

Management Plan for Antarctic Specially Protected Area No. 149

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

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) following the initiative of Chile in the light of results from the first census of Pinnipedia carried out in the South Shetland Islands (Aguayo and Torres, 1966). Formal proposal of the SPA was made by the United States of America. 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 increase. 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 that could be 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 United States of America. 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 programme 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 USA, 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.

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, reproduction parameters: it numbered around 20,000 individuals in 2003-2004. 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 CEMP, monitoring is 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 compared alongside environmental and other biological data and fisheries statistics in order to help identify possible cause-effect relationships between fisheries and pinniped and seabird populations.

In 2001 imprints of megaflores were discovered in rocks incorporated within moraines of the Livingston Island glacier (Palma-Heldt *et al.*, in review 2004) (Map 2). The fossiliferous rocks

II. Measures

are of two different ages, and early interpretations suggest the rocks may assist understanding relationships between nearby fossil localities at Williams Point and Byers Peninsula, also on Livingston Island (Map 1). Studies of the fossils are on-going and it is important that they are protected from over-sampling.

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 boundaries of the Area designated under Recommendation XV-7 have been revised in this Management Plan to include a larger marine component and also to incorporate the two new sites where plant fossils were discovered (Maps 1 and 2). The designated Area (9.7 km²) 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 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, and includes the adjacent part of the Livingston Island permanent ice cap where the fossil discoveries were recently made.

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 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:
 - a. accommodation facilities at Cape Shirreff;
 - b. Saint Kliment Ohridski Station (Bulgaria), Hurd Peninsula, Livingston Island;
 - c. Arturo Prat Station (Chile), Discovery Bay/Chile Bay, Greenwich Island; and
 - d. 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 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.

- 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.

4. Period of Designation

Designated for an indefinite period.

5. Maps

- Map 1: Cape Shirreff and San Telmo Island, ASPANo. 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 (ASPANo. 126), also on Livingston Island.

Map specifications: Projection: Lambert Conformal Conic; Spheroid: WGS84; Standard parallels: 1st 60°00' S; 2nd 64°00' S; Central Meridian: 60°45' W; Latitude of Origin: 62°00' S; Horizontal accuracy: $< \pm 200$ m. Bathymetric contour interval 50 m and 500 m; vertical accuracy unknown. Data sources: land features from SCAR Antarctic Digital Database v. 4.0 (2002); bathymetry supplied by D. Demer & AMLR, NOAA, USA (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, ASPANo. 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, ASPANo. 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

General description

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.

Boundaries

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

II. Measures

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 62°29' S, passing around the western shore of a small island and proceeding a further 1.2 km south-east to the shore of Livingston Island at 62°28'30" 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).

Meteorology

Meteorological records for Cape Shirreff have been collected for a number of years by Chilean and US scientists. Data for recent summer seasons (4 Dec-24 Feb, 1998-99, 1999-2000 and 2000-01) recorded a mean daily air temperature of between 2.0°C and 2.5°C (Goebel et al. 2000; 2001). Precipitation recorded in these seasons (21 Dec-24 Feb) ranged from 56.0 mm (recorded on 36 days in 2000-01) to 59.6 mm (recorded on 43 days in 1998-99). Year-round meteorological data have not been collected at Cape Shirreff. The peninsula is snow-covered for much of the year, but is usually mostly snow-free by the end of the summer. The peninsula is particularly exposed to weather from the Drake Passage in the north and northwest, the directions from which winds prevail.

Geology, Geomorphology and soils

The geology at Cape Shirreff has not been studied in detail. The Cape Shirreff peninsula is predominantly a raised marine platform, 46 to 53 m above sea level, formed of inclined lava flows belonging to the Younger Volcanic Group of the Middle Jurassic to Lower Cretaceous (Bonner and Smith, 1985). The rocks are volcanic and volcanoclastic, including greenish andesite, basalt lavas, tuffs and agglomerates. 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 a.s.l (Hobbs, 1968).

