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The current environmental situation and proposals for the management of the Fildes Peninsula Region

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The current environmental situation and proposals for the management of the Fildes Peninsula Region

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16. Abstract
With its airport and a high density of stations and field huts, the Fildes Peninsula forms the logistical centre of King George Island (South Shetland Islands) and the logistical hub for the northern Antarctic Peninsula area as a whole. Due to the severe overlapping of various interests, such as research, the conservation of flora and fauna, the protection of places of geological and historical value, station operations, transport logistics and tourism, there was an urgent need for research. An assessment of the risk for the area was carried out between 2003 and 2006, along with the development of management plans for its designation as a Specially Managed Area. In support of the political discussions initiated, data relating to the current environmental situation was once again collected between 2008 and 2012. An analysis was made of the current state of the protected areas and the values to be protected, the numbers of breeding birds and seals, the changes to the stations (particularly building activities), the use of field huts, the mapping of the waste situation and current waste management, sources of drinking water and risks associated with it, wastewater treatment and occurrences of oil contamination. In addition, changes to air traffic, shipping traffic and surface transport, along with the effects of scientific and tourist activities, were outlined in order to serve as a basis for an updated risk analysis. The required action with respect to management and prognoses for the future was extrapolated from the conclusions of this risk assessment. Due to the increased threat posed to the area, the preference is still for it to be designated a Fildes Peninsula Region ASMA.

17. Keywords
Antarctica, Ardley Island, ASMA, AUG, behaviour, disturbance, Protocol on Environmental Protection to the Antarctic Treaty, Fildes Peninsula, human activities, King George Island, logistics, management, monitoring, penguins, science, seabirds, seals, tourism, traffic, waste

18.	**19.**	**20.**

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List of abbreviations

APASI	Antarctic Peninsula Advanced Science Information System
APECS	Association of Polar Early Career Scientists
ASMA	Antarctic Specially Managed Area
ASOC	Antarctic and Southern Ocean Coalition
ASPA	Antarctic Specially Protected Area
ATCM	Antarctic Treaty Consultative Meeting
ATS	Antarctic Treaty Secretariat
AWI	The Alfred Wegener Institute for Polar and Marine Research, Bremerhaven
AUG	Gesetz zur Ausführung des Umweltschutzprotokolls vom 4. Oktober 1991 zum Antarktis-Vertrag (Umweltschutzprotokoll-Ausführungsgesetz) = German Law for implementing the EP into German jurisdiction
BP	Breeding pairs
CAA	Chinese Arctic and Antarctic Administration
Capuerto	Estación Marítima Antártica, before: Capitanía de Puerto de Bahía Fildes de la Marina de Chile
CCAMLR	Convention on the Conservation of Antarctic Marine Living Resources
CEE	Comprehensive Environmental Evaluation
CEP	Committee for Environmental Protection
CHINARE	Chinese National Arctic/Antarctic Research Expedition
COMNAP	Council of Managers of National Antarctic Programmes
DGAC	Dirección General de Aeronáutica Civil
EIA	Environmental Impact Assessment
EP	Protocol on Environmental Protection to the Antarctic Treaty
FAB	Força Aérea Brasileira
FACH	Fuerza Aérea de Chile
FAU	Fuerza Aérea Uruguaya
GIS	Geographic Information System
GLONASS	Globalnaja Nawigazionnaja Sputnikowaja Sistema (Russian Global Navigation Satellite System)
GPS	Global Positioning System
HSM	Historic Sites and Monuments
IAATO	International Association of Antarctic Tour Operators
IAU	Instituto Antártico Uruguayo
IEE	Initial Environmental Evaluation
IMO	International Maritime Organization
INACH	Instituto Antártico Chileno
IPY	International Polar Year
IUCN	International Union for Conservation of Nature
IWG	International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island
KGI	King George Island, South Shetland Islands, Antarctica
KGIS	SCAR King George Island GIS Project
KOPRI	Korea Polar Research Institute
MARPOL	International Convention for the Prevention of Marine Pollution from Ships
PANC	Patrulla Antártica Naval Combinada
PBDE	Polybrominated diphenyl ethers
RAE	Russian Antarcic Expedition
SAR	Search and Rescue
SCAR	Scientific Committee on Antarctic Research
SPA	Specially Protected Area

SSSI	Site of Special Scientific Interest
TLS	Transponder Landing System
UBA	Federal Environment Agency, Dessau, Germany (Umweltbundesamt, Dessau - Roßlau)
WAP	Western Antarctic Peninsula

Place names used

In order to avoid ambiguity of use, the following report uses the place names listed in the SCAR Antarctic Composite Gazetteer SCARCGA (http://data.aad.gov.au/aadc/gaz/scar/). If a place was not listed in the Gazetteer it was given an original name. Descriptions of places were also taken from SCARCGA, where available (in italics). Positional information for the locations named is taken from the SCAR KGIS project (www.kgis.scar.org/mapviewer, site no longer active).

Name	Description (in italics if from SCARCGA)	SCARCGA Ref. No.
Admiralty Bay	*Irregular bay, 5 mi wide at its entrance between Demay Point and Martins Head, indenting the S coast of King George Island for 10 mi in the South Shetland Islands. The name appears on a map of 1822 by Capt. George Powell, a British sealer, and is now established in international usage.*	86
Ardley Cove	*A cove that lies N of Ardley Island (q.v.) in Maxwell Bay, King George Island. It was named "Caleta Ardley" by an Argentine expedition (c. 1957) in association with Ardley Island.*	477
Ardley Island	*Island on W side of Maxwell Bay, King George Island. Charted by Discovery Investigations in 1935; named Ardley Peninsula after Lieut. Richard Arthur Blyth Ardley, RNR (1906-42), of Discovery II (GBR chart 1935 & gaz. 1955). Shown to be an island by FIDASE air photography, 1956; renamed Ardley Island (GBR gaz. 1960).* *Island 1 mi long, lying in Maxwell Bay close off the SW end of King George Island, in the South Shetland Islands. Charted as a peninsula in 1935 by DI personnel of the Discovery II and named for Lt. R.A.B. Ardley, RNR, officer on the ship in 1929-31 and 1931-33. Air photos have since shown that the feature is an island.*	478
Ardley Isthmus	Connection between Fildes Peninsula and Ardley Island, passable at low tide.	
Baliza Uruguaya	*Lighted beacon tower.*	15227
Biologenbucht	A bay on the west coast south of Gemel Peaks.	1345
Braillard Point	*Point forming the NE end of Ardley Island, off the SW end of King George Island in the South Shetland Islands. Charted and named by DI personnel on the in 1931-33 and 1933-35.*	1746
Collins Glacier	Part of the King George Island ice cap bordering the Fildes Peninsula on the north.	
Collins Harbor	*Bay indenting the S coast of King George Island immediately E of Fildes Peninsula, in the South Shetland Islands. The name appears on a chart by Scottish geologist David Ferguson, who roughly charted the bay in 1913-14, but may reflect an earlier naming.*	2847
Dar Point	Northernmost point of Ardley Island.	
Dart Island	*The largest of several small islands lying in the W entrance to Fildes Strait in the South Shetland Islands. This island and the two islands to the E and S of it were first surveyed and named collectively 70 Islets by DI personnel on the Discovery II in 1934-35, because at least two of them were*	3337

Name	Description (in italics if from SCARCGA)	SCARCGA Ref. No.
	reported to be 70 ft high. The name was rejected by the UK-APC in 1961 and a new name substituted for the largest island in the group. Dart Island is named for the British sealing vessel Dart from London, which visited the South Shetland Islands in about 1823.	
Davies Heights	*An elevated area, roughly elliptical in form and 1 mi long, rising to 150 m in north-central Fildes Peninsula, King George Island. The feature has steep sides and an undulating top which rise 60 m above the surrounding plain. Named by the UK-APC for Robert E.S. Davies, BAS geologist who worked in this area, 1975-76.*	3374
Diomedea Island	*Small island lying in Ardley Cove, Fildes Peninsula, King George Island. The SovAE called the feature Ostrov Albatros or Albatross Island in 1968, but the English form duplicates a name in the Bay of Isles. To avoid confusion, the UK-APC recommended a new name in 1979; Diomedea is the generic name for several species of albatross.*	3659
Drake Coast	West coast of Fildes Peninsula adjacent to Drake Passage.	
Drake Passage	The stretch of sea between Tierra del Fuego and the Antarctic Peninsula bordering the Fildes Peninsula on the west.	3862
Drinking water lake	Lake in the western area of the Bellingshausen research station that is fed from Kitezh Lake.	
Exotic Point	*Point on the SW side of Fildes Peninsula, King George Island, forming the S entrance point to Geographers Cove. The approved name is a translation of the Russian "Mys Ekzoticheskiy" applied by SovAE geologists in 1968. The name presumably refers to the different nature of the rocks from those adjoining the point*.	4409
Faro Point	Rocky point on northeast beach of Ardley Island, 500 m west of Braillard Point.	
Fildes (Peninsula)	*Peninsula 4.5 mi long, forming the SW extremity of King George Island, in the South Shetland Islands. Named from association with nearby Fildes Strait by the UK-APC in 1960.*	4587
Fildes Peninsula Region = Fildes Region	The area including the Fildes Peninsula and the associated islands; Ardley, Diomedia, Geologists, Two Summit, and all islands of the Fildes Strait and on t he west coast of the Fildes Peninsula.	
Fildes Strait	*Strait which extends in a general E-W direction between King George Island and Nelson Island, in the South Shetland Islands. This strait has been known to sealers in the area since about 1822, but at that time it appeared on the charts as Field s Strait. Probably named for Robert Fildes, a British sealer of that period.*	4589
Flat Top Peninsula	*Small, flat-topped peninsula 1 mi N of the SW extremity of King George Island, South Shetland Islands. The peninsula was named on a chart based upon a survey by DI personnel of the Discovery II during 1935.*	4692
Fossil Hill	*Low hill, E-W orientation approx. 1.5 km W of Ardley Island isthmus, Byers Peninsula, King George Island, South*	17014

