comm. 2002). On 2 Nov 1999 34 pups were counted on beaches south of Condor Hill (AMLR, unpublished data). During the 2008-09 season, a total of 34 Southern Elephant seal pups were born at Cape Shirreff and an additional six were born on a small sandy point between Cape Shirreff and Punta Oeste (Goebel *et al.* 2009). Groups of non-breeding Southern Elephant seals are also present, while isolated animals, mainly juveniles, may be found on various beaches. The foraging behavior of Southern Elephant seals has been studied using satellite tracking of animals tagged at Cape Shirreff and analyzed in relation to the physical properties of the water column (Huckstadt *et al.* 2006; Goebel *et al.* 2009). Seals were found to forage as far afield as the Amundsen Sea and one animal was observed travelling 4700 km due west of the Antarctic Peninsula.

Weddell seals, Leopard seals and Crabeater seals have been observed on the Cape Shirreff peninsula and are the subject of monitoring programs (O'Gorman 1961; Bengtson *et al.* 1990; Oliva *et al.* 1988; Torres 1995; Goebel, pers. comm. 2010). Monitoring of leopard seal predation on the Antarctic fur seal pup population was initiated in 2001-02 and was recorded during the 2003-04 Antarctic season (Vera *et al.* 2004). Leopard seals hauling out at Cape Shirreff have been fitted with satellite trackers to monitor their foraging range and dispersal. Observations of leopard seal feeding behaviour and pup survival studies suggest that they consume up to half of all Antarctic fur seal pups born within the Area each year (Goebel *et al.* 2008, 2009.). During the 2008-09 field season, DNA samples were collected from four seal species at Cape Shirreff and stored in the Southwest Fisheries Science Center DNA archives (Goebel *et al.* 2009). Humpback whales (*Megaptera novaeangliae*) have been observed in the offshore area immediately to the north-east of the Area (Cox *et al.* 2009).

Marine environment and ecosystem

The seafloor surrounding the Cape Shirreff peninsula slopes relatively gently from the coast, reaching depths of 50 m approximately 2-3 km from the shore and 100 m at about 6-11 km (Map 1). This relatively shallow and broad submarine ridge extends to the NW for about 24 km before dropping more steeply at the continental shelf edge. The ridge is about 20 km in width and flanked either side by canyons reaching depths of around 300-400 m. There is abundant macroalgae present in the intertidal zone. The limpet *Nacella concinna* is common, as elsewhere in the South Shetland Islands.

The waters offshore from Cape Shirreff have been identified as one of three areas of consistently high krill biomass density in the South Shetland Islands area, although absolute krill populations fluctuate significantly over time (Hewitt *et al.* 2004; Reiss *et al.* 2008). The spatial distribution, demography, density and size of krill and krill swarms have been studied in the nearshore region at Cape Shirreff, primarily using acoustic surveys and also using an Autonomous Underwater Vehicle (AUV) (Reiss *et al.* 2008; Warren *et al.* 2005). Acoustic surveys of the nearshore environment indicate that krill in this area are most abundant in to the south and SE of Cape Shirreff and at the margins of the two submarine canyons, which are believed to be a source of nutrient rich water that may increase productivity in the nearshore area surrounding Cape Shirreff (Warren *et al.* 2006, 2007). Nearshore net tows indicated that the organisms identified in acoustic surveys were primarily the euphausiids, *Euphausia superba*, *Thysanoessa macrura* and *Euphausia frigida*, and may also include chaetognaths, salps, siphonophores, larval fish, myctophids and amphipods (Warren *et al.* 2007).

The nearshore environment surrounding Cape Shirreff has been identified as a primary feeding ground for penguins resident at the site, particularly during the breeding season when chick provisioning limits foraging range (Cox *et al.* 2009). Fur seals and penguins at Cape Shirreff depend strongly upon krill for prey, particularly when juvenile. Predator foraging ranges are known to overlap with areas of commercial krill fisheries and changes in the abundance of both predators and krill have been linked to climatic change. Research at Cape Shirreff therefore aims to monitor krill abundance in combination with predator populations and breeding success, in order to assess the potential effects of commercial fishing, as well as environmental variability and climatic change on the ecosystem.

Numerous studies of the marine environment have been conducted in the region offshore from Cape Shirreff as part of research carried out within the AMLR survey grid. These studies include investigations into various aspects of the marine environment, including physical oceanography, environmental conditions, phytoplankton distribution and productivity, krill distribution and biomass and the distribution and density of seabirds and marine mammals (AMLR 2008, 2009).

Historical features

Following discovery of the South Shetland Islands in 1819, intensive sealing at Cape Shirreff between 1820 and 1824 exterminated almost the entire local populations of Antarctic fur seals and Southern Elephant seals (Smith and Simpson 1987). In January 1821 60–75 British sealers were recorded living ashore at Cape Shirreff and 95,000 skins were taken during the 1821–22 season (O’Gorman 1963). Evidence of the sealers’ occupation remains, with ruins of at least one sealers’ hut in the northwestern region of the peninsula and remains of sealer’s settlements recorded on a number of the beaches (D. Torres, A. Aguayo and J. Acevedo, pers. comm. 2010). The shoreline of several bays is also littered with timbers and sections of wrecked sealers’ vessels. Other evidence of sealing activity includes the remains of stoves, pieces of glass bottles, a wooden harpoon, and a handcrafted bone figure (Torres and Aguayo 1993). Fildes (1821) reported that sealers found spars and an anchor stock from the Spanish ship San Telmo on Half Moon Beach around the time she was lost. The ship sank in the Drake Passage at around 62°S on 4 September 1819, with 644 persons aboard (Headland 1989; Pinochet de la Barra 1991). These were possibly the first people to die in Antarctica, and the event remains the greatest single loss of life yet to occur south of 60°S. A cairn has been erected on the northwestern coast of Cape Shirreff peninsula to commemorate the loss, which is designated as Historic Monument No. 59 (Map 3).

The remains of a camp were found close to the site of present camp facilities (Torres and Aguayo 1993). On the evidence of the script on items found at the site, the camp is believed to be of Russian origin and date from the 1940–50s, although its exact origins have yet to be determined. Items found include parts of an antenna, electrical wires, tools, boots, nails, battery cells, canned food, and a wooden box covered by a pyramid of stones. Several notes in Russian, dating from later visits, were found in this box.

In January 1985 a human skull was found at Yamana Beach (Torres 1992), determined to be that of a young woman (Constantinescu and Torres 1995). In January 1987 part of a human femur was found on the ground surface nearby, inland from Yamana Beach. After a careful surface survey, no other remains were evident at that time. However, in January 1991, another part of a femur was found in close proximity to the site of the earlier (1987) find. In January 1993 an archaeological survey was carried out in the area, although no further human remains were found. The original samples were dated as from approximately 175 years BP, and it was hypothesised they belong to a single individual (Torres 1999).

Human activities / impacts

The modern era of human activity at Cape Shirreff has been largely confined to science. During the past three decades, the population of Antarctic fur seals in the South Shetland Islands grew to a level at which tagging and other research could be undertaken without threatening the existence and growth of the local population. Chilean studies on Cape Shirreff began in 1965 (Aguayo and Torres 1966, 1967), with a more intensive program initiated by Chilean scientists in 1982, including an ongoing Antarctic fur seal tagging program (Cattan *et al.* 1982; Torres 1984; Oliva *et al.* 1987). United States investigators have conducted pinniped and seabird surveys at Cape Shirreff and San Telmo Island since 1986–87 (Bengtson *et al.* 1990).

CEMP studies at Cape Shirreff began in the mid-1980s, initiated by Chilean and US scientists. Cape Shirreff was designated as a CEMP Site in 1994 to protect the site from damage or disturbance that could adversely affect long-term CEMP monitoring. As part of the CEMP, long-term studies are assessing and monitoring

the feeding ecology, growth and condition, reproductive success, behavior, vital rates, and abundance of pinnipeds and seabirds that breed in the Area. The results of these studies will be evaluated in context with environmental data, offshore sampling data, and fishery statistics to identify possible cause-effect relationships between krill fisheries and pinniped and seabird populations.