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 glacier (Palma-Heldt et al., in review 2004) (Map 2). Rocks in the first group are assigned to the Carnian-Lias (Upper Triassic-Lower Jurassic), and the dominant plant taxa are *Cladophlebis oblonga* Halle, *C. antarctica* Nathorst, *Taeniopteris* Brongniart, *Goepfertella neuqueniana* Herbst, *Coniopteris cf. hymenophylloides* Brongniart, *Sphenopteris metzgerioides* Harris, and *S. anderssonii* Halle. The second group consists of rocks assigned to the Lower Cretaceous, and is dominated by conifers from the Araucareaceae Family and *Ptilophyllum acutifolium* Morris.

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

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.

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 the chinstrap and gentoo penguins are found in small colonies on the northeastern and northwestern coasts of Cape Shirreff peninsula (Map 3). In 2000-01 there were 29 active breeding sub-colonies – 16 chinstrap, seven gentoo, and six with both species (Taft et al. 2001) – although the number of the sub-colonies and their composition show some inter-annual variation. In general, the chinstrap penguins nest on higher escarpments, although are also found breeding on small promontories near the shore. Gentoo penguins tend to breed on more gentle slopes and rounded promontories. Data available on penguin numbers are presented in Table 1.

Several other species breed within the Area (Map 3), although data on numbers are intermittent. 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 (Wayne Trivelpiece, U.S. Antarctic Marine Living Resources Program, pers. comm. 2000; Saxer et al. 2003; Shill et al. 2003; Taft et al. 2001). 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 (Daniel Torres, Instituto Antartico Chileno, 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 shags (*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 petrels (*Oceanites oceanicus*) also breed on the western coast of the Area. Black-bellied storm petrels (*Fregatta tropica*) have been observed to breed near the field camp on the eastern coast.

II. Measures

A large number of non-breeding southern giant petrels (*Macronectes giganteus*) frequent the Area in the summer, although a report of a breeding colony on the peninsula (Bonner 1989, in Heap 1994) is incorrect (Daniel Torres, Instituto Antartico Chileno, pers. comm. 2002). Other bird species recorded but not breeding within the Area include macaroni penguins (*Eudyptes chrysolophus*), king penguins (*Aptenodytes patagonicus*) snow petrels (*Pagadroma nivea*), white-rumped sandpipers (*Calidris fuscicollis*), black-necked swan (*Cygnus melanocorypha*), and the heron *Bubulcus ibis* (Torres, 1995; Olavarría et al., 1999).

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

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 and San Telmo Island are presently the site of the largest known breeding colony of the Antarctic fur seal (*Arctocephalus gazella*) 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 (Tuftt, 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. A second female arrived three days later, and by mid-March 32 Antarctic fur seals were present. The colony has continued to increase in size, as shown in Table 2. 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 either end of the island, with juveniles commonly found near the middle (Torres, 1995). A small number of southern elephant seals (*Mirounga leonina*) breed in October on beaches at Half Moon Bay (U.S. Antarctic Marine Living Resources Program, pers. comm. 2000; Daniel Torres, Instituto Antartico Chileno, pers. comm. 2002). On 2 Nov 1999, 34 pups were counted on beaches below Condor Hill (U.S. Antarctic Marine Living Resources Program, unpublished data). Groups of non-breeding southern elephant seals are also present, while isolated animals, mainly juveniles, may be found on various beaches. Weddell seals (*Leptonychotes weddelli*), leopard seals (*Hydrurga leptonyx*), and crabeater seals (*Lobodon carcinophagus*) have been observed on the Cape Shirreff peninsula (Bengtson et al., 1990; Oliva et al., 1988; Torres, 1995). Monitoring of *H. leptonyx* predation on the *A. gazella* pup population was initiated in 2001-02 and was recorded during the 2003-04 Antarctic season (Vera et al., 2004).

Table 2: Antarctic fur seal (*Arctocephalus gazella*) numbers at Cape Shirreff and San Telmo Island.