Name	Description (in italics if from SCARCGA)	SCARCGA Ref. No.
	Shetland Islands. The name was in common use in geological literature (Brazilian, Chilean and Chinese) from the 1980's. (APC, 2001).	
Geographers Cove	*A cove between Flat Top Peninsula and Exotic Point on the SW side of Fildes Peninsula, King George Island. The approved name is a translation of the Russian "Bukhta Geografov" (geographers bay), applied in 1968 following SovAE surveys from nearby Bellingshausen Station.*	5238
Geologists Island	*An island, 0.25 mi long, lying S of Ardley Island in the entrance of Hydrographers Cove, Fildes Peninsula, King George Island. The approved name is a translation of the Russian Ostrov Geologov (geologists island), applied in 1968 following SovAE surveys from Bellingshausen Station.*	5243
Gradzinski Cove	*A cove between Flat Top Peninsula and Exotic Point on the SW side of Fildes Peninsula, King George Island. The approved name is a translation of the Russian "Bukhta Geografov" (geographers bay), applied in 1968 following SovAE surveys from nearby Bellingshausen Station.*	5567
Halfthree Point	*Point forming the SE end of Fildes Peninsula, King George Island, in the South Shetland Islands. Charted and named by DI personnel on the Discovery II in 1935.*	5890
Jasper Point	*The NE entrance point to Norma Cove, Fildes Peninsula, King George Island. The point is bounded by cliffs of black and buff rocks, in which occur veins of red and green jasper. So named by UK-APC following geological work by BAS, 1975-76.*	7083
King George Island	*Island 43 mi long and 16 mi wide at its broadest part, lying E of Nelson Island in the South Shetland Islands. Named about 1820 for the then reigning sovereign of England.*	7527
Kiteshbach/ Station Creek	*A creek that flows SE from Lake Kitezh into Ardley Cove, Fildes Peninsula, King George Island. The name derives from the proximity of the SovAE Bellingshausen Station, erected 1968, which is located just E of the creek. The approved name, Station Creek, is a translation of the Russian "Ruch'ye Statsionnyy."*	7586/ 13954
Kitezh Lake	*A lake 0.3 mi long near the centre of Fildes Peninsula, King George Island. The largest of many lakes on the peninsula, it has been used as a reservoir by the SovAE Bellingshausen Station and the Chilean Rodolfo Marsh Station. The name is adapted from the Russian "Ozero Kitezh" used in a 1973 geographical report by L.S. Govorukha and I.M. Simonov. Named after Kitezh, an ancient Russian city of legendary fame.*	7587
Lago Uruguay	*Place from where the drinking water for the Artigas Station is taken.*	15226
Laguna Las Estrellas	Lake 300 m east of the buildings of Villa Las Estrellas.	
Maxwell Bay	*Bay 10 mi long, lying between King George Island and Nelson Island, in the South Shetland Islands. The main entrance to the bay is at the SE side and is wide open; Fildes Strait on the NW side is encumbered by rocks and is*	9188

Name	Description (in italics if from SCARCGA)	SCARCGA Ref. No.
	only navigable by boats. The name Maxwells Straits was given to this bay and to Fildes Strait by British sealing captain James Weddell in 1822-24, for Lt. Francis Maxwell who served with Weddell in 1813-14. The name was altered and limited to the feature here described by the UK-APC in 1960.	
Meseta la Cruz	A hill south east of the Chilean station.	
Nebles Point	*Point forming the W side of the entrance to Collins Harbor in the SW part of King George Island, South Shetland Islands. On his chart of 1825, James Weddell, Master, RN, applied the name Nebles Harbour to Collins Harbor, or possibly to an anchorage close N of Ardley Island; the detail of this part of his map cannot be interpreted with certainty. Nebles Point was given by the UK-APC in 1960 in order to preserve Weddell's naming in the area. The point lies between the two possible positions of his name.*	10121
Neftebasa	Coastal area in Rocky Cove where a number of fuel tanks stand (SCARCGA 12273).	
Nelson Island	*Island 12 mi long and 7 mi wide, lying SW of King George Island in the South Shetland Islands. The name dates back to at least 1821 and is now established in international usage.*	10143
Nordwestplattform	Lowland to the north and east of Davies Heights	10362
Potter Peninsula	*Low ice-free peninsula between Potter Cove and Stranger Point in SW King George Island, South Shetland Islands. Named "Península Potter" in association with the cove by Chilean geologists Roberto Araya and Francisco Hervé, 1966, following field work at Potter Cove. The English form of the name has been approved.*	11525
Punta Torres	Rocky outcrop on the northwest Drake Coast	
Skuabucht	Bay on t he north west coast between Punta Winkel and Punta Escobar.	13455
South Shetland Islands	*A group of more than twenty islands and islets lying northward of Antarctic Peninsula and extending about 280 mi from Smith Island and Snow Island in the WSW to Elephant Island and Clarence Island in the ENE The islands were sighted by Capt. William Smith of the brig Williams in February 1819 while cruising close to the northern edge of the islands. The name "New South Britain" was used briefly, but was soon changed to South Shetland Islands. The name is now established international usage.*	13740
Südberge	Upland south of the Südpassage.	14200
Südpassage	Lowland area between hills that leads from the east to the west coasts in the southern Fildes Peninsula.	14203
Suffield Point	*The SW entrance point of Norma Cove, Fildes Peninsula, King George Island, in the South Shetland Islands.*	*14207*
Two Summit Island	*Small island marked by two prominent summits, lying at the E entrance to Fildes Strait in the South Shetland Islands. It was named Two Hummock Island by DI personnel following their survey in 1935, but this name has been rejected*	15138

Name	**Description (in italics if from SCARCGA)**	**SCARCGA Ref. No.**
	because of probable confusion with Two Hummock Island in the N entrance to Gerlache Strait. Two Summit Island, equally descriptive of the feature, was recommended by the UK-APC in 1954.	
Valle Grande	Valley leading to Biologenbucht, also named Grande Valley (SCARCGA 18229).	
Valle Klotz	A valley in the north-west of Fildes Peninsula draining from the Collins Glacier to Drake Passage, also named Klotz Valley (SCARCGA 18230).	
Windbach	Stream trough the Südpassage	16129
Withem Island	*Island lying off the NW side of Nelson Island in the South Shetland Islands. Named by the UK-APC in 1961 after Nicholas Withem Master of the American sealing vessel Governor Brooks from Salem, MA, who visited the South Shetland Islands in 1820-21. Originally proposed and approved as "Withen Island," the name was amended in 1990 to agree with the correct spelling of the personal name.*	16169

1 Introduction

The Fildes Peninsula and neighbouring Ardley Island are part of the largest ice-free areas in the maritime Antarctic region. This region is characterised by its comparatively high biodiversity. At the same time, this area is home to the highest density of scientific stations used all year round in the whole of the Antarctic. Diverse activities in the fields of research and logistics, but also tourism, are putting a considerable strain on the area and are leading to a conflict of interests between the various user groups and the nature conservation and environmental protection measures according to international law (*cf.* Protocol on Environmental Protection to the Antarctic Treaty). Previous management measures (*e.g.* ASPA designations) have only partly addressed the complexity of human activities in the Fildes Region. This has resulted in there being a great need for research into the Fildes Peninsula area. Within the context of the German environmental research project, "Risk Assessment for the Fildes Peninsula and Ardley Island, and development of management plans for their designation as Specially Protected or Specially Managed Areas" (FKZ 203 13 124), and with the involvement of the Federal Agency for Nature Conservation, the Federal Foreign Office, the Alfred Wegener Institute for Polar and Marine Research (and other parties), an initial contribution was made to a possible designation of the Fildes Region (the Fildes Peninsula along with the surrounding small islands and rocks, including Ardley Island) as an *Antarctic Specially Managed Area* (ASMA). For this purpose a scientific GPS- and GIS-based study was carried out of the biotic and abiotic parameters of this area in order to create a database, and human activities and environmental effects in the Fildes Region were quantified (Peter et al., 2008). This included the following studies:

Over three field seasons (2003/04 to 2005/06), the terrestrial environmental situation and that of areas near to the coast were analysed. By mapping waste outside the stations and examining current and old waste disposal sites, further spreading of what were sometimes large amounts of waste was verified. In addition, the accumulation of marine debris on the beaches constitutes a further hazard to Antarctic seals and birds.

Information regarding waste management, fuel requirements and wastewater treatment was gathered through questioning station members and scientists in the field. In spite of the efforts made to avoid any oil contamination in the stations, numerous cases of contamination of the ground surface and of some lakes were recorded.

In addition, building work carried out during this first period of research (the building of a church and the expansion of the airport) and its effects on the environment were documented, and supplemented with data relating to the use of space by the individual station grounds. This was done using detailed information relating to the field huts and containers in the area.

Sources of gas and noise emissions, as well as the frequency and purpose of traffic movements, were also determined. It was shown that traffic movements were not limited to the 13.4 km road network between the stations, but that they had extended to areas beyond the roads, primarily in the past, and had caused considerable damage to vegetation. Travel by station staff in the winter was primarily motorised due to snow cover, thereby representing a potential source of disturbance to seals at their pupping beaches and haul-outs along the coast.

Air traffic, particularly helicopter flights for logistical purposes, increased steadily during the period of research. The minimum distances from animal colonies recommended by the Antarctic Treaty Parties were regularly and clearly transgressed, particularly where nesting southern giant petrel and penguins in the Fildes Strait and Ardley Island area were concerned.

Due to the increase in logistical and tourist activities in the Fildes Region, the number of ships arriving at Maxwell Bay approximately doubled between 2003 and 2006. Supply ships and cruise ships were the most prevalent.

Population figures were compiled for all breeding bird species in the area along with distribution maps. Irrespective of sharp annual fluctuations, a severe decline in populations of chinstrap and Adélie penguins *(Pygoscelis antarctica, P. adeliae)* was recorded. The populations of southern giant petrel *(Macronectes giganteus),* known to be very sensitive to disturbance, have recuperated over the last few years on islands far away from stations. However, breeding success is clearly below the levels determined in the 1980s. Regularly updated population figures for Antarctic seals coming ashore to moult are also available.

A vegetation survey of an area covering 5.4 km^2 identified sensitive areas which were already damaged by tracks made by feet or wheels. The continual proliferation of Antarctic hair grass (*Deschampsia antarctica*) due to climate warming was documented, along with the first appearance of non-native species introduced to the region, such as various grasses.

In addition to the occurrence of fossils in ASPA No. 125 already known about, two further areas rich in fossils were mapped. This led to a change in the shape and size of the area of this ASPA when it was revised (ATS, 2009d).

Furthermore, fossil beach ridges potentially of scientific interest can be found along the coast of the research area. However, due to their suitability as a source of building materials, these are still under acute threat of destruction.

The spatial and temporal overlapping of scientific field work, station operations and leisure behaviour, as well as the transportation of people and freight, were regularly observed. These factors represent a risk to flora and fauna through their cumulative effects.

The decision on whether an area is designated as an ASMA is made by the Antarctic Treaty Parties at their annual meeting (ATCM). The international working group (IWG) specially set up for the Fildes Region within the CEP, under German-Chilean leadership, is charged with developing a management system for the various user groups (research, logistics, tourism, for example) in the Fildes Region. Both the ASMA designation process and the introduction of alternative management measures proved to be protracted.

This situation therefore requires the availability of current data, so a second project was assigned to the University of Jena by the German Federal Environment Agency. The aim of the follow-up project proposed and carried out in the summers of 2008/2009 to 2011/2012 was therefore the continuation of research into the environmental state of the region in order to keep the scientific basis for the designation of the area up to date and thus usable during the discussion process at an international level (ATCM). Since the end of the forerunner project, new forms of traffic, documented changes in the leisure behaviour of station members and widespread current construction activities are clear indicators of the need for further research. During the project period there was a fairly large spillage of diesel fuel, the visable effects of which were included in the research. Also integrated in the research was the intensification of the use of beach ridges for building material, which are very valuable as climate archives, along with the severe effects of increased visitor activities by station members on the population development and breeding success of the southern giant petrel.