Brucella and herpes virus antibodies were detected in tissue samples taken from Antarctic fur seals at Cape Shirreff over summer seasons from 1998-2001, and Brucella antibodies were also detected in Weddell seal tissue (Blank *et al.* 1999; Blank *et al.* 2001a & b). Studies on the mortality of Antarctic fur seal pups from diseases began in the 2003-04 Antarctic season (Torres and Valdenegro 2004). Enteropathogenic *Escherichia coli* (EPEC) has been recorded in swabs from Antarctic fur seals at Cape Shirreff, with two out of 33 pups sampled testing positive for the pathogen. The findings were the first reports of EPEC in Antarctic wildlife and in pinnipeds, and the effects of the pathogen on Antarctic wildlife is unknown (Hernandez *et al.* 2007).

Plastic rubbish was first reported at Cape Shirreff by Torres and Gajardo (1985), and marine debris monitoring studies have been carried out regularly since 1992 (Torres and Jorquera 1995). Debris remains an ongoing problem at the site, with over 1.5 tons of material removed from the area by Chilean scientists to date (D. Torres, A. Aquayo and J. Acevedo, pers. comm., 2010). Recent surveys have yielded large numbers of articles, mostly made of plastic, but have also included vegetable waste from ships, metal oil drums, rifle shells and an antenna on beaches. For example, the 2000-01 season survey recorded a total of 1,774 articles, almost 98% of which were made of plastic and the remainder made of glass, metal and paper. It is significant that 34% of the plastic items found in 2000-01 were packing bands, representing approximately 589 bands. Of these, 40 were uncut and another 48 had been knotted into a loop. Several articles found in this survey were oiled, and some plastic articles were partially burnt. Antarctic fur seal entanglement in marine debris has been recorded frequently at Cape Shirreff (Torres 1990; Hucke-Gaete *et al.* 1997c; Goebel *et al.* 2008, 2009), primarily in fishing equipment such as nylon ropes, net fragments and packing bands. Between 1987-1997 a total of 20 Antarctic fur seals were recorded with 'neck collars' from such debris. Plastic fibers are also found in Kelp gull and Chinstrap penguin nests (Torres and Jorquera 1992), as well as those of Sheathbills (Torres and Jorquera 1994).

The waters surrounding Cape Shirreff represent an important krill fishing area. Catch data specifically for Cape Shirreff are unavailable, but fishing statistics are published for CCAMLR Statistical Subarea 48.1, within which the Area lies. In 2008-09, 33970 tons of Antarctic krill (*Euphausia superba*) were caught in Subarea 48.1 compared with an average of 32993 tons per year caught during the period 1999-00 to 2008-09 (CCAMLR 2010). On 10 October 2010, the krill fishery in Subarea 48.1 was closed for the remainder of the 2009-10 fishing season (1 December 2009- 30 November 2010) because the catch reached 99.9% of the annual limit for the Subarea (155,000 tonnes). Nations recorded as fishing for krill within the Subarea during the recent past included Japan, Korea, Norway, Poland, Ukraine, Uruguay, the United States and Vanuatu. Krill fishing generally occurred between December and August, with the highest catches usually occurring between March and May. Catches of other species occurred in very much smaller quantities and included *Champocephalus gunnari*, *Champocephalus gunnari*, *Nototheniops nybelini*, *Notothenia coriiceps*, *Notolepis* spp, *Notothenia gibberifrons*, *Notothenia neglecta*, *Notothenia rossii*, *Pseudochaenichthys georgianus* and *Chaenocephalus aceratus* (CCAMLR 2010).

6(ii) Access to the Area

Access to the Area may be made by small boat, by aircraft or across sea ice by vehicle or on foot. Historically seasonal sea ice formation in the South Shetlands area generally began in early April and persisted until early December, although more recently the South Shetland Islands can be ice-free year round as a result of regional warming.

Air access restrictions apply for the period 01 November – 31 March inclusive. During this time, helicopters may land at either of the two helicopter landing sites (Map 2), but landing at site A is preferred under most circumstances. Landing site A is located approximately 150m north-west of the summit of Condor Hill on the eastern side of the peninsula (62°46'27"S, 60°28'17"W). Landing site B is situated on a wide area of flat ground on Ancho Pass, approximately 300m east of Selknam Hill (62°46'48"S, 60°28'16"W). To the maximum extent practicable, aircraft should follow the Helicopter Access Zone when accessing the Area and should approach from the south, across the Livingston Island permanent ice cap. Air access is prohibited within the Restricted Zone, unless authorised by permit. The zone is situated north of 62°28' S (Map 2), or north of 62°29' S and west of 60°48' W and is designated because it contains the highest concentrations of

wildlife in the Area. Due to the presence of wildlife, aircraft are encouraged to maintain a horizontal and vertical separation of 2000 ft (~610 m) from the protected area boundary, unless accessing the designated landing sites or otherwise authorized by permit.

When access to the Area is made from the sea, small boats should land at one of the following locations: the eastern coast of the peninsula at El Módulo Beach, where a deep channel enables relatively easy access; the northern end of Half Moon Beach; the northern end of Yámana Beach, on the western coast (suitable at high tide only); or the southern end of the northern beach on San Telmo Island. Small boats may land at any other location within the Area, provided that this is consistent with the purposes for which a permit has been granted and where practicable, visitors should avoid landing where wildlife colonies are present. Two anchorages have been identified close to the Area; 1600 m north-east of the main camp facilities and approximately 800 m north of San Telmo Island. Sea states are generally between 1 and 4 m, decreasing closer to shore or in lea of Cape Shirreff (Warren *et al.* 2006, 2007).

When sea ice conditions allow, the Area may be accessed over sea ice on foot or by vehicle. However, vehicle use within the Area is restricted to the coastal zone between Módulo Beach and the Chilean / US camp facilities only. Persons entering the Area may not move beyond the immediate vicinity of their landing site unless authorised by Permit.

6(iii) Restricted and managed zones within the Area

A zone in the north and west of the Area is designated as a Restricted Zone, due to its high concentrations of wildlife. Restrictions apply to air access only and prohibit overflight below 2000 ft (~610m), unless specifically authorized by permit. The Restricted Zone is defined as the area north of 62°28' S (Map 2), and north of 62°29' S and west of 60°48' W.

A Helicopter Access Zone (Map 2) has been defined which applies to aircraft entering the Area and accessing the designated landing sites. The Helicopter Access Zone extends from the Livingston Island permanent ice cap northward following the main ridgeline of the peninsula for 1200 m (~0.65 n. mi.) towards Selknam Hill. The Helicopter Access Zone then extends east by 300 m (~0.15 n. mi) (to helicopter landing site B at Ancho Pass and a further 400 m (~0.23 n. mi) east to the summit of Condor Hill close to helicopter landing site. The southern boundary of the Helicopter Access Zone is coincident with the southern boundary of the Area.

6(iv) Structures within and near the Area

A semi-permanent summer-only research camp has been established on the eastern coast of the Cape Shirreff peninsula, located at the base of Condor Hill (62°28'12" S, 60°46'17" W) (Map 3). Buildings for the camp remain *in situ* year-round. In 2010, the field camp known as Cape Shirreff Field Station (US), consisted of four small buildings and an outhouse. The camp 'Dr Guillermo Mann-Fischer' (Chile) is located around 50 m from the US station and comprised of a main hut, laboratory, store house, a fiberglass igloo, an outhouse and a wind-powered generator in 2010 (Goebel pers. comm. 2010, D. Torres, A. Aquayo and J. Acevedo, pers. comm., 2010)). The Chilean fiberglass igloo was originally installed in 1990-91, while the US camp was established in 1996-97. Storage areas are also present, and tents are erected seasonally nearby as required. During the 2009-10 season, an All Terrain Vehicle (ATV) shed, with secondary containment for summer use and winter storage of ATVs, was constructed at the US camp. The site was selected to remain within the existing station footprint and to avoid interference with seal traffic. A 'Weatherport' is stored at Cape Shirreff as additional accommodation for visiting scientists and is erected within 10 m of the south side of the US station when needed.

Two automatic weather stations are mounted on the exterior of existing buildings at Cape Shirreff. A remote receiving station used for seal tracking studies is stored within a box (90x60x100cm) located on a small ridge to the southeast of Mansa Bay.

A boundary marker is located at Módulo Beach, close to the Chilean and US stations. The marker states that the Area is protected and that access is prohibited. In 2009-10 season, the marker was weathered but legible (Goebel, pers. comm. 2010). The boundaries of the protected area are not otherwise marked.