	Cape Shirreff			San Telmo Island			Whole Area Totals		
	Adults	Pups	Subtotal	Adults	Pups	Subtotal	Adults	Pups	All
1965-66 ¹						N/a	38	12	50
1972-73 ¹						N/a	1441	300	1741
1986-87 ¹	2430	718	3148	3906	1875	5781	6336	2593	8929
1991-92 ¹	4771	2973	7744	684	2340	3024	5455	5313	10768
1992-93 ¹	5277	3672	8949	2243	2050	4293	7520	5722	13242
1993-94 ¹	5868	3474	9342	3214	2583	5797	9082	6057	15139
1994-95 ¹	7020	4036	11056	2702	2083	4785	9722	6119	15841
1995-96 ¹	7251	4968	12219	3212	2684	5896	10463	7652	18115
1996-97 ¹	6901	5689	12590	3765	3326	7091	10666	9015	19681
1997-98 ²	5531	4943	10474	3205	2808	6013	8736	7751	16487
1998-99 ³	8218	5497	13715	2481	3027*	5508*	10699*	8524*	19223*
1999-00 ⁴	8267	5865	14132	3308	2699	6007	11575	8564	20139
2000-01 ⁵	9289	5951	15240	2444	2328	4772*	11733*	8279	20012*
2001-02 ⁶	8389	6453	14842	4224	2124	6348*	12613*	8577	21190*
2002-03 ⁷	5232	5408	10640	7604	3505*	11109*	12836*	8913*	21749*

N/a – Not available

* Data based on modelled projections.

Sources: (1) Hucke-Gaete et al., 1997b; (2) Hucke-Gaete et al., 1998; (3) Hucke-Gaete et al., 1999; (4) Vallejos et al., 2000; (5) Hucke-Gaete et al., 2001; (6) Acevedo et al., 2002; (7) Vallejos et al., 2003.

Marine environment

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

II. Measures

and flanked either side by canyons reaching depths of around 300-400 m. Little published information is available on the nearshore marine environment within the Area. There is abundant macroalgae present in the intertidal zone. The limpet *Nacella concinna* is common, as elsewhere in the South Shetland Islands.

Historical features

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. Evidence of the sealers' occupation remains, with ruins of at least one sealers' hut in the northwestern region of the peninsula, and the shoreline of several bays is 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, etc. (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; DNA analyses are planned to determine whether this is the case (Torres, 1999).

Human activities and impact

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 continued 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 compared 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 *A. gazella* pups from diseases began in the 2003-04 Antarctic season (Torres and Valdenegro, 2004).

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). Recent surveys have yielded large numbers of articles, mostly of plastic. For example, the 2000-01 season survey recorded a total of 1,774 articles with a total weight of 124.5 kg, almost 98% of which were of plastic and the remainder being of glass, metal and paper. These quantities are comparable to the 1996-97 survey (Torres et al. 1997). 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, in contravention of CCAMLR Conservation Measure 63/XV and Annex IV of the Madrid Protocol. 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), primarily in fishing equipment such as nylon ropes, net fragments and packing bands. Between 1987-97 a total of 20 Antarctic fur seals were recorded with 'neck collars'. 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).

6(ii) Restricted and managed zones within the Area

None.

6(iii) 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 2001 the camp comprised a four-person fiberglass cabin (Chile), known as 'Guillermo Mann', and three additional small buildings with accommodation for six known as Cape Shirreff Field Station (US). The Chilean cabin was installed in 1990-91, while the US camp was established in 1996-97. Toilet facilities and storage areas are also present, and tents are erected seasonally nearby as required. 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 sealers' 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(iv) 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). CEMP Site No. 1 Seal Islands (60°59'S, 55°23'W), the only other CEMP site in the vicinity, is located 325 km to the northeast, 7 km north of Elephant Island.

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 reasons that cannot be served elsewhere; or

II. Measures

- it is issued for essential management purposes consistent with plan objectives such as inspection, maintenance or review;
- the actions permitted will not jeopardize the 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 an authorized 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 either of the following locations (Map 2):

- 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;
- the northern end of Half Moon Beach, on the eastern coast of the peninsula;
- the northern end of Yámana Beach, on the western coast (suitable at high tide only);
- 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 [note: these remain in need of confirmation – positions in the CEMP plan do not conform with those on CEMP maps]. Visitors should, where practicable, avoid landing where pinniped or seabird colonies are present on or near the coast.