Two publications resulted from the two studies in 2003-2006 and 2008-2012:Braun et al., 2012; Braun et al., accepted.

The project required close cooperation with scientists from other countries, as well as with all the nations represented on the Fildes Peninsula, all of whom were informed of the plans as early as possible and were requested to cooperate. This was particularly relevant in terms of investigating current data on infrastructure, traffic, research, etc. We extend our thanks to the managers and members of the stations who provided us with information regarding these points.

There has been close cooperation with the Russian Arctic and Antarctic Research Institute and with the Russian Antarctic Expedition since the 1980s, mainly at a logistical level. Special thanks in this respect to the directors of these organisations in St. Petersburg, V. V. Lukin and V. L. Martyanov, as well as to the station managers at the Russian research station Bellingshausen, where we were guests during the summer months.

Furthermore, there was close cooperation with Russian scientists (including Mikhail Andreev, Russian Academy of Sciences, Komarov Institute, and Evgeny Abakumov, Departement of Soil Science and Soil Ecology, both University of St. Petersburg), as well as with colleagues from Korea (Jeong-Hoon Kim, Korea Polar Research Institute, Incheon).

Within Germany, mention must be made of the excellent cooperation with the Federal Environment Agency (Fritz Hertel and Heike Herata).

Additionally, the AWI of Bremerhaven supported us as always with polar clothing and with aspects of the logistical organisation.

Finally, our thanks go to our colleagues Matthias Kopp, Simeon Lisovski, Jan Esefeld, Anne Fröhlich and Tobias Gütter for their support in the fieldwork and in providing data.

2 Current state of the protected areas and of the values to be protected

2.1 General

The Fildes Region currently includes four designated historical monuments (Historic Sites and Monuments (HSM)) and two protected areas (Antarctic Specially Protected Areas (ASPA)).

Despite the designation and recognition of the HSMs and ASPAs of the Fildes Region at international level, there are clear shortcomings in knowledge at the stations in the area of the protected areas and of the guidelines relating to the management plans (ATS, 2009d, e). Only three of the stations had current versions of the management plans for ASPA No. 125 and No. 150 at their disposal. The aim of having this information available through the display of the plans at the stations is currently not being fulfilled.

2.2 Historic sites and monuments

A Polish plaque to the south of the Chilean and Russian stations is a reminder of the landing of the first Polish Antarctic expeditions (HSM No. 50, Fig. 1). Another historical monument is a monolith commemorating the opening of Great Wall station on 20 February 1985 (HSM No. 52). A memorial to the signing of the Antarctic Treaty, erected in 1999 at Frei station, was also awarded the status of an HSM in 2007 (HSM No. 82, 62°12’01’’ S, 58°57’42’’ W, Chile, 2007c). A plaque was added to the memorial in 2011 (ATS, 2011a; Chile, 2011). Further details on the three monuments can be found on the “List of Historic Sites and Monuments” (CEP, 2010). However, the list contains discrepancies regarding the coordinates for HSM No. 50 and No. 52. The correct details are 62°12’08’’ S, 58°57’34’’ W for HSM No. 50 and 62°13’03’’ S, 58°57’42’’ W for HSM No. 52.

Following a proposal from China, an additional HSM was designated in 2011 (HSM, No. 86, 62°13′4″ S, 58°57′44″ W), placing the first Great Wall research station building under protection (ATS, 2011b; China, 2011).

The remains of a 19th-century shipwreck not far from Artigas station (Uruguay, 2004) are not currently protected. The general regulation of putting artefacts predating 1958 and not previously discovered or registered under protection is not effective in this case as the regulation is limited to a period of three years following discovery (ATS, 2001b). Current investigations of the extent of the wreck include depth sounder, sonar and film recordings (Uruguay, 2010a). The date and provenance of the wreck are determined through laboratory analyses of wood samples. In accordance with Resolution 3 (ATS, 2009a), Uruguay is striving to have the wreck put under protection. It has also drawn attention to other objects that may be historically relevant (Fig. 1).

Along the coast of the Fildes Peninsula, archaeologists indicated a variety of artefacts from seal hunting and whaling times, along with some artefacts of a later date (Fig. 1; Pearson & Stehberg, 2006; Chile, 2007a; Stehberg, 2008; Stehberg et al., 2008). Although the project members did not systematically record historical places or artefacts, numerous other artefacts are known, which could be possibly be of historical significance (Fig. 1; Braun & Lüdecke, 2012).

All the historical artefacts mentioned have no protection status as yet, making them vulnerable to inadvertent destruction due t o ignorance (Pearson, 2008; Stehberg, 2008; Pearson et al., 2010; Roura, 2010; Pearson & Stehberg, 2011). The essential precondition for the preservation of historical objects in the region is that all findings must be comprehensively documented. Although Chile has made initial efforts in this direction, such records are not yet available (Chile, 2007a; Pearson et al., 2010).

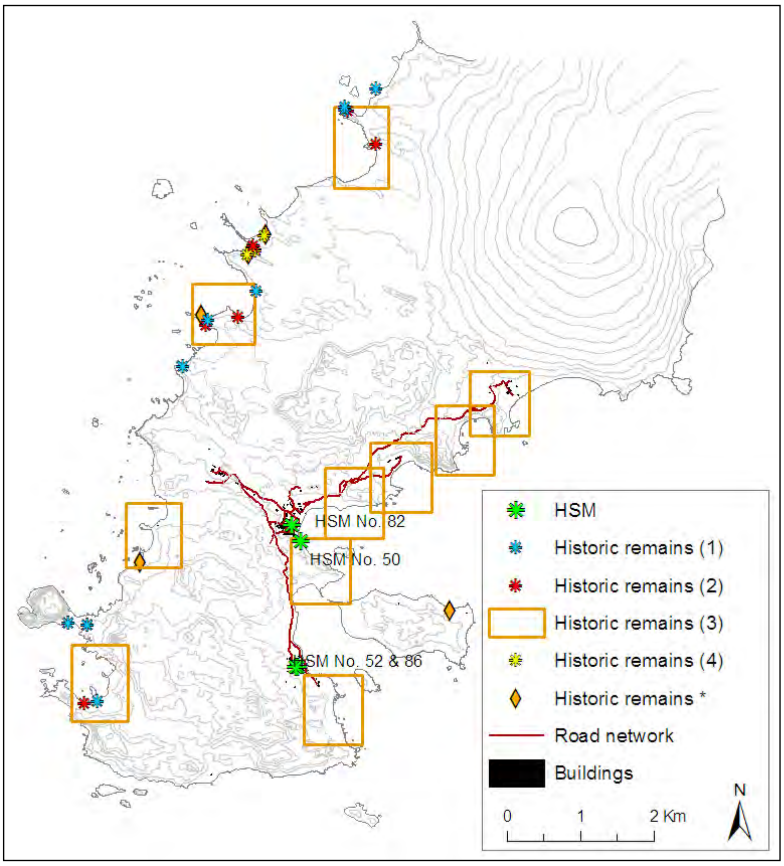


*Fig. 1: Locations of the four HSMs and other historical finds on the Fildes Peninsula (amended according to (1) Chile, 2007, (2) Stehberg et al., 2008 , (3) Stehberg, 2008 and Uruguay, 2011, * own data. Coordinates of sites were partly corrected compared to the original data*

2.3 ASPA No. 125 Fildes Peninsula

The first act of putting the rich fossil occurrences of the Fildes Peninsula under protection took place in 1966 as SPA No. 12 (ATS, 2009d). Despite names having been changed (SSSI No. 5, ASPA No. 125) there was no change to the originally designated zones A (Fossil Hill) and B (west of Suffield Point). However, there were later palaeontological investigations and sites of fossil discoveries outside these zones (Poole et al., 2001; Peter et al., 2008; Sec. 4.1.1.1.), making a review of the boundaries of the protected area necessary. At the ATCM XXX in New Delhi, Chile accordingly submitted a proposal (Chile, 2007b). In the final version of the management plan which came into effect in 2009, both original zones were amended (to 125a and 125b) and six further zones were added: the edge of the Collins Glacier (125c), Halfthree Point (125d), Suffield Point (125e), Jasper Point (125f, called Fossil Point in the management plan), Gradzinski Cove (125g), and Skuabucht (125h, called Skuas Cove in the management plan) (Fig. 2; ATS, 2009d). Three of these newly added zones provide valuable insights into the evolution of the palaeoenvironment of the west Antarctic during the Upper Cretaceous period. In expanding the protected area, in particular the quality and the uniqueness of the fossils were taken into account, with greater value being placed on information *in situ*. During revision little account was taken of Peter et al. (2008, Chapter

6.3.2.5.) and its call for the inclusion of mineral occurrences, which are also subject to intensified exploitation by souvenir hunters (Sec. 3.4.2.3 & 3.4.3). The beach ridges, which are not only valuable for palaeoclimatic reasons, were similarly given little consideration. The beach ridge system at the eastern exit of the Südpassage, which is particularly highly valued for its scientific importance (Barsch et al., 1985; Peter et al., 2008 Chapter 4.4.2.), has now been irretrievably destroyed, in part due to the removal of materials on a massive scale for construction purposes (Sec. 3.2.1.2).

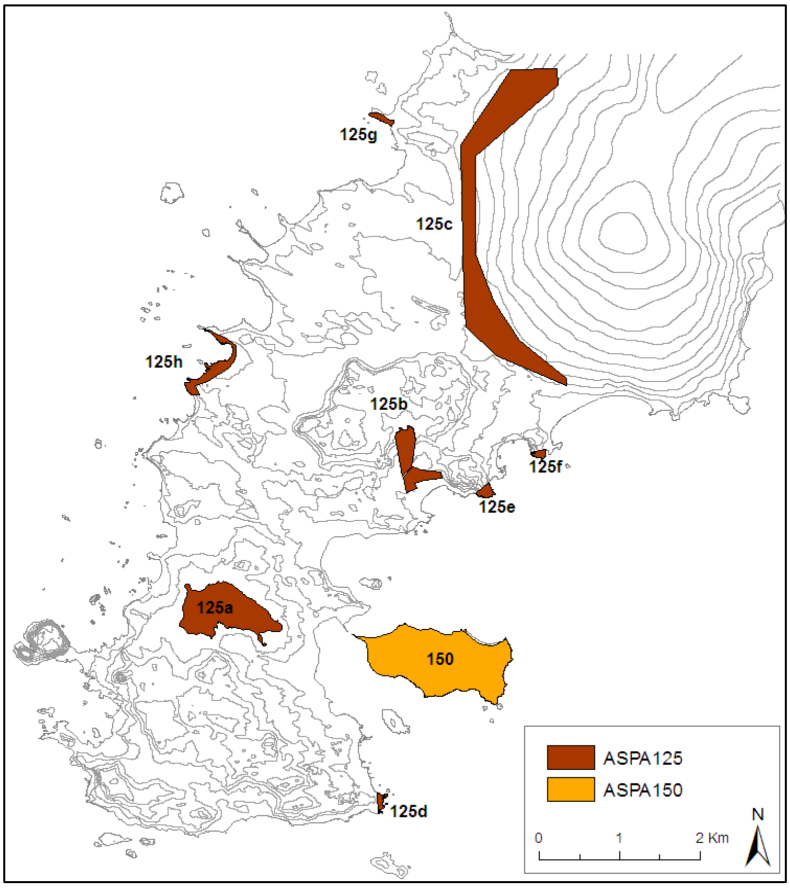


Fig. 2: Locations of the protected areas ASPA No. 125 and No. 150 in the Fildes Region.