The remains of a camp, believed to be of Russian origin, are present near the Chilean and US camps. In other parts of the peninsula, sparse evidence may be found of 19th Century scalers' camps (Smith and Simpson 1987; Torres 1993; Stehberg and Lucero 1996). A cairn (Historic Monument No. 59) has been erected on

Gaviota Hill on the northwestern coast to commemorate the loss of those aboard the San Telmo in 1819 (Map 3). In 1998-99 a 5x7 m bird observation / emergency hut (62°27'41" S, 60°47'28" W) was installed by US scientists on the northern slopes of Enrique Hill above Bahamonde Beach, close to the penguin colonies (Map 3).

6(v) Location of other protected areas within close proximity of the Area

The nearest protected areas to Cape Shirreff are Byers Peninsula (ASPA No. 126), which lies about 20 km to the southwest; Port Foster (ASPA No. 145, Deception Island) and other parts of Deception Island (ASPA No. 140), which are approximately 30 km to the south; and 'Chile Bay' (Discovery Bay) (ASPA No. 144), which lies about 30 km to the east at Greenwich Island (Map 1).

7. Permit conditions

Entry into the Area is prohibited except in accordance with a Permit issued by an appropriate national authority. Conditions for issuing a Permit to enter the Area are that:

- it is issued only for scientific study associated with the CEMP, or for compelling scientific, educational, archaeological or historic purposes that cannot be served elsewhere; or
- it is issued for essential management purposes consistent with plan objectives such as inspection, maintenance or review;
- the actions permitted will not jeopardize the ecological, scientific, educational archaeological or historic values of the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- the Permit, or a copy, shall be carried within the Area;
- a visit report shall be supplied to the authority named in the Permit;
- permits shall be issued for a stated period.

7(i) Access to and movement within the Area

Access to the Area shall be by small boat, by helicopter, on foot or by vehicle.

Boat access

Access by small boats should be at one of the following locations (Map 2):

1. the eastern coast of the peninsula at El Módulo Beach, 300 m north of the camp facilities, where a deep channel enables relatively easy access;
2. the northern end of Half Moon Beach, on the eastern coast of the peninsula;
3. the northern end of Yámana Beach, on the western coast (suitable at high tide only);
4. the southern end of the northern beach on San Telmo Island.

Access by small boat at other locations around the coast is allowed, provided this is consistent with the purposes for which a Permit has been granted. Two anchorages have been identified close to the Area; 1600 m north-east of the main camp facilities and approximately 800 m north of San Telmo Island. Visitors should, where practicable, avoid landing where pinniped or seabird colonies are present on or near the coast.

Aircraft access and overflight

Due to the widespread presence of pinnipeds and seabirds over the Cape Shirreff peninsula during the breeding season (01 November – 31 March), access to the Area by aircraft in this period is strongly discouraged. Where possible and by preference, access should be by small boat. All restrictions on aircraft access and overflight apply between 01 November – 31 March inclusive, when aircraft shall operate and land within the Area according to strict observance of the following conditions:

- 1) It is recommended that aircraft maintain a horizontal and vertical separation distance 2000 ft (~610 m) from the Antarctic Specially Protected Area boundary (Map 2), unless accessing the designated landing sites through the Helicopter Access Zone or otherwise authorized by permit;
- 2) Overflight of the Restricted Zone is prohibited below 2000 ft (~610 m) unless authorized by permit. The Restricted Zone is defined as the area north of 62°28' S, or north of 62°29' S and west of 60°48' W (Map 2), and includes the areas of greatest wildlife concentration;
- 3) Helicopter landing is permitted at two designated sites (Map 2). The landing sites with their coordinates are described as follows:
 - (A) on a small area of flat ground, ~150 m northwest of the summit of Condor Hill (50 m, or ~150 ft) (62°46'27"S, 60°28'17"W), which is the preferred landing site for most purposes; and
 - (B) on the wide flat area on Ancho Pass (25 m), situated between Condor Hill and Selknam Hill (62°46'48"S, 60°28'16"W).
- 4) Aircraft accessing the Area should follow the Helicopter Access Zone to the maximum extent practicable. The Helicopter Access Zone allows access from the south across the Livingston Island permanent ice cap and extends along the main ridgeline of the peninsula for 1200 m (~ 0.65 n. mi.) towards Selknam Hill (elevation = 50 m, or ~150 ft). The Helicopter Access Zone then extends east by 300m (~ 0.15 n. mi) to Ancho Pass, where helicopter landing site B is situated, and a further 400m (~0.23 n. mi) east to the summit of Condor Hill (elevation = 50 m, or ~150 ft), close to helicopter landing site A. Aircraft should avoid overflight of the hut and beach areas on the eastern side of Condor Hill.
- 5) The preferred approaches to the Helicopter Access Zone are from the south across the Livingston Island permanent ice cap, from the southwest from the direction of Barclay Bay, and from the southeast from the direction of Hero Bay (Maps 1 and 2).
- 6) Weather with a low cloud ceiling often prevails at Cape Shirreff, particularly in the vicinity of the permanent ice cap, which can make snow/ice ground definition difficult to discern from the air. On-site personnel who may be advising on local conditions before aircraft approaches should be aware that a minimum cloud base of 150 m (500 ft) AMSL over the approach zone of the Livingston Island ice cap is necessary in order for access guidelines to be followed;
- 7) Use of smoke grenades to indicate wind direction is prohibited within the Area unless absolutely necessary for safety, and any grenades used should be retrieved.

Vehicle access and use

Access by vehicle over land may be made to the boundary to the Area. Access by vehicle over sea ice may be made to the shore within the Area. Vehicles are permitted to operate on land only in the coastal zone between Módulo Beach and the Chilean / US camp facilities (Map 3). The use of vehicles elsewhere within the Area is prohibited.

Foot access and movement within the Area

With the exception of the restricted use of vehicles described above, movement on land within the Area shall be on foot. Pilots, air, boat or vehicle crew, or other people in aircraft, boats, or vehicles are prohibited from moving on foot beyond the immediate vicinity of their landing site or the hut facilities unless specifically authorised by Permit. Visitors should move carefully so as to minimize disturbance to flora, fauna, and soils, and should walk on snow or rocky terrain if practical, but taking care not to damage lichens. Pedestrian traffic should be kept to the minimum consistent with the objectives of any permitted activities and every reasonable effort should be made to minimize effects.

7(ii) Activities that are or may be conducted in the Area, including restrictions on time or place

- Scientific research that will not jeopardize the values of the Area, in particular those associated with the CEMP;
- Essential management activities, including monitoring;
- Activities with educational aims (such as documentary reporting (photographic, audio or written) or the production of educational resources or services) that cannot be served elsewhere.
- Activities with the aim of preserving or protecting historic resources within the Area.

- Archaeological research that will not threaten the values of the Area.

7(iii) Installation, modification or removal of structures

- No structures are to be erected within the Area except as specified in a permit;
- The principal camp facilities shall be limited to the area within 200 m of the existing Chilean and US field camps (Map 3). Small temporary hides, blinds or screens may be constructed for the purpose of facilitating scientific study of the fauna;
- All structures, scientific equipment or markers installed in the Area must be authorized by permit and clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of harm to fauna or of contamination of the Area;
- Installation (including site selection), maintenance, modification or removal of structures shall be undertaken in a manner that minimizes disturbance to flora and fauna, preferably avoiding the main breeding season (1 November – 31 March);
- Removal of structures, equipment, hides or markers for which the permit has expired shall be the responsibility of the authority which granted the original Permit, and shall be a condition of the Permit;

7(iv) Location of field camps

Camping is permitted within 200 m of the facilities of the Chilean and US field camps, on the eastern coast of the Cape Shirreff peninsula (Map 3). Temporary camping is permitted at the northern extremity of Yamana beach to support fieldwork on the San Telmo Islets (Map 3). The US bird observation hut on the northern slopes of Enrique Hill (62°27'41" S, 60°47'28" W) may be used for temporary overnight camping for research purposes, although should not be used as a semi-permanent camp. Camping is permitted on San Telmo Island when necessary for purposes consistent with plan objectives. The preferred camping location is at the southern end of the northern beach on the island. Camping is prohibited elsewhere within the Area.