AIRCRAFT ACCESS AND OVERFLIGHT

Because of the widespread presence of pinnipeds and seabirds over the Cape Shirreff peninsula during the breeding season (1 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 stipulated in this plan shall apply during the period 1 November–31 March. When necessary for purposes consistent with plan objectives and alternative means of access are unavailable or impractical, aircraft may operate and land within the Area according to strict observance of the following conditions:

- All overflight of the Area for purposes other than access shall be conducted according to the height restrictions imposed in the following table:

Minimum overflight heights within the Area according to aircraft type

Aircraft type	Number of Engines	Minimum height above ground	
		Feet	Meters
Helicopter	1	2460	750
Helicopter	2	3300	1000
Fixed-wing	1 or 2	1500	450
Fixed-wing	4	3300	1000

- Helicopter access is prohibited within the Area north of 62°28' S (Map 2), or north of 62°29' S and west of 60°48' W, which includes the areas where the greatest concentrations of wildlife are found;
- Helicopter landing is permitted at two designated sites (Map 2). The landing sites with their coordinates are described as follows:

- (A) 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).

- The designated aircraft approach route is from the south over the Livingston Island ice cap, proceeding from the permanent ice edge north along the main ridgeline of the peninsula for 1200 m (~ 0.65 n. mi.) towards Selknam Hill (50 m, or ~150 ft). From here aircraft should proceed east across Ancho Pass (where landing is permitted, when appropriate) for 700 m (~ 0.4 n. mi.) direct to the summit of Condor Hill (50 m, or ~150 ft). Aircraft should avoid overflight of the hut and beach areas on the eastern side of Condor Hill. The departure route is identical in reverse;
- 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;
- 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.

FOOD 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;
- Restrictions on times and places at which activities may be conducted apply within the Area, and are specified in the relevant sections of this management plan;
- The appropriate authority should be notified of any activities/measures undertaken that were not included in the authorized Permit.

7(iii) Installation, modification or removal of structures

- Structures shall not 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 approved by Permit for a specified period, and adequately identified by country, name of the

II. Measures

responsible investigator or agency, 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, 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–1 March).

- Removal of structures, equipment, hides or markers for which the period specified in the Permit has expired 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).
- 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 or microorganisms shall be deliberately introduced into the Area and the precautions listed in 7(ix) below shall be taken against accidental introductions.
- 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 and 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 is not to be stored in the Area, unless specifically authorized by Permit for scientific or management purposes.
- Anything 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 by Permit issued in accordance with Annex II to the Protocol on Environmental Protection to the Antarctic Treaty.
- Where taking or harmful interference with animals is involved, the *SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica* should be used as a minimum standard. 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*

- Collection or removal of anything not brought into the Area by the Permit holder shall only be in accordance with a Permit and should be limited to the minimum necessary to meet scientific or management needs.
- Anything of human origin likely to compromise the values of the Area, which was not brought into the Area by the Permit Holder or otherwise authorized, may be removed unless the impact of removal is likely to be greater than leaving.

7(viii) Disposal of waste

- All wastes shall be removed from the Area, except human 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

- 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.
- Any specific sites of long-term monitoring that are vulnerable to inadvertent disturbance should be appropriately marked.
- To help maintain the scientific values found at Cape Shirreff and San Telmo Island visitors shall take special precautions against introductions. Of concern are pathogenic, microbial or plant introductions sourced from other Antarctic sites, including stations, or from regions outside Antarctica. Visitors shall ensure that sampling equipment or 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.
- 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.
- 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 suggested by SCAR.

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, which should be 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.

8. References Documents

Acevedo, J., Vallejos, V., Vargas, R., Torres, J.P. and 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.*

Agnew, A.J. 1997. Review: the CCAMLR Ecosystem Monitoring Programme. *Antarctic Science* 9 (3): 235-242.

II. Measures

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. and 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. and 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. and 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.