2.4 ASPA No. 150 Ardley Island

Ardley Island, off the coast of the Fildes Peninsula, is distinguished by a high diversity of nesting seabirds and by extensive rich plant cover by maritime Antarctic standards. Based on its scientific importance resulting from this, the island was first placed under protection as Site of Special Scientific Interest (SSSI) No. 33 in 1991 (ATS, 1991). Of note in this protected area was the enclosed visitor zone, stretching along the island's northern beach originally from Dar Point to 400 m east of Faro Point. Following two extensions of its protected status (ATS, 2001a, 2005a), a revised management plan came into effect in 2009 (ATS, 2009e). This involved the visitor zone being greatly reduced in size. It now extends over 500 m, between Faro and Braillard Point. The visitor zone was also separated from the protected area and therefore no longer forms a part of it. Entering the visitor zone from the sea is possible without any special permission under the limitations of the Visitor Site Guidelines (Chile & Argentina, 2011), while an appropriate permit from the national authorities is required for entering the ASPA and must be carried on entering the protected area. Observations over past years have shown that these regulations have been violated on numerous occasions (Sec. 3.3.3, 3.4.2.3 & 3.4.3). In addition, the management plan's overflight guidelines were amended in line with those of Resolution 2 (ATS, 2004) so that a minimum vertical distance of 610 m and a minimum horizontal distance of 460 m became compulsory. However, transgressions of these minimum distances can still be regularly observed, though in decreasing numbers (Sec. 3.3.1 & 3.4.3).

3 Current Environmental Situation (Results and Discussion)

3.1 Fauna and Flora

3.1.1 Birds

In the 2008/09, 2009/10, 2010/11 and 2011 /12 seasons the numbers of breeding birds, visitors and m igrants were determined in the Fildes Region, using the methodology described in Peter et al. (2008, Chapter 3.4.1.; Tab. 1).

Tab. 1: General overview of bird species recorded in the Fildes Region to date (amended according to Peter et al., 2008).

Familie	**Art**	**Status**
Spheniscidae	Adélie penguin - *Pygoscelis adeliae* Chinstrap penguin - *Pygoscelis antarctica* Gentoo penguin - *Pygoscelis papua* Emperor penguin - *Aptenodytes forsteri* King penguin - *Aptenodytes patagonicus* Macaroni penguin - *Eudyptes chrysolophus* Rockhopper penguin - *Eudyptes chrysocome*	Breeding bird Breeding bird Breeding bird Visitor Visitor (Moult) Visitor (Moult) Visitor (Moult)
Diomedeidae	Light-mantled sooty albatross - *Phoebetria palpebrata* Wandering albatross - *Diomedea exulans* Black-browed albatross - *Diomedea melanophris*	Breeding bird Visitor Visitor
Procellariidae	Cape petrel - *Daption capense* Southern giant petrel - *Macronectes giganteus* Southern fulmar - *Fulmarus glacialoides* Soft-plumaged petrel - *Pterodroma mollis* Kerguelen petrel - *Pterodroma brevirostris* Blue petrel - *Halobaena caerulea* Snow petrel - *Pagodroma nivea* Antarctic prion - *Pachyptyla desolata* Atlantic petrel - *Pterodroma incerta* Antarctic petrel - *Thalassoica antarctica*	Breeding bird Breeding bird Visitor / Migrant Visitor Visitor Visitor Visitor / Migrant Visitor Visitor Migrant
Hydrobatidae	Black-bellied storm petrel - *Fregetta tropica* Wilson's storm petrel - *Oceanites oceanicus*	Breeding bird Breeding bird
Pelecanoididae	Diving-petrel - *Pelecanoides spec.*	Vagrant
Chionididae	Snowy cheathbill - *Chionis alba*	Breeding bird
Anatidae	Black-necked swan - *Cygnus melancoryphus* South georgia pintail - *Anas georgica* Chilöe wigeon - *Anas sibilatrix*	Vagrant Vagrant Vagrant
Scolopacidae	White-rumped sandpiper - *Calidris fuscicollis* Pectoral sandpiper - *Calidris melanotos*	Visitor / Migrant Vagrant
Ardeidae	Cattle egret - *Bubulcus ibis*	Vagrant
Laridae	Kelp gull - *Larus dominicanus*	Breeding bird
Stercorariidae	South polar skua - *Catharacta maccormicki* Brown skua - *Catharacta antarctica lonnbergi* Chilean skua - *Catharacta chilensis* Pomarine skua - *Stercorarius pomarinus*	Breeding bird Breeding bird Visitor Visitor
Sternidae	Antarctic tern - *Sterna vittata* Arctic tern - *Sterna paradisaea*	Breeding bird Visitor
Phalacrocoracidae	Blue-eyed shag - *Phalacrocorax atriceps*	Breeding bird / Visitor

3.1.1.1 Penguins (*Pygoscelis spp.*)

We continued monitoring of the three penguin species that breed sympatrically on Ardley Island (including data from 2006/07 and 2007/08), so there are now records covering more than 30 y ears. With the exception of the 2009/10 season, when there were very large amounts of snow, high breeding pair (BP) numbers were recorded for gentoo penguins (*Pygoscelis papua*), with more than 5,600 BP in each of the 2008/09, 2010/11 and 2011/12 seasons. The number of breeding gentoo penguins in the 2011/12 season, at 5,761 BP, was the highest since continuous data collection began 1979/80 (Fig. 3). In contrast, the lowest numbers of breeding pairs since continuous data collection began were counted in the case of chinstrap penguins (*P. antarctica*, 8 BP in 2007/08 and 2008/ 09) and Adélie penguins (*P. adeliae*, 307 BP in 2009/10). The slight rise in the number of Adélie penguins to more than 400 BP in the 2010/11 and 2011/12 seasons was probably a result of better winter conditions and t he limited snow cover at the start of the breeding season, compared to 2009/10.

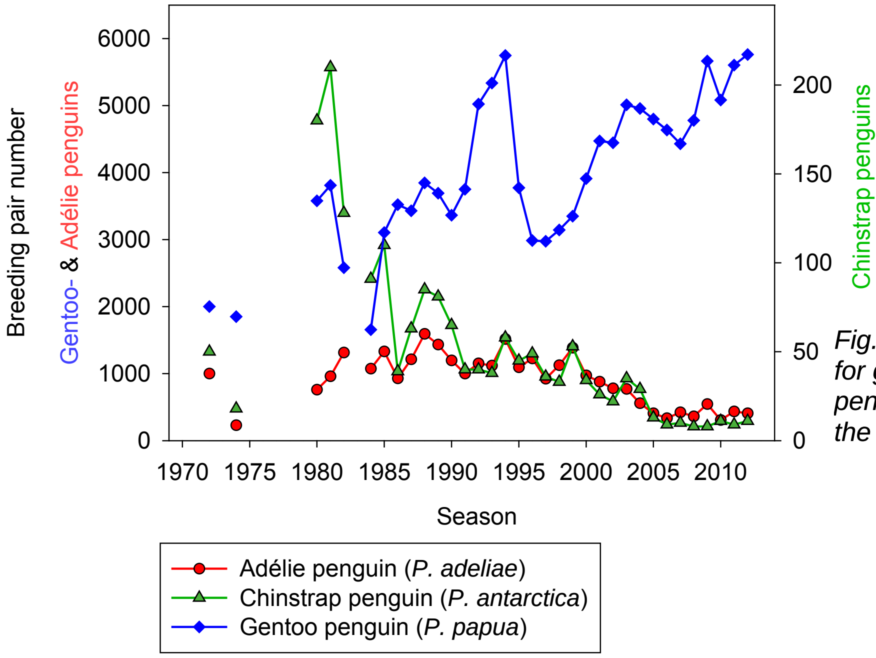


Fig. 3: Breeding pair numbers for gentoo, Adélie and chinstrap penguins on Ardley Island over the last 40 years.

Current figures confirm the trend that has been observed for years in the population development of this colony. Despite sharp fluctuations, we can observe an increase in numbers of gentoo penguins and a dec rease in the Adélie and chinstrap penguin populations, with the latter two appearing to have settled at a consistently low level. Similar population developments are known in other colonies in the Antarctic Peninsula region (Woehler et al., 2001; Forcada et al., 2006; Sander et al., 2007a; Sander et al., 2007b; Chwedorzewska & Korczak, 2010; Barbosa et al., 2012; Lynch et al., 2012). Probable causes are the continuing warming of the climate and the associated reduction in winter sea ice expansion, which is itself connected with the development of krill, the main food source for Adélie penguins (Smith et al., 2003; Ducklow et al., 2007; Fraser & Trivelpiece, 1996; Ainley et al., 2010; Trivelpiece et al., 2011). Anthropogenic disturbance by scientists and visitors from the nearby stations also have an influence (see also Woehler et al., 1994; Bricher et al., 2008; Chwedorzewska & Korczak, 2010). However, guided groups of tourists, who keep to the visitor zone and thus remain far away from the nest groups of the two penguin species affected by population reduction, can to a great extent be considered harmless.

In the last five breeding seasons, chinstrap penguins had above-average breeding success (fledglings per brood started) (Tab. 2), while gentoo penguins raised fewer chicks than the average over many years. The same was true of Adélie penguins in the seasons 2007/08 to 2009/10. However, in 2010/11 and 2011/12 the breeding success of this species was above the long-term average, at 1.27 young per breeding pair in 2010/11 and 1.45 in the following season. This made 2011/12 the most successful season for this species since 2000/01.

Tab. 2: Breeding success (fledglings for each brood started) of the penguins on Ardley Island compared to the average over a long period (see Peter et al., 2008, Chapter 4.5.1.).

Season	*P. antarctica*	*P. adeliae*	*P. papua*
1994/95 – 2005/06	0.89 ± 0.41	1,16 ± 0.15	1.34 ± 0.08
2007/08	1.38	1.00	1.00
2008/09	1.88	0.97	1.31
2009/10	1.64	0.88	1.02
2010/11	1.67	1.27	1.30
2011/12	1.73	1.45	1.24

The limited breeding success of gentoo and Adélie penguins in recent years may be due to weather conditions, among other things, as the winter and spring of both 2007/08 and 2009/10 saw heavy snow and a late thaw, which delayed the start of the breeding season. chinstrap penguins, which start breeding comparatively late (e.g. Peter et al., 1988; Lynch et al., 2009), are less strongly affected by such environmental factors.