7(v) Restrictions on materials and organisms which can be brought into the Area

- No living animals, plant material, microorganisms or soils shall be deliberately introduced into the Area and the precautions listed below shall be taken against accidental introductions;
- To help maintain the ecological and scientific values at Cape Shirreff and San Telmo Island visitors shall take special precautions against introductions. Of concern are pathogenic, microbial, invertebrate or plant introductions sourced from other Antarctic sites, including stations, or from regions outside Antarctica. Visitors shall ensure that sampling equipment and markers brought into the Area are clean. To the maximum extent practicable, footwear and other equipment used or brought into the area (including backpacks, carry-bags and tents) shall be thoroughly cleaned before entering the Area;
- Dressed poultry should be free of disease or infection before shipment to the Area and, if introduced to the Area for food, all parts and wastes of poultry shall be completely removed from the Area or incinerated or boiled long enough to kill any potentially infective bacteria or viruses;
- No herbicides or pesticides shall be brought into the Area;
- Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the Permit, shall be removed from the Area at or before the conclusion of the activity for which the Permit was granted;
- Fuel, food, and other materials are not to be stored in the Area, unless required for essential purposes connected with the activities for which a permit has been granted;
- All materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimized;
- If release occurs which is likely to compromise the values of the Area, removal is encouraged only where the impact of removal is not likely to be greater than that of leaving the material in situ.

7(vi) Taking or harmful interference with native flora or fauna

Taking or harmful interference with native flora or fauna is prohibited, except in accordance with a separate permit issued under Article 3 of Annex II by the appropriate national authority specifically for that purpose.

CEMP research programs in progress within the Area should be consulted before other Permits for taking or harmful interference with animals are granted.

7(vii) Collection or removal of anything not brought into the Area by the Permit holder

- Material may be collected or removed from the Area only in accordance with a Permit and should be limited to the minimum necessary to meet scientific or management needs.
- Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the Permit Holder, and is clearly of no historic value or otherwise authorized, may be removed unless the impact of removal is likely to be greater than leaving the material in situ: if this is the case the appropriate authority should be notified.
- Material found that is likely to possess important archaeological, historic or heritage values should not be disturbed, damaged, removed or destroyed. Any such artifacts should be recorded and referred to the appropriate authority for a decision on conservation or removal. Relocation or removal of artifacts for the purposes of preservation, protection, or to re-establish historical accuracy is allowable by permit;
- The appropriate national authority should be notified of any items removed from the Area that were not introduced by the permit holder.

7(viii) Disposal of waste

All wastes shall be removed from the Area, except human wastes and domestic liquid wastes, which may be removed from the Area or disposed of into the sea.

7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

- 1) Permits may be granted to enter the Area to carry out biological monitoring and site inspection activities, which may involve the collection of limited samples for analysis or review, or for protective measures.
- 2) Any specific sites of long-term monitoring should be appropriately marked.
- 3) To avoid interference with long-term research and monitoring activities or possible duplication of effort, persons planning new projects within the Area should consult with established programs working at Cape Shirreff, such as those of Chile and the US, before initiating the work.
- 4) In view of the fact that geological sampling is both permanent and of cumulative impact, visitors removing geological samples from the Area shall complete a record describing the geological type, quantity and location of samples taken, which should, at a minimum, be deposited with their National Antarctic Data Centre or with the Antarctic Master Directory.

7(x) Requirements for reports

- Parties should ensure that the principal holder for each Permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report form contained in Appendix 4 of Resolution 2 (1998)(CEP I).
- Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the management plan and in organizing the scientific use of the Area.
- The appropriate authority should be notified of any activities/measures undertaken, and / or of any materials released and not removed, that were not included in the authorized permit.

References

Acevedo, J., Vallejos, V., Vargas, R., Torres, J.P. & Torres, D. 2002. Informe científico. ECA XXXVIII (2001/2002). Proyecto INACH 018 "Estudios ecológicos sobre el lobo fino antártico, *Arctocepalus gazella*", cabo Shirreff, isla Livingston, Shetland del Sur, Antártica. Ministerio de Relaciones Exteriores, Instituto Antártico Chileno. N° Ingreso 642/710, 11.ABR.2002.

- Acevedo, J., Aguayo-Lobo, A. & Torres, D. 2009a. Albino Weddell seal at Cape Shirreff, Livingston Island, Antarctica. *Polar Biology* **32** (8):1239–43.
- Acevedo, J., Aguayo-Lobo, A. & Torres, D. 2009b. Rare piebald and partially leucistic Antarctic fur seals, *Arctocephalus gazella*, at Cape Shirreff, Livingston Island, Antarctica. *Polar Biology* **32** (1): 41–45.
- Agnew, A.J. 1997. Review: the CCAMLR Ecosystem Monitoring Programme. *Antarctic Science* **9** (3): 235-242.
- Aguayo, A. 1978. The present status of the Antarctic fur seal *Arctocephalus gazella* at the South Shetland Islands. *Polar Record* **19**: 167-176.
- Aguayo, A. & Torres, D. 1966. A first census of Pinnipedia in the South Shetland Islands and other observations on marine mammals. In: SCAR / SCOR / IAPO / IUBS Symposium on Antarctic Oceanography, Santiago, Chile, 13-16 September 1966, Section 4: Coastal Waters: 166-168.
- Aguayo, A. & Torres, D. 1967. Observaciones sobre mamíferos marinos durante la Vigésima Comisión Antártica Chilena. Primer censo de pinípedos en las Islas Shetland del Sur. *Revta. Biol. Mar.*, **13**(1): 1-57.
- Aguayo, A. & Torres, D. 1993. Análisis de los censos de *Arctocephalus gazella* efectuados en el Sitio de Especial Interés Científico No. 32, isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **43**: 87-91.
- AMLR 2008. AMLR 2007-2008 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. October 2008.
- AMLR 2009. AMLR 2008-2009 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. May 2009.
- Antolos, M., Miller, A.K. & Trivelpiece, W.Z. 2004. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2003-2004. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2003-2004 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Bengston, J.L., Ferm, L.M., Härkönen, T.J. & Stewart, B.S. 1990. Abundance of Antarctic fur seals in the South Shetland Islands, Antarctica, during the 1986/87 austral summer. In: Kerry, K. and Hempel, G. (Eds). *Antarctic Ecosystems, Proceedings of the Fifth SCAR Symposium on Antarctic Biology*. Springer-Verlag, Berlin: 265-270.
- Blank, O., Retamal, P., Torres D. & Abalos, P. 1999. First record of *Brucella* spp. antibodies in *Arctocephalus gazella* and *Leptonychotes weddelli* from Cape Shirreff, Livingston Island, Antarctica. (SC-CAMLR-XVIII/BG/17.) *CCAMLR Scientific Abstracts* 5.
- Blank, O., Retamal, P., Abalos P. & Torres, D. 2001a. Additional data on anti-*Brucella* antibodies in *Arctocephalus gazella* from Cape Shirreff, Livingston Island, Antarctica. *CCAMLR Science* **8**: 147-154.
- Blank, O., Montt, J.M., Celedón M. & Torres, D. 2001b. Herpes virus antibodies in *Arctocephalus gazella* from Cape Shirreff, Livingston Island, Antarctica. WG-EMM- 01/59.
- Bonner, W.N. & Smith, R.I.L. (Eds) 1985. *Conservation areas in the Antarctic*. SCAR, Cambridge: 59-63.
- Carten, T.M., Taft, M., Trivelpiece W.Z. & Holt, R.S. 2001. Seabird research at Cape Shirreff, Livingston Island, Antarctica, 1999/2000. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 1999-2000 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Cattan, P., Yáñez, J., Torres, D., Gajardo, M. & Cárdenas, J. 1982. Censo, marcaje y estructura poblacional del lobo fino antártico *Arctocephalus gazella* (Peters, 1875) en las islas Shetland del Sur, Chile. *Serie Científica Instituto Antártico Chileno* **29**: 31-38.
- CCAMLR 1997. Management plan for the protection of Cape Shirreff and the San Telmo Islands, South Shetland Islands, as a site included in the CCAMLR Ecosystem Monitoring Program. In: *Schedule of Conservation Measures in Force 1996/97*: 51-64.
- CCAMLR 2010. *CCAMLR Statistical Bulletin* **22** (2000–2009). CCAMLR, Hobart, Australia.