Bengston, J.L., Ferm, L.M., Härkönen, T.J. and 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. and 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. and Torres, D. 2001a. Additional data on anti-*Brucella* antibodies in *Arctocephalus gazella* from Cape Shirreff, Livingston Island, Antarctica. *CCAMLR Science* 8 (2001): 147-154.

Blank, O., Montt, J.M., Celedón M. and Torres, D. 2001b. Herpes virus antibodies in *Arctocephalus gazella* from Cape Shirreff, Livingston Island, Antarctica. *WG-EMM- 01/59.*

Bonner, W.N. and Smith, R.I.L. (Eds) 1985. Conservation areas in the Antarctic. *SCAR, Cambridge: 59-63.*

Carten, T.M., Taft, M., Trivelpiece W.Z. and 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. and 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.*

Constantinescu, F. and Torres, D. 1995. Análisis bioantropológico de un cráneo humano hallado en cabo Shirreff, isla Livingston, Antártica. *Ser. Cient. INACH* 45: 89-99.

Croxall, J.P. and 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. and 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. and 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.*

Garcia, M., Aguayo, A. and 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 and 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.*

Hucke-Gaete, R., Acevedo, J., Osman, L., Vargas, R., Blank, O. and 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., and 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., and 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. and 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., and 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.*

Olavarría, C., Coria, N., Schlatter, R., Hucke-Gaete, R., Vallejos, V., Godoy, C., Torres D. and 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. and 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. and 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.*

II. Measures

Palma-Heldt, S., Leppe, M., Fernandoy, F. and Moisan, P. [in review 2004]. Mesozoic paleoflora from Cape Shirreff, Livingston Island, Antartic Peninsula. *Submitted to Antarctic Science in October 2003.*

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.*

Sallaberry, M. and 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., and Trivelpiece W.Z. 2003. Seabird research at Cape Shirreff. 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. NOAA-TM-NMFS-SWFSC-350.*

Shill, L.F., Antolos, M., and Trivelpiece W.Z. 2003. Seabird research at Cape Shirreff. In: *Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2002/2003 Field Season Report, Ch. 6. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California. NOAA-TM-NMFS-SWFSC-355.*

Smith, R.I.L. and Simpson, H.W. 1987. Early Nineteenth Century sealers' refuges on Livingston Island, South Shetland Islands. *British Antarctic Survey Bulletin 74: 49-72.*

Stehberg, R. and 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., and 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. NOAA-TM-NMFS-SWFSC-314.*

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. and Aguayo, A. 1993. Impacto antrópico en cabo Shirreff, isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno 43: 93-108.*

Torres, D. and 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. and 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. and 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. and 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., and Vicuña, P. 2001. Cartografía digital de cabo Shirreff, isla Livingston, Antártica: un avance importante. *Boletín Antártico Chileno 20 (2): 4-6.*

Torres, D., Jorquera, D., Vallejos, V., Hucke-Gaete, R. and Zarate, S. 1997. Beach debris survey at Cape Shirreff, Livingston Island, during the Antarctic season 1996/97. *Serie Científica Instituto Antártico Chileno 47: 137-147.*

Torres, D.E. and 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. and 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. and 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.*