The severe polluting of Ardley Cove by diesel fuel in the 2009/10 season (Sec. 3.2.5) was also detrimental to the penguins. When ingested with food or during preening, these hydrocarbon compounds can lead to inflammation of the mucus membranes and immunosuppression, amongst other ailments (Samiullah, 1985; Eppley & Rubega, 1990; Culik et al., 1991; Briggs et al., 1996; Briggs et al., 1997). Although no direct impact on the penguins was observed during this study, negative long-term consequences cannot be ruled out.

In the chinstrap penguin colonies on the Drake Coast of the Fildes Peninsula (*cf.* Peter et al., 2008, Chapter 4.5.1.), parts of which are inaccessible, the population was estimated to be at least 50 BP in total (2009/10 at least 54 BP, 2011/12 at least 133 BP).

Over a period of seven seasons, on repeated occasions, no evidence was found of chinstrap penguins breeding on Exotic Point in the extreme south-west of the Fildes Peninsula. After this period, in which no signs of breeding activity could be observed on rocks previously used for breeding, this small colony is considered to have died out.

3.1.1.2 Southern giant petrel (Macronectes giganteus)

Although the worldwide population of the southern giant petrel has risen over recent years to an estimated 47,000 breeding pairs, the Antarctic colonies are continuing to decline (Small & Taylor, 2006). The annual decline of 3.9 % observed in these latitudes is attributed above all to disturbance by station staff and station logistics, as this long-lived seabird is considered to be very sensitive to disturbance (González-Solís et al., 2000; Micol & Jouventin, 2001; Pfeiffer & Peter, 2004). This characteristic means that the species plays a particularly important role as an indicator of anthropogenic disturbance.

The population of southern giant petrel nesting in the Fildes Region was determined at the start of each field season on the basis of the number of occupied nests. An additional count was carried out at the end of February to determine breeding success (*cf*. also Peter et al., 2008, Chapter 3.4.1.). The number of breeding southern giant petrels reached 407 in the 2008/09 season, the highest level since continuous data collection began in 2002/03, but then fell back sharply to 225 BP the following year (Fig. 4). Reasons for this could include the very heavy snow in spring 2009/10 and the late thaw, with the result that, at the start of the breeding season, nesting places were still under deep snow and were unusable. However, there were similar weather conditions in the 2003/04 and 2007/08 seasons, without any significant impact on the number of occupied nests. It is also assumed that anthropogenic disturbance in a number of colonies led to the strong decline in numbers of breeding pairs (see below).

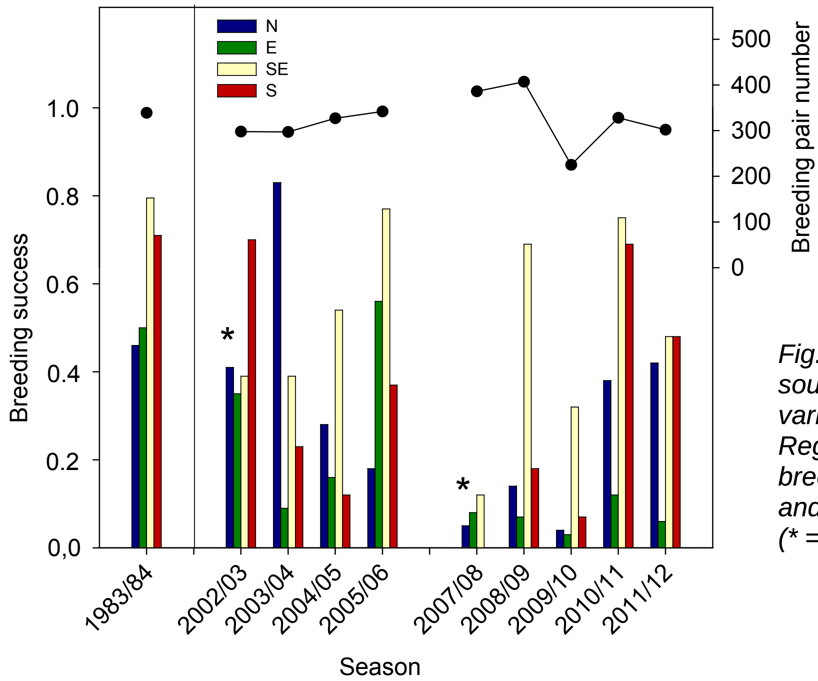


Fig. 4: Breeding success of the southern giant petrel in the various zones of the Fildes Region and the number of breeding pairs since 2002/03, and for 1984/85 in comparison (= incomplete data).*

In 2010/11 and 2011/12 the number of breeding pairs rose again, compared with the 2008/09 season, to an average number (see also Fig. 4), which could be attributed to better weather conditions and a possible change in the pattern of movements by station members, among other things. With breeding success of 0.5 fledglings per brood started, the 2010/11 season was the most successful since 2002/03. However, the decline in breeding success, which has been causing concern for years despite sharp fluctuations, can be clearly seen when comparisons are made over a long period ($R^2 = 0.42$, $p < 0.05$). Thus, southern giant petrel in the Fildes Region raised an average of 0.58 ± 0.11 young in the 1979/80, 1983/84 and 1984/85 seasons (Bannasch & Odening, 1981; Peter et al., 1988; Peter et al., 2008, Chapter 4.5.2.; In comparison, breeding success on Bird Island, South Georgia: 0.71 ± 0.68, Hunter, 1984). While breeding success was 0.41 ± 0.08 on average between 2002/03 and 2005/06, it was only 0.33 ± 0.14 in the period between 2008/09 and 2011/12. This development is partly due to the almost total breeding failure of the previously very successful colonies on Dart Island and near the Russian field hut, Priroda. It is suspected that this decline is directly connected to anthropogenic disturbance. It is known, for example, that members of various stations deliberately seek out the islands of the Fildes Region in order to fish from the rocky shores, and in some cases deliberately look for southern giant petrel nests (Sec. 3.4.2.3). For some station members, Priroda is also a popular destination for outings. Repeated disturbance of the sensitive breeding birds and non -breeding individuals can, over the longer term, cause them to move their nesting sites to undisturbed areas, even if these habitats are suboptimal in other regards (Riffenburgh, 2007). It appears that a transfer by southern giant petrel of nesting sites from the area around Great Wall station and from Nebles Point to Dart and T wo Summit Island – previously observed following construction of the Great Wall and Artigas stations (Peter et al., 2008, Chapter 4.5.2.) – is again taking place. A trend can be seen of birds moving away from the Priroda area, Dart and Geologists Island to the smaller colonies of Bay 1, Fildes Strait and Diomedea Island (Fig. 5). Southern giant petrel did not use Diomedea Island or nesting sites at Halfthree Point for a number of years (Peter et al., 2008). For the last five years they have been slowly returning to these colonies, even though broods there have so far had only limited success. Of particular note is Two Summit Island, which is currently home to the largest breeding colony in the Fildes Region. In accordance with Resolution 5 (ATS, 2009c), measures should be taken urgently to regulate access to the colonies and to minimise human disturbance, especially in the breeding colonies.

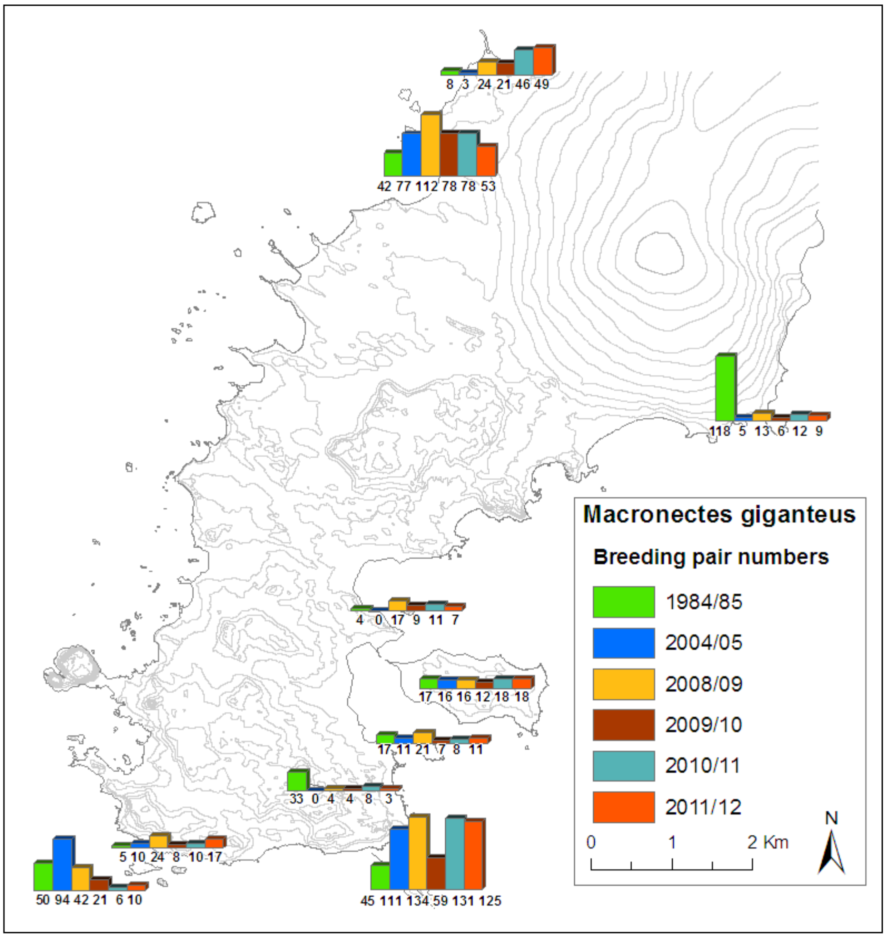


Fig. 5: Breeding pair numbers (occupied nests) of the southern giant petrel, comparing 1984/85 and 2004/05 to 2008/09-2011/12.

A positive factor to mention is that the number of extremely low flights outside the usual approach route to the runway, which can cause southern giant petrel to leave their nests, has declined been sharply in the last few years. During the research period, no such low flights were observed over Fildes Strait any more, in contrast to Ardley Island (Sec. 3.3.1). They can therefore presumably be r uled out as a p ossible cause for the negative population development in the southern Fildes Region.

On Two Summit Island a hook used in long-line fishing was found in December 2009 not far from a dead southern giant petrel. We suspect that these two findings are connected as southern giant petrels are known to interact with fishing activities and to die as a result, for example after swallowing long-line hooks (Weimerskirch et al., 2000; Favero et al., 2001).