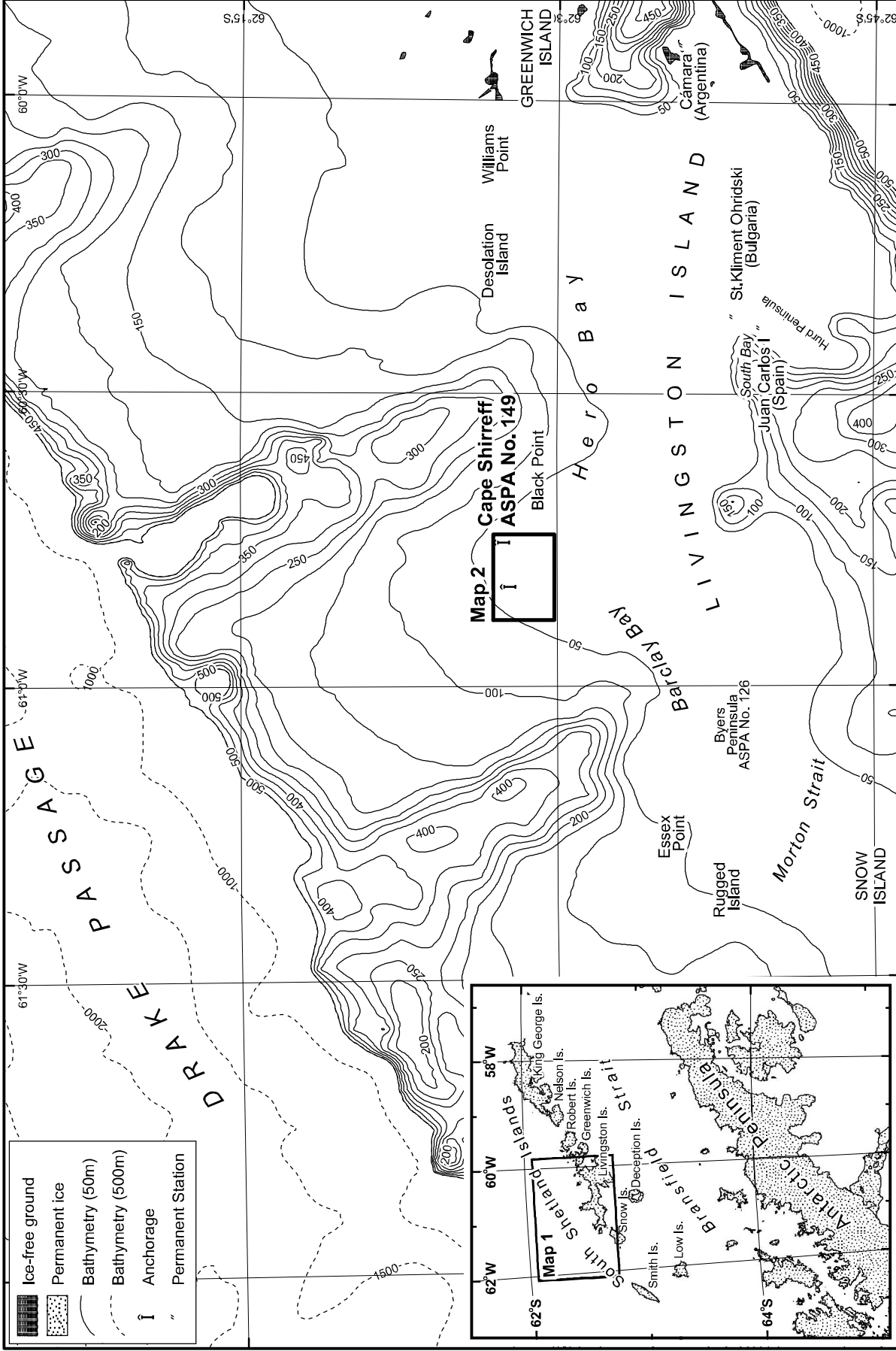
- Chisholm, S.E., Pietrzak, K.W., Miller, A.K. & Trivelpiece, W.Z. 2008. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2007-2008. In Van Cise, A.M. (ed) AMLR (Antarctic Marine Living Resources) 2007-2008 Field Season Report, Ch. 5. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Constantinescu, F. & Torres, D. 1995. Análisis bioantropológico de un cráneo humano hallado en cabo Shirreff, isla Livingston, Antártica. Ser. Cient. INACH **45**: 89-99.
- Cox, M.J., Demer, D.A., Warren, J.D., Cutter, G.R. & Brierley, A.S. 2009. Multibeam echosounder observations reveal interactions between Antarctic krill and air-breathing predators. *Marine Ecology Progress Series* **378**: 199–209.
- Croxall, J.P. & Kirkwood, E.D. 1979. *The distribution of penguins on the Antarctic Peninsula and the islands of the Scotia Sea*. British Antarctic Survey, Cambridge.
- Everett, K.R. 1971. Observations on the glacial history of Livingston Island. *Arctic* **24** (1): 41-50.
- Fildes, R. 1821. A journal of a voyage from Liverpool towards New South Shetland on a sealing and sea elephant adventure kept on board Brig Robert of Liverpool, Robert Fildes, 13 August - 26 December 1821. MS 101/1, Scott Polar Research Institute, Cambridge.
- Goebel, M.E., Rutishauser, M., Parker, B., Banks, A., Costa, D.P., Gales, N. & Holt, R.S. 2001a. Pinniped research at Cape Shirreff, Livingston Island, Antarctica, 1999/2000. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 1999-2000 Field Season Report, Ch. 8. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Goebel, M.E., Parker, B., Banks, A., Costa, D.P., Pister, B. & Holt, R.S. 2001b. Pinniped research at Cape Shirreff, Livingston Island, Antarctica, 2000/2001. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2000-01 Field Season Report, Ch. 8. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Goebel, M.E., McDonald, B.I., Freeman, S., Haner, R., Spear, N. & Sexton, S. 2008. Pinniped Research at Cape Shirreff, Livingston Island, 2008/09. In AMLR 2007-2008 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. La Jolla, California.
- Goebel, M.E., Krause, D., Freeman, S., Burner, R., Bonin, C., Vasquez del Mercado, R., Van Cise, A.M. & Gafney, J. 2009. Pinniped Research at Cape Shirreff, Livingston Island, Antarctica, 2008/09. In AMLR 2008-2009 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. La Jolla, California.
- García, M., Aguayo, A. & Torres, D. 1995. Aspectos conductuales de los machos de lobo fino antártico, *Arctocephalus gazella* en Cabo Shirreff, isla Livingston, Antártica, durante la fase de apareamiento. *Serie Científica Instituto Antártico Chileno* **45**: 101-112.
- Harris, C.M. 2001. Revision of management plans for Antarctic protected areas originally proposed by the United States of America and the United Kingdom: Field visit report. Internal report for the National Science Foundation, US, and the Foreign and Commonwealth Office, UK. *Environmental Research & Assessment*, Cambridge.
- Headland, R. 1989. *Chronological list of Antarctic expeditions and related historical events*. Cambridge University Press, Cambridge.
- Heap, J. (ed) 1994. *Handbook of the Antarctic Treaty System*. 8th Edn. U.S. Department of State, Washington.
- Hobbs, G.J. 1968. The geology of the South Shetland Islands. IV. The geology of Livingston Island. *British Antarctic Survey Scientific Reports* **47**.
- Henadez, J., Prado, V., Torres, D., Waldenström, J., Haemig, P.D. & Olsen, B. 2007. Enteropathogenic *Escherichia coli* (EPEC) in Antarctic fur seals *Arctocephalus gazella*. *Polar Biology* **30** (10):1227–29.
- Hewitt, R.P., Kim, S., Naganobu, M., Gutierrez, M., Kang, D., Taka, Y., Quinones, J., Lee Y.-H., Shin, H.-C., Kawaguchi, S., Emery, J.H., Demer, D.A. & Loeb, V.J. 2004. Variation in the biomass density and demography of Antarctic krill in the vicinity of the South Shetland Islands during the 1999/2000 austral summer. *Deep-Sea Research II* **51** 1411–1419.