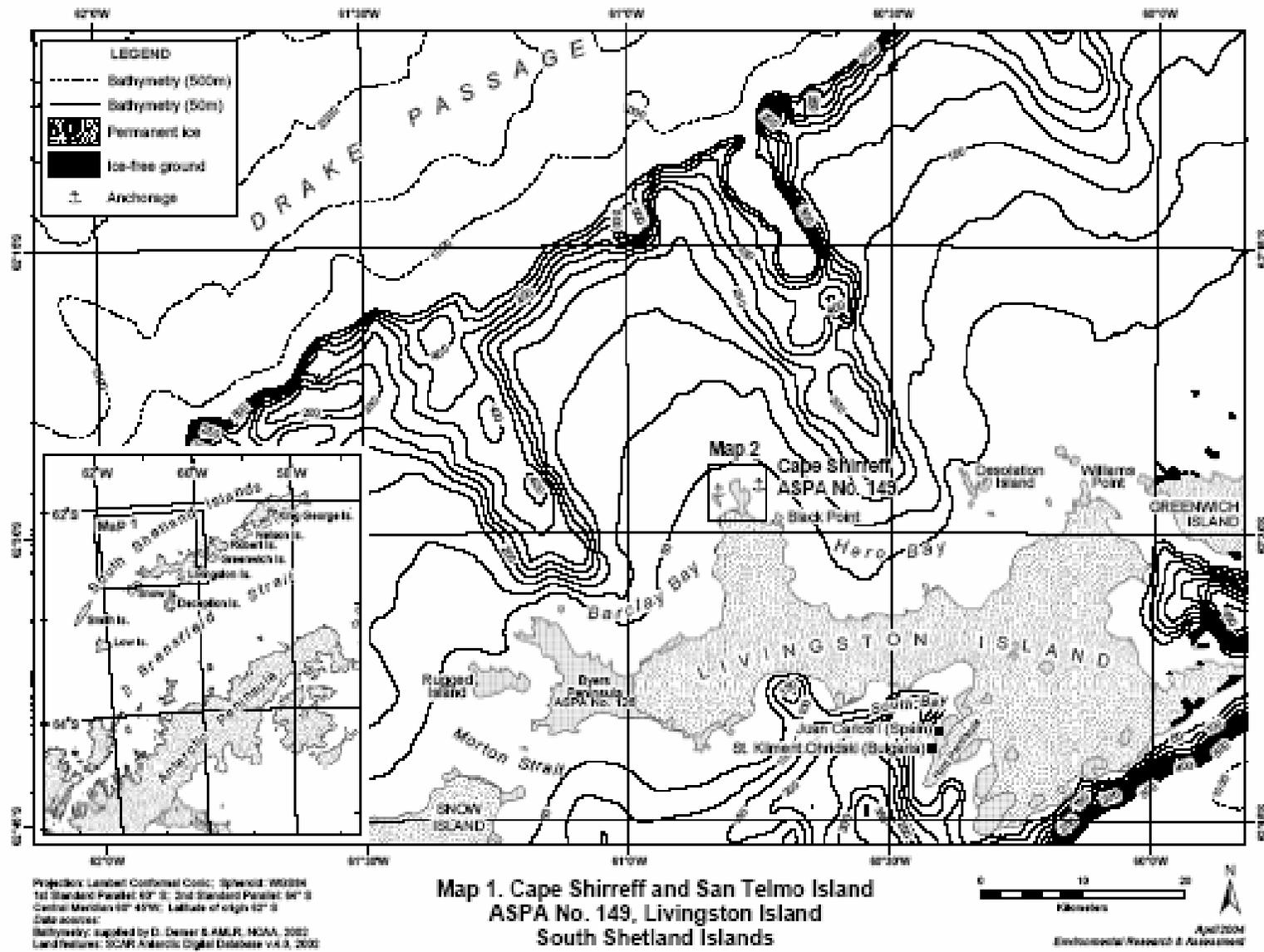
Vallejos, V., Acevedo, J., Blank, O., Osman, L. and Torres, D. 2000. Informe científico - logístico. ECA XXXVI (1999/2000). Proyecto 018 "Estudios ecológicos sobre el lobo fino antártico, *Arctocephalus gazella*", cabo Shirreff, archipiélago de las Shetland del Sur, Antártica. *Ministerio de Relaciones Exteriores, Instituto Antártico Chileno. N° Ingreso 642/712, 19 ABR.2000.*