In December 2011 a dead southern giant petrel with a broken wing was found at the base of an aerial situated outside the station. Because of where the bird was found, it is very likely that the cause of death was bird strike. The aerial is a radio mast more than 20m tall, with a triangular cross section, which stands on a hill and is guyed with cables that are difficult to see. If this finding is not an isolated case, it points to a potential danger for seabirds in the region, which has as yet not been considered, as there are numerous similar aerials near stations. Markers on the wires could reduce the risk of bird strike.

3.1.1.3 Cape petrel (Daption capense)

The precise number of cape petrels that breed on cliffs in the research area can only be established to a limited extent, *i. e.* in specific places, principally due to the inaccessibility of the main colony on the rock Flat Top, so that the numbers of breeding pairs are only estimated values. Sufficiently precise counts of 262 BP in 2008/09, 232 BP in 2009/10 and 238 BP 2010/11 and 191 BP in the 2011/12 season (Fig. 6 a - d), however, point to a possible decline in this species, as over the last three decades researchers have always counted a minimum of 300 breeding pairs (Peter et al., 2008). This trend is noticeable at some breeding sites that are either unoccupied or considerably less well used, such as Halfthree Pointor Punta Torres. Direct anthropogenic disturbance is excluded as a cause because of the inaccessibility of most breeding sites.

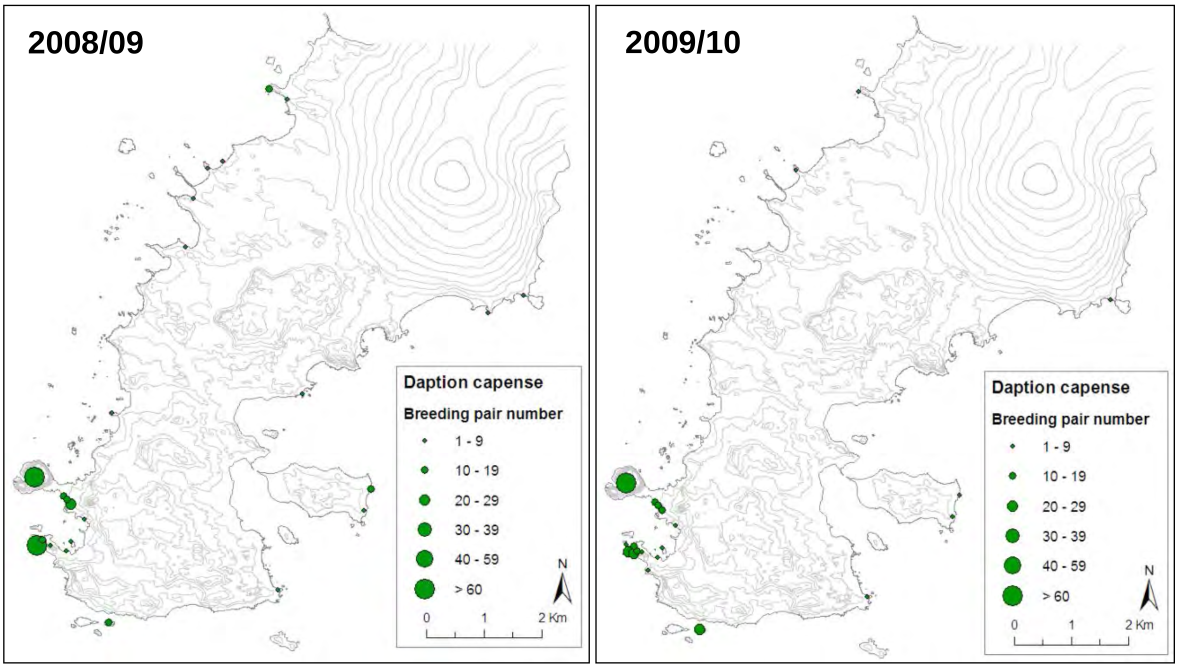
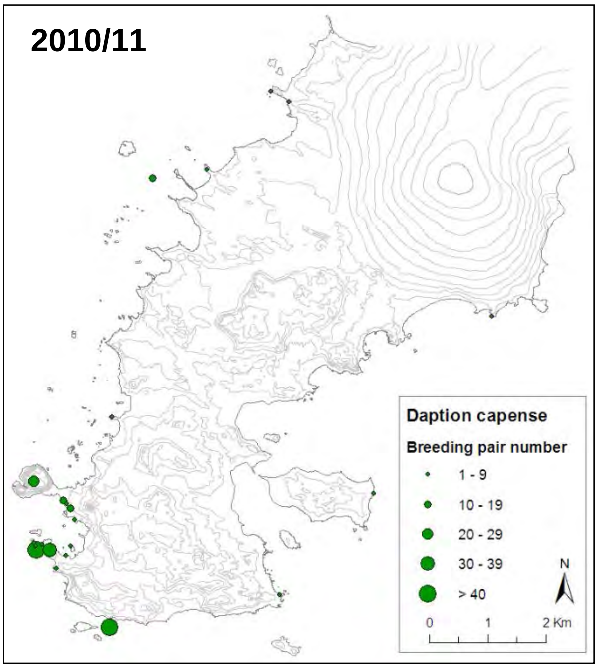


Fig. 6 a - b: Location and size of cape petrel breeding colonies in the seasons 2008/09 to 2009/10.



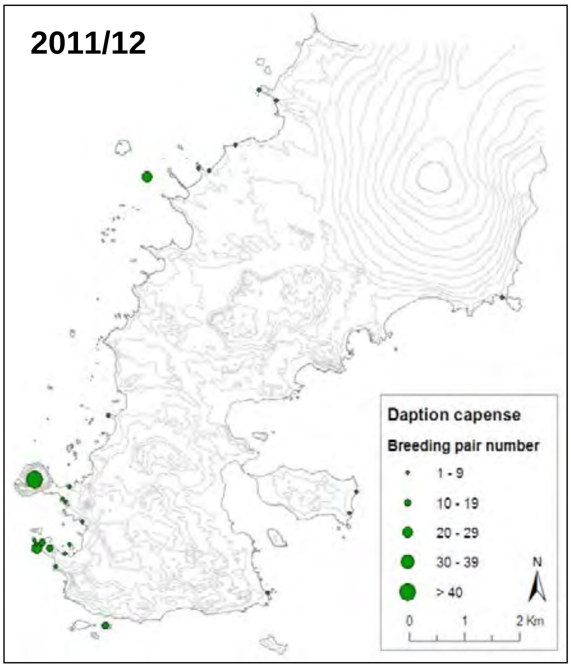


Fig. 7 c - d: Location and size of cape petrel breeding colonies in the seasons 2010/11 to 2011/12.

3.1.1.4 Storm petrels (*Oceanites oceanicus* and *Fregetta tropica*)

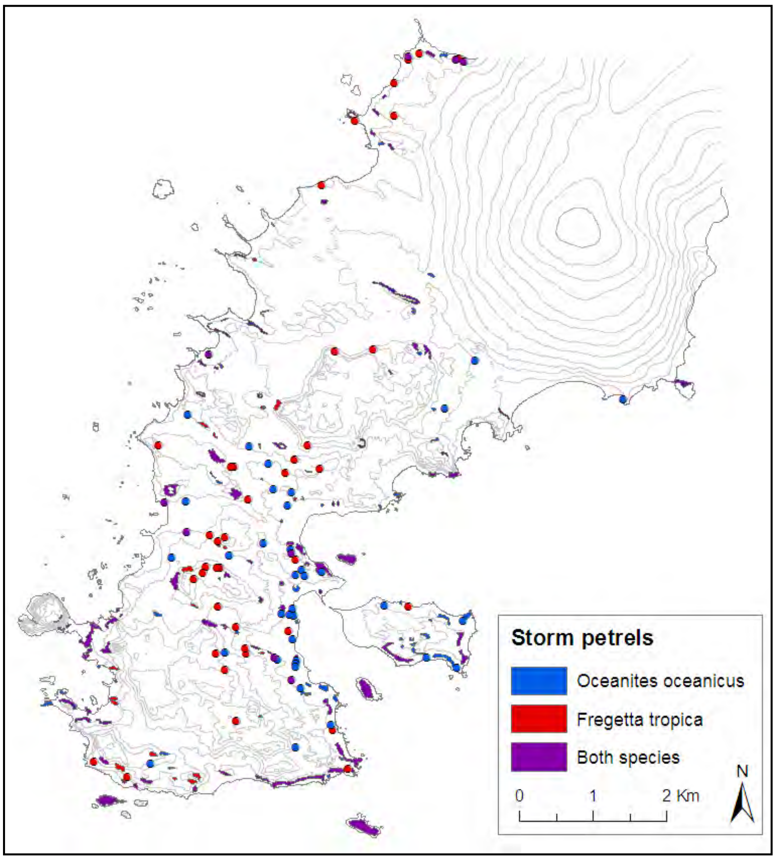


Fig. 8: Current distribution of the breeding areas of Wilson's storm petrel and black-bellied storm petrel in the Fildes Region (2003-2006 and 2008-2012).

There was no new comprehensive night-time mapping of storm petrels in the research area because of their loyalty to breeding sites (Roberts, 1940) and because no major changes were expected compared to the results presented in Peter et al. (2008). Three breeding sites were added to existing rec ords as a result of observations made during field work. The current distribution of the Wilson's storm petrel (*Oceanites oceanicus*) and the black-bellied storm petrel (*Fregetta tropica*) in the Fildes Region is shown in Fig. 7. Due to the late start of the snow melt period, many burrows were still blocked by snow and ice at the beginning of the 2009/10 breeding season, which had a strongly detrimental effect on breeding performance in both storm petrel species in that season.

3.1.1.5 Light-mantled sooty albatross (Phoebetria palpebrata)

After repeated sightings of light-mantled sooty albatross as early as the 1980s led Peter et al. (1988) to suspect the presence of a brood on the cliffs of the Flat Top Peninsula, without being able to substantiate it, the existence of such a colony was verified (Lisovski et al., 2009). This new colony is located approximately 1,520 km southwest of the nearest known nesting site on South Georgia. It is thus the most southerly breeding colony of albatross in the world (Lisovski et al., 2009).

Five nests were clearly identified and photographed in 2008/09 (Fig. 8). It was not possible to verify whether there are more nests in other, hard-to-see, parts of the cliffs, due to the inaccessibility of such places. In the 2009/10 season, we did not see either attempts to breed or individuals sitting on nesting sites. The only observation was of a light-mantled sooty albatross in flight off Flat Top Peninsula. There was also no evidence of breeding activity in 2010/11, although five adult birds did spend time at the old breeding sites during the breeding season. In the 2011/12 season researchers again observed a breeding pair of light-mantled sooty albatrosses on the cliffs of Flat Top Peninsula.