- Hinke, J.T., Salwicka, K., Trivelpiece, S.G., Watters, S.G., & Trivelpiece, W.Z. 2007. Divergent responses of *Pygoscelis* penguins reveal a common environmental driver. *Oecologia* **153**:845–855.
- Hucke-Gaete, R., Acevedo, J., Osman, L., Vargas, R., Blank, O. & Torres, D. 2001. Informe científico. ECA XXXVII (2000/2001). Proyecto 018 "Estudios ecológicos sobre el lobo fino antártico, *Arctocephalus gazella*", cabo Shirreff, isla Livingston, Shetland del Sur, Antártica.
- Hucke-Gaete, R., Torres, D., Aguayo, A. & Vallejos, V. 1998. Decline of *Arctocephalus gazella* population at SSSI No. 32, South Shetlands, Antarctica (1997/98 season): a discussion of possible causes. WG-EMM-98/17. August 1998. Kochin. 10: 16–19
- Hucke-Gaete, R., Torres, D. & Vallejos, V. 1997a. Population size and distribution of *Pygoscelis antarctica* and *P. papua* at Cape Shirreff, Livingston Island, Antarctica (1996/97 Season). CCAMLR WG-EMM-97/62.
- Hucke-Gaete, R., Torres, D., Vallejos, V. & Aguayo, A. 1997b. Population size and distribution of *Arctocephalus gazella* at SSSI No. 32, Livingston Island, Antarctica (1996/97 Season). CCAMLR WG-EMM-97/62.
- Hucke-Gaete, R., Torres, D. & Vallejos, V. 1997c. Entanglement of Antarctic fur seals, *Arctocephalus gazella*, by marine debris at Cape Shirreff and San Telmo Islets, Livingston Island, Antarctica:1998-1997. *Serie Científica Instituto Antártico Chileno* **47**: 123-135.
- Hucke-Gaete, R., Osman, L.P., Moreno, C.A. & Torres, D. 2004. Examining natural population growth from near extinction: the case of the Antarctic fur seal at the South Shetlands, Antarctica. *Polar Biology* **27** (5): 304–311
- Huckstadt, L., Costa, D. P., McDonald, B. I., Tremblay, Y., Crocker, D. E., Goebel, M. E. & Fedak, M. E. 2006. Habitat Selection and Foraging Behavior of Southern Elephant Seals in the Western Antarctic Peninsula. American Geophysical Union, Fall Meeting 2006, abstract #OS33A-1684.
- INACH (Instituto Antártico Chileno) 2010. Chilean Antarctic Program of Scientific Research 2009-2010. Chilean Antarctic Institute Research Projects Department. Santiago, Chile.
- Kawaguchi, S., Nicol, S., Taki, K. & Naganobu, M. 2006. Fishing ground selection in the Antarctic krill fishery: Trends in patterns across years, seasons and nations. *CCAMLR Science*, **13** : 117–141.
- Leppe, M., Fernandoy, F., Palma-Heldt, S. & Moisan, P 2004. Flora mesozoica en los depósitos morrénicos de Cabo Shirreff, Isla Livingston, Shetland del Sur, Península Antártica, in Actas del 10º Congreso Geológico Chileno. CD-ROM. Resumen Expandido, 4pp. Universidad de Concepción. Concepción. Chile.
- Leung, E.S.W., Orben, R.A. & Trivelpiece, W.Z. 2006. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2005-2006. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2005-2006 Field Season Report, Ch. 9. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Miller, A.K., Leung, E.S.W. & Trivelpiece, W.Z. 2005. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2004-2005. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2004-2005 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Miller, A.K. & Trivelpiece, W.Z. 2007. Cycles of *Euphausia superba* recruitment evident in the diet of Pygoscelid penguins and net trawls in the South Shetland Islands, Antarctica. *Polar Biology* **30** (12):1615–1623.
- Miller, A.K. & Trivelpiece, W.Z. 2008. Chinstrap penguins alter foraging and diving behavior in response to the size of their principle prey, Antarctic krill. *Marine Biology* **154**: 201-208.
- Miller, A.K., Karnovsky, N.J. & Trivelpiece, W.Z. 2008. Flexible foraging strategies of gentoo penguins *Pygoscelis papua* over 5 years in the South Shetland Islands, Antarctica. *Marine Biology* **156**: 2527-2537.
- O’Gorman, F.A. 1961. Fur seals breeding in the Falkland Islands Dependencies. *Nature* **192**: 914-16.
- O’Gorman, F.A. 1963. The return of the Antarctic fur seal. *New Scientist* **20**: 374-76.

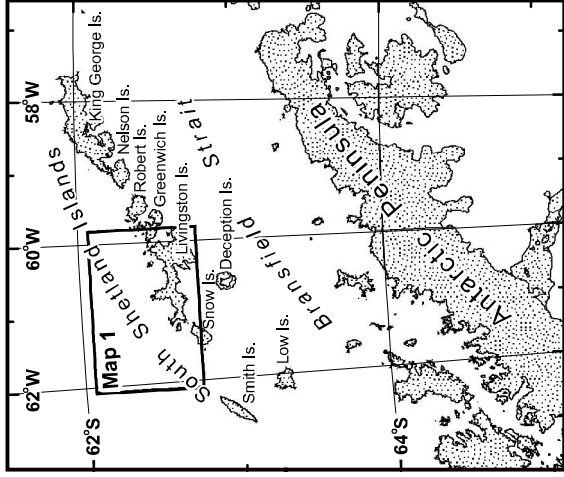
- Olavarría, C., Coria, N., Schlatter, R., Hucke-Gaete, R., Vallejos, V., Godoy, C., Torres D. & Aguayo, A. 1999. Cisnes de cuello negro, *Cygnus melanocoripha* (Molina, 1782) en el área de las islas Shetland del Sur y península Antártica. *Serie Científica Instituto Antártico Chileno* **49**: 79-87.
- Oliva, D., Durán, R., Gajardo, M. & Torres, D. 1987. Numerical changes in the population of the Antarctic fur seal *Arctocephalus gazella* at two localities of the South Shetland Islands. *Serie Científica Instituto Antártico Chileno* **36**: 135-144.
- Oliva, D., Durán, R., Gajardo, M. & Torres, D. 1988. Population structure and harem size groups of the Antarctic fur seal *Arctocephalus gazella* Cape Shirreff, Livingston Island, South Shetland Islands. Meeting of the SCAR Group of Specialists on Seals, Hobart, Tasmania, Australia. *Biomass Report Series* **59**: 39.
- Orben, R.A., Chisholm, S.E., Miller, S.K. & Trivelpiece, W.Z. 2007. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2006-2007. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2006-2007 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Osman, L.P., Hucke-Gaete, R., Moreno, C.A., & Torress, D. 2004. Feeding ecology of Antarctic fur seals at Cape Shirreff, South Shetlands, Antarctica. *Polar Biology* **27**(2): 92-98.
- Palma-Heldt, S., Fernandoy, F., Quezada, I. & Leppe, M 2004. Registro Palinológico de Cabo Shirreff, Isla Livingston, nueva localidad para el Mesozoico de Las Shetland del Sur, in V Simposio Argentino y I Latinoamericano sobre Investigaciones Antárticas CD-ROM. Resumen Expandido N° 104GP. Buenos Aires, Argentina.
- Palma-Heldt, S., Fernandoy, F., Henríquez, G. & Leppe, M 2007. Palynoflora of Livingston Island, South Shetland Islands : Contribution to the understanding of the evolution of the southern Pacific Gondwana margin. U.S. Geological Survey and The National Academies; USGS OF-2007-1047, Extended Abstract 100.
- Pietrzak, K.W., Breeden, J.H, Miller, A.K. & Trivelpiece, W.Z. 2009. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2008-2009. In Van Cise, A.M. (ed) AMLR (Antarctic Marine Living Resources) 2008-2008 Field Season Report, Ch. 6. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Pinochet de la Barra, O. 1991. El misterio del "San Telmo". ¿Náufragos españoles pisaron por primera vez la Antártida? *Revista Historia* (Madrid), **16** (18): 31-36.
- Reid, K., Jessop, M.J., Barrett, M.S., Kawagucji, S., Siegel, V. & Goebel, M.E. 2004. Widening the net: spatio-temporal variability in the krill population structure across the Scotia Sea. *Deep-Sea Research II* **51**: 1275-1287
- Reiss, C. S., Cossio, A. M., Loeb, V. & Demer, D. A. 2008. Variations in the biomass of Antarctic krill (*Euphausia superba*) around the South Shetland Islands, 1996-2006. *ICES Journal of Marine Science* **65**: 497-508.
- Sallaberry, M. & Schlatter, R. 1983. Estimación del número de pingüinos en el Archipiélago de las Shetland del Sur. *Serie Científica Instituto Antártico Chileno* **30**: 87-91.
- Saxer, I.M., Scheffler, D.A. & Trivelpiece, W.Z. 2003. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2001-2002. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2001-2002 Field Season Report, Ch. 6. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Shill, L.F., Antolos, M. & Trivelpiece, W.Z. 2003. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2002-2003. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2002-2003 Field Season Report, Ch. 8. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Smellie, J.L., Pallàs, R.M., Sàbata, F. & Zheng, X. 1996. Age and correlation of volcanism in central Livingston Island, South Shetland Islands: K-Ar and geochemical constraints. *Journal of South American Earth Sciences* **9** (3/4): 265-272.