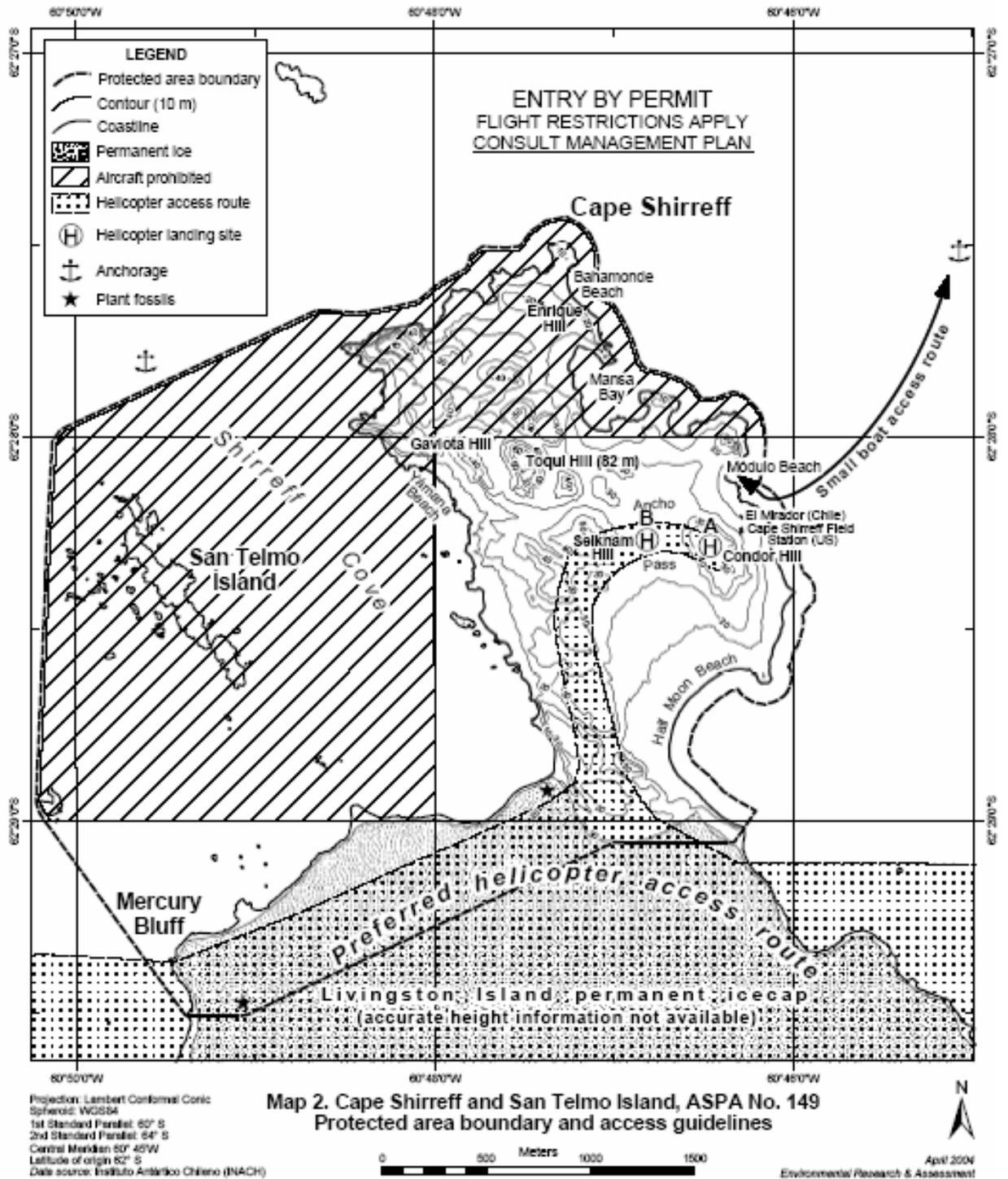
Vallejos, V., Osman, L., Vargas, R., Vera, C. and Torres, D. 2003. Informe científico. ECA XXXIX (2002/2003). Proyecto INACH 018 "Estudios ecológicos sobre el lobo fino antártico, *Arctocephalus gazella*", cabo Shirreff, isla Livingston, Shetland del Sur, Antártica. *Ministerio de Relaciones Exteriores, Instituto Antártico Chileno.*

Vera, C., Vargas, R. and 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).*

Woehler, E.J. (ed) 1993. The distribution and abundance of Antarctic and sub-Antarctic penguins. *SCAR, Cambridge.*

II. Measures





II. Measures