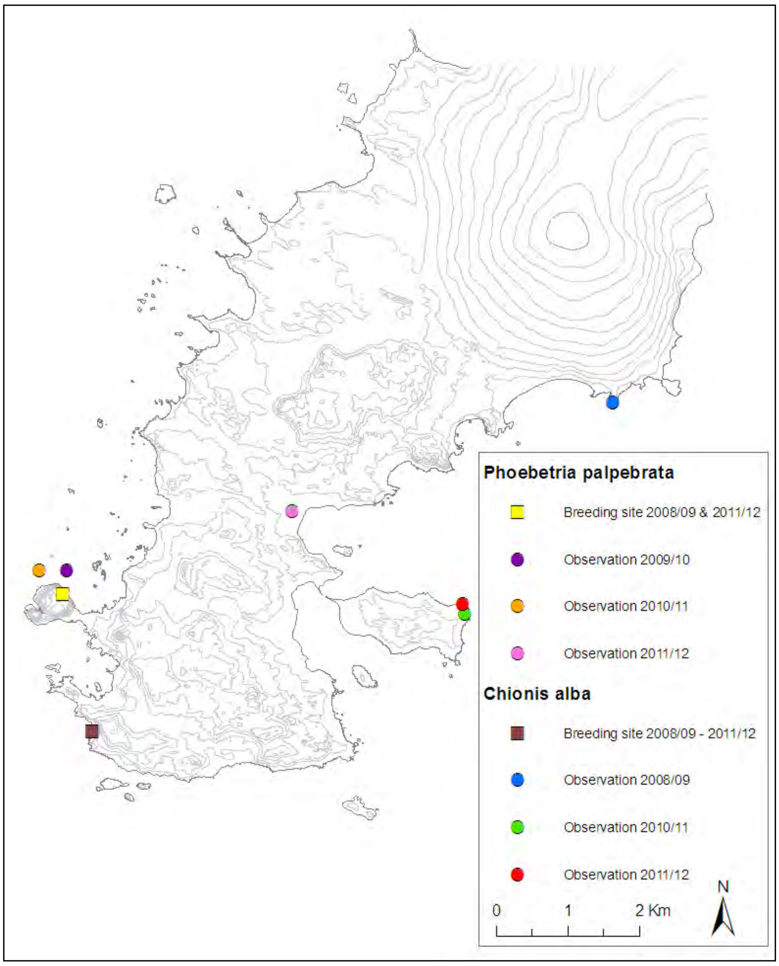


Fig. 9: Known breeding places and sightings of light-mantled sooty albatross and snowy sheathbill in the seasons 2008/09 to 2011/12.

3.1.1.6 Snowy sheathbill (Chionis alba)

Following the disappearance of the chinstrap penguin colony from the south-western point of the Fildes Peninsula, the nesting site of the snowy sheathbill there was also abandoned, as the birds' food source disappeared along with the penguins (Peter et al., 2008). One active nesting site with two broods of two chicks each was observed in the 2008/09 season (pers. comm. S. Lisovski), and at least one breeding pair was observed in 2009/10, 2010/11 and 2011/12, in both cases in the extreme south-west of the peninsula (Fig. 8). It is possible that these snowy sheathbills use the densely-populated cape petrel colonies as food sources, as the nearest penguin colonies are further away on Ardley Island (5.5 km to the north-east) or on Withem Island (4 km to the south-west).

3.1.1.7 Skuas (Catharacta spp.)

Data on the presence and distribution of skuas in the study area were provided by A. Fröhlich (2006/07), M. Kopp (2007/08-2009/10), S. Lisovski (2008/09), J. Esefeld (2009/10 and 2010/11), and T. Gütter (2010/11 and 2011/12). In the last three seasons a total of 216 (2008/09), 243 (2009/10) 357 (2010/11) and 197. These totals for breeding pairs of the two species are thus average over the long term. In 2010/11 the second-highest population since 1979/80 was recorded. Only in 2006/07 was the population marginally higher, with 360 BP. The number of breeding pairs of skuas is generally subject to strong fluctuations (Fig. 9). Two factors affect them most of all: local weather conditions, especially at the start of the breeding season, and food availability. In the 2008/09 season, considerably more skuas occupied territories than in 2007/08 but they bred only in much lower numbers, probably due to a lack of food. The distribution of skua nests on the Fildes Peninsula and Ardley Island is shown in Fig. 10 a - d. The strong affinity of brown skuas for breeding sites near the coast can clearly be seen.

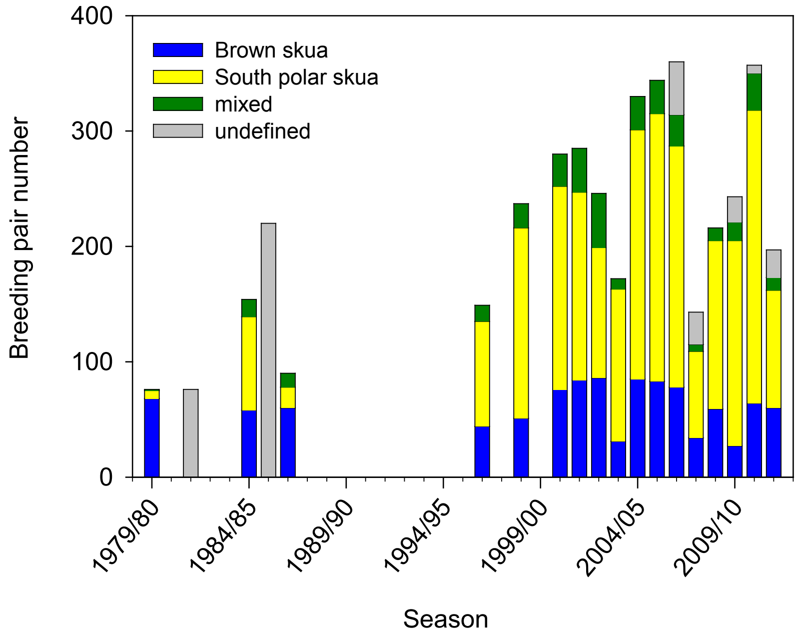


Fig. 10: Breeding pair numbers of skuas nesting on the Fildes Peninsula and Ardley Island. There are no data for the seasons without indications. Skua pairs of which the species of one partner is not known, and which can therefore not be included in any of the other categories, are classified as "undetermined".

Where south polar skuas are present sympatrically with brown skuas, the former search for food exclusively at sea, while brown skuas obtain food overwhelmingly from terrestrial sources, eating birds and dead seals (Hahn et al., 2007). As the two skua species exploit different food sources, a good year for reproduction in one species does not necessarily mean that breeding conditions are good for the other species.

Despite repeated educational efforts by project workers in the stations of the Fildes Peninsula, skuas continue to be fed there, or food waste is disposed of in such a way that it is easily accessible to skuas (Sec. 3.2.2.5 & 3.4.2.3). Problems resulting from this are the risk of disease transmission (Kerry et al., 1999) and the potential negative effects on nestling development of food that is atypical for skuas and often of low quality (Peter et al., 2002).

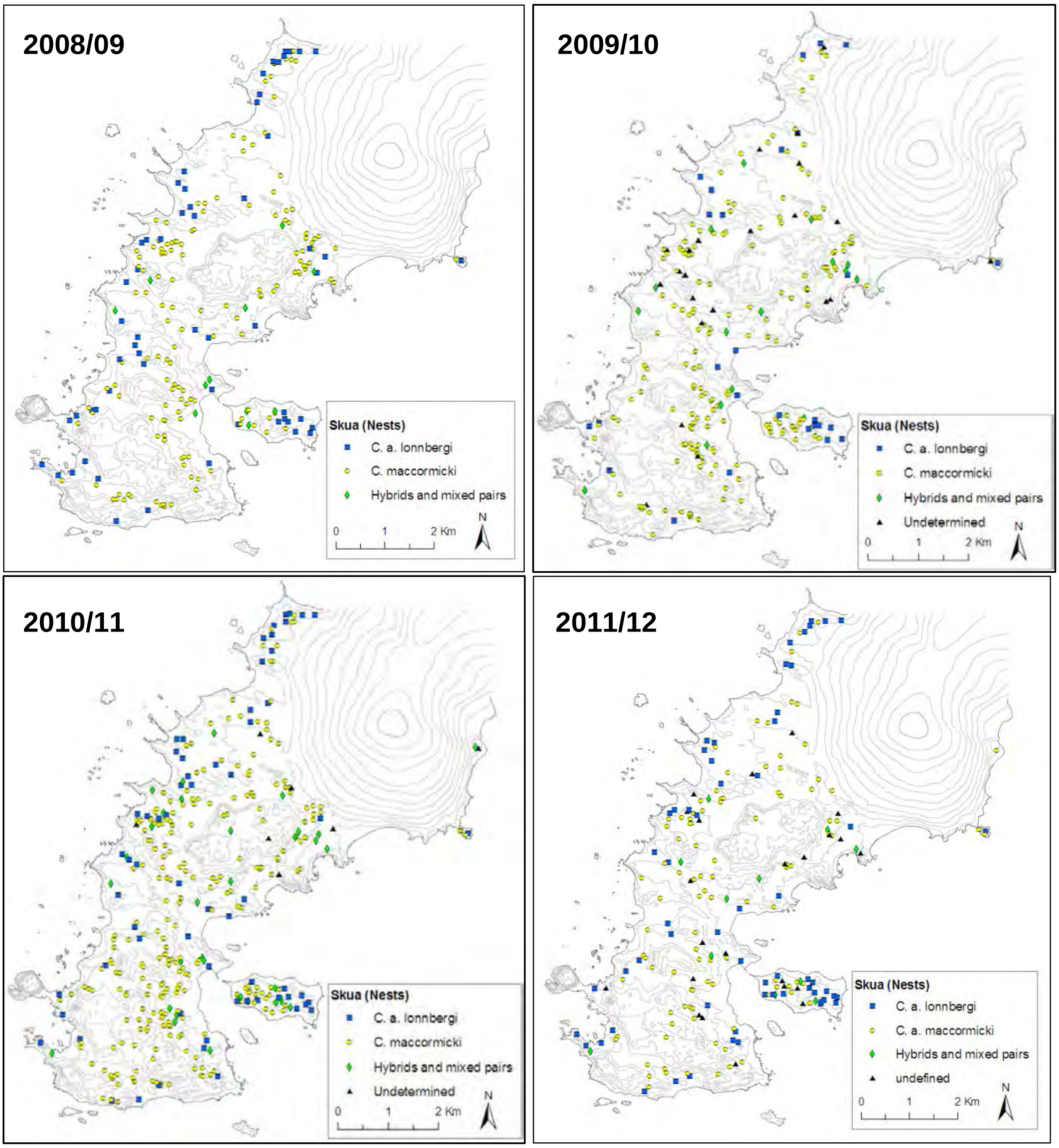
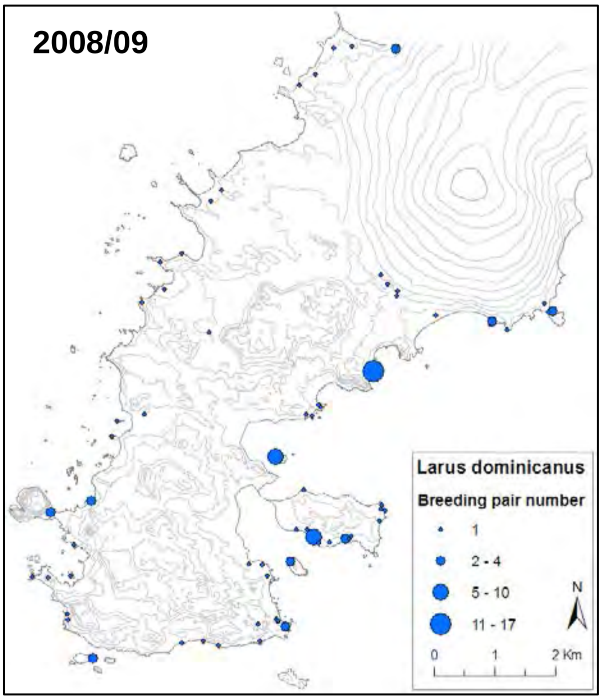
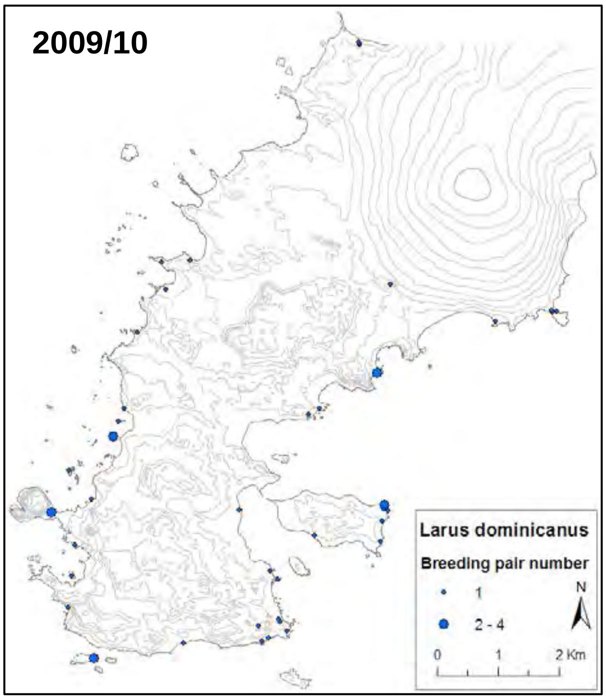