- Smith, R.I.L. & Simpson, H.W. 1987. Early Nineteenth Century sealers' refuges on Livingston Island, South Shetland Islands. *British Antarctic Survey Bulletin* **74**: 49-72.
- Stehberg, R. & V. Lucero, 1996. Excavaciones arqueológicas en playa Yámana, cabo Shirreff, isla Livingston, Shetland del Sur, Antártica. *Serie Científica Instituto Antártico Chileno* **46**: 59-81.
- Taft, M.R., Saxer, I.M. & Trivelpiece W.Z 2001. Seabird research at Cape Shirreff, Livingston Island, Antarctica, 2000/2001. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2000-01 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.
- Torres, D. 1984. Síntesis de actividades, resultados y proyecciones de las investigaciones chilenas sobre pinípedos antárticos. *Boletín Antártico Chileno* **4**(1): 33-34.
- Torres, D. 1990. Collares plásticos en lobos finos antárticos: Otra evidencia de contaminación. *Boletín Antártico Chileno* **10** (1): 20-22 .
- Torres, D. 1992. ¿Cráneo indígena en cabo Shirreff? Un estudio en desarrollo. *Boletín Antártico Chileno* **11** (2): 2-6.
- Torres, D. 1994. Synthesis of CEMP activities carried out at Cape Shirreff. Report to CCAMLR WG-CEMP 94/28.
- Torres, D. 1995. Antecedentes y proyecciones científicas de los estudios en el SEIC No. 32 y Sitio CEMP «Cabo Shirreff e islotes San Telmo», isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **45**: 143-169.
- Torres, D. 1999. Observations on ca. 175-Year Old Human Remains from Antarctica (Cape Shirreff, Livingston Island, South Shetlands). *International Journal of Circumpolar Health* **58**: 72-83.
- Torres, D. & Aguayo, A. 1993. Impacto antrópico en cabo Shirreff, isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **43**: 93-108.
- Torres, D. & Gajardo, M. 1985. Información preliminar sobre desechos plásticos hallados en cabo Shirreff, isla Livingston, Shetland del Sur, Chile. *Boletín Antártico Chileno* **5**(2): 12-13.
- Torres, D. & Jorquera, D. 1992. Analysis of Marine Debris found at Cape Shirreff, Livingston Island, South Shetlands, Antarctica. SC-CAMLR/BG/7, 12 pp. CCAMLR, Hobart, Australia.
- Torres, D. & Jorquera, D. 1994. Marine Debris Collected at Cape Shirreff, Livingston Island, during the Antarctic Season 1993/94. CCMALR-XIII/BG/17, 10 pp. 18 October 1994. Hobart, Australia.
- Torres, D. & Jorquera, D. 1995. Línea de base para el seguimiento de los desechos marinos en cabo Shirreff, isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **45**: 131-141.
- Torres, D., Jaña, R., Encina, L. & Vicuña, P. 2001. Cartografía digital de cabo Shirreff, isla Livingston, Antártica: un avance importante. *Boletín Antártico Chileno* **20** (2): 4-6.
- Torres, D.E. & Valdenegro V. 2004. Nuevos registros de mortalidad y necropsias de cachorros de lobo fino antártico, *Arctocephalus gazella*, en cabo Shirreff, isla Livingston, Antártica. *Boletín Antártico Chileno* **23** (1).
- Torres, D., Vallejos, V., Acevedo, J., Hucke-Gaete, R. & Zarate, S. 1998. Registros biológicos atípico en cabo Shirreff, isla Livingston, Antártica. *Boletín Antártico Chileno* **17** (1): 17-19.
- Torres, D., Vallejos, V., Acevedo, J., Blank, O., Hucke-Gaete, R. & Tirado, S. 1999. Actividades realizadas en cabo Shirreff, isla Livingston, en temporada 1998/99. *Boletín Antártico Chileno* **18** (1): 29-32.
- Torres, T. 1993. Primer hallazgo de madera fósil en Cabo Shirreff, isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **43**: 31-39.
- Tufft, R. 1958. Preliminary biology report Livingston Island summer survey. Unpublished British Antarctic Survey report, BAS Archives Ref. AD6/2D/1957/N2.
- Vargas, R., Osman, L.P. & Torres, D. 2009. Inter-sexual differences in Antarctic fur seal pup growth rates: evidence of environmental regulation? *Polar Biology* **32** (8):1177–86

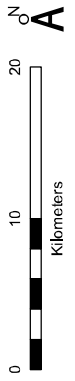
- Vallejos, V., Acevedo, J., Blank, O., Osman, L. & Torres, D. 2000. Informe científico - logístico. ECA XXXVI (1999/2000). Proyecto 018 "Estudios ecológicos sobre el lobo fino antártico, *Arctocephalus gazella*", cabo Shirreff, archipiélago de las Shetland del Sur, Antártica. Ministerio de Relaciones Exteriores, Instituto Antártico Chileno. N° Ingreso 642/712, 19 ABR.2000.
- Vallejos, V., Osman, L., Vargas, R., Vera, C. & Torres, D. 2003. Informe científico. ECA XXXIX (2002/2003). Proyecto INACH 018 "Estudios ecológicos sobre el lobo fino antártico, *Arctocephalus gazella*", cabo Shirreff, isla Livingston, Shetland del Sur, Antártica. Ministerio de Relaciones Exteriores, Instituto Antártico Chileno.
- Vera, C., Vargas, R. & Torres, D. 2004. El impacto de la foca leopardo en la población de cachorros de lobo fino antártico en cabo Shirreff, Antártica, durante la temporada 2003/2004. *Boletín Antártico Chileno* 23 (1).
- Warren, J., Sessions, S., Patterson, M. Jenkins, A., Needham, D. & Demer, D. 2005. Nearshore Survey. In AMLR 2004-2005 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. La Jolla, California.
- Warren, J., Cox, M., Sessions, S. Jenkins, A., Needham, D. & Demer, D. 2006. Nearshore acoustical survey near Cape Shirreff, Livingston Island. In AMLR 2005-2006 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. La Jolla, California.
- Warren, J., Cox, M., Sessions, S. Jenkins, A., Needham, D. & Demer, D. 2007. Nearshore acoustical survey near Cape Shirreff, Livingston Island. In AMLR 2006-2007 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. La Jolla, California.
- Woehler, E.J. (ed) 1993. *The distribution and abundance of Antarctic and sub-Antarctic penguins*. SCAR, Cambridge.



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| | Ice-free ground |
| | Permanent ice |
| | Bathymetry (50m) |
| | Bathymetry (500m) |
| | Anchorage |
| | Permanent Station |

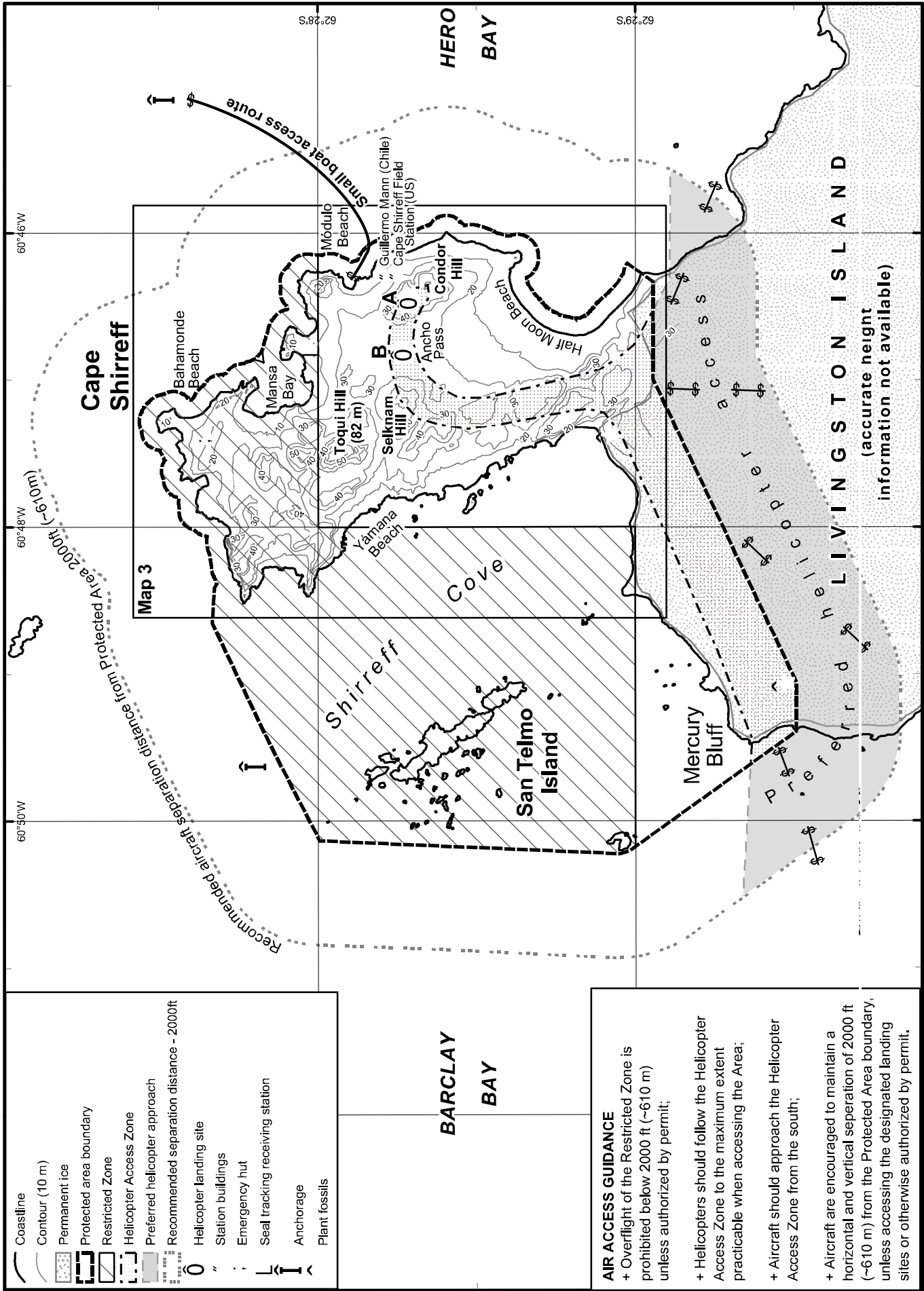


Projection: Lambert Conformal Conic; Spheroid: WGS84
 1st Standard Parallel: 60° S; 2nd Standard Parallel: 64° S
 Central Meridian 60° 45' W; Latitude of origin 62° S
 Data sources:
 Bathymetry: supplied by D. Demer & AMLR, NOAA, 2002
 Land features: SCAR Antarctic Digital Database v.4.1, 2004



09 March 2011
 United States Antarctic Program / INACH
 Environmental Research & Assessment

ASPANo. 149
Cape Shirreff & San Telmo Island
Map 1: Regional overview

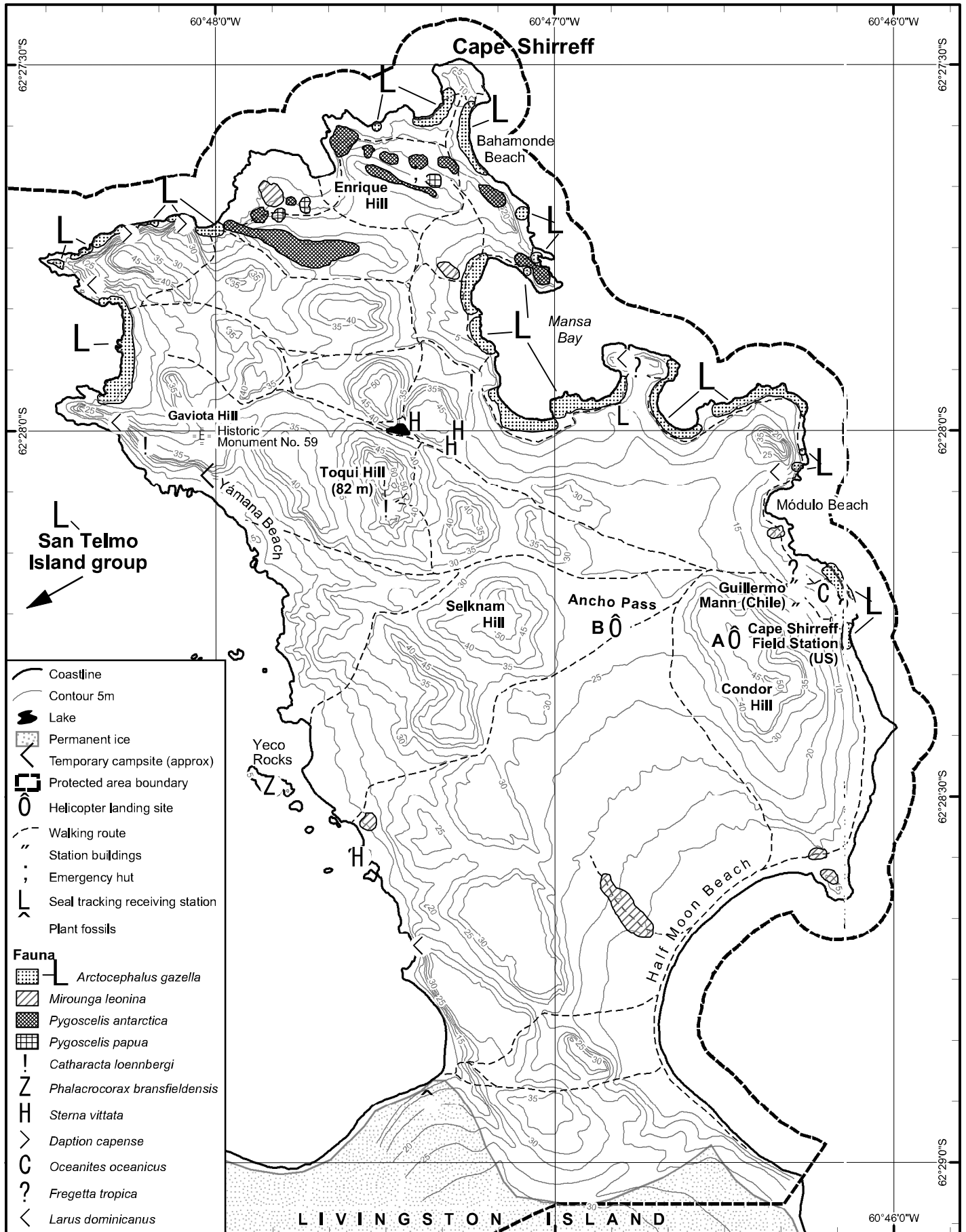


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|--|--|
| | Coastline |
| | Contour (10 m) |
| | Permanent ice |
| | Protected area boundary |
| | Restricted Zone |
| | Helicopter Access Zone |
| | Preferred helicopter approach |
| | Recommended separation distance - 2000ft |
| | Helicopter landing site |
| | Station buildings |
| | Emergency hut |
| | Seal tracking receiving station |
| | Anchorage |
| | Plant fossils |

BARCLAY BAY

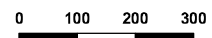
AIR ACCESS GUIDANCE

- + Overflight of the Restricted Zone is prohibited below 2000 ft (~610 m) unless authorized by permit;
- + Helicopters should follow the Helicopter Access Zone to the maximum extent practicable when accessing the Area;
- + Aircraft should approach the Helicopter Access Zone from the south;
- + Aircraft are encouraged to maintain a horizontal and vertical separation of 2000 ft (~610 m) from the Protected Area boundary, unless accessing the designated landing sites or otherwise authorized by permit.



Projection: Lambert Conformal Conic
 CM 60° 45'W; SP1 60° S; SP2 64° S; LO 62° S
 Spheroid: WGS84
 Data sources: Seal tracking station: M. Goebel (2010);
 All other data: Instituto Antártico Chileno (INACH)

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Map 3: Breeding colonies & human features



Meters
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 United States Antarctic Program / INACH
 Environmental Research & Assessment