Fig. 11 a - d: Distribution of skua nests on the Fildes Peninsula and Ardley Island in the seasons 2008/09 to 2011/12.

3.1.1.8 Kelp gull (Larus dominicanus)

Although the kelp gull populations on King George Island are considered to be stable (Sander et al., 2006; Peter et al., 2008, Chapter 4.5.7.), they dropped from a maximum of 180 BP (1884/85, Peter et al., 1988) through 109 BP (2008/09) to only 50 BP (2009/10, Fig. 11 a - c). It is to be assumed that this decline is not a trend but rather a case of natural fluctuations in numbers of breeding pairs as many more pairs were present in the study area, especially in the 2009/10 season, but they did not begin to breed due to adverse weather conditions. In the 2010/11 season, 86 breeding pairs of kelp gulls were counted. No mapping was carried out in the 2011/12 season.





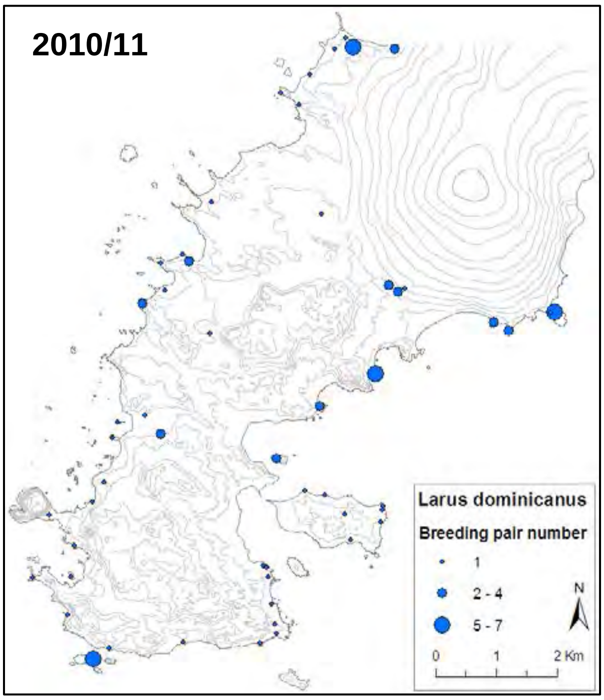
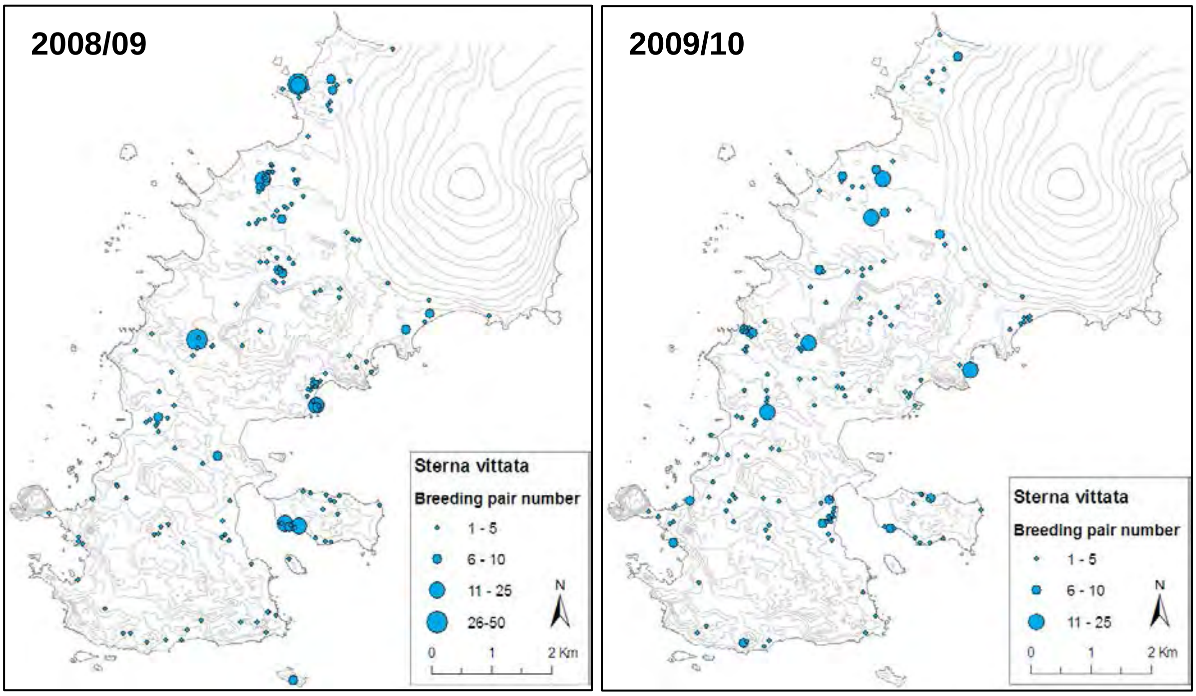


Fig. 12 a - c: Colonies and single nests of kelp gulls in the seasons 2008/09 to 2010/11.

3.1.1.9 Antarctic tern (Sterna vittata)



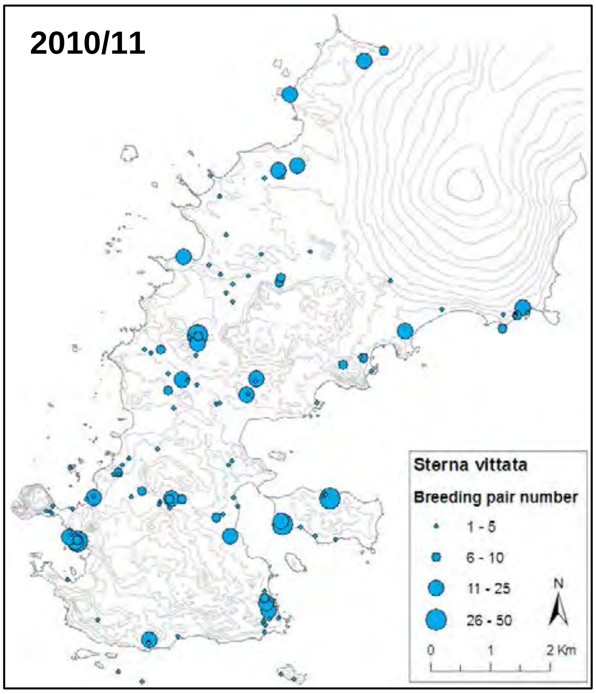


Fig. 13 a - c: Antarctic tern nesting places in the study area in the seasons 2008/09 to 2010/11.

From December to February, a total of 567 BP (2008/09), 463 BP (2009/10) and 884 BP (2010/11) of Antarctic tern were counted (Fig. 12 a - c). This means that numbers in the 2010/11 season very nearly matched the maximum recorded in 1984/85 (approx. 900 BP, Peter et al., 1988). A correspondingly high number of BP – 129 – was recorded in the 2010/2011February count, whereas in the seasons 2003/04 to 2009/10, fewer than 50 BP were counted in February. However, it is likely that the actual population is smaller, as these birds are very sensitive to disturbance and may move their nesting sites several times during the breeding season. It can thus not be excluded that the same breeding pairs may have been counted several times. In the season 2011/12 no mapping was carried out.

Large-scale and extended use of heavy machinery north of Great Wall station to remove material from the beach ridges there and from the area near the adjacent road (Sec. 3.2.1.2) in the 2008/09 and 2009/10 seasons subjected the Antarctic terns nesting there to extreme disturbance, which prompted them to leave this nesting site early in both seasons.

3.1.1.10 Potential breeding birds, migrants and accidental visitors

Blue-eyed shag (*Phalacrocorax atriceps*) – either single birds or groups of up to 18 individuals – are frequently observed along the coast of the Fildes Peninsula and on the offshore islands. No active nesting sites of this species have been identified in the Fildes Region since 1986/87 (Mönke & Bick, 1988), but they are known to exist on neighbouring Nelson Island, for example. Compared to previous years, a rise in the number of king penguins (*Aptenodytes patagonicus*) was recorded in the study area. A total of three living individuals were reported, on 27.12.2008 (pers. comm. M. Kopp and S. Lisovski) and in June and July 2009 (pers. comm. Russian station staff). In December 2009 a finding of a dead bird was recorded). In the 2009/10 season a further five, and in 2011/12 a further five and two, king penguins were found dead on the coasts of the Fildes Peninsula and Ardley Island. It is also worth noting the report from Argentinian scientists about a king penguin brood that was started, but then abandoned, on the nearby Potter Peninsula (pers. comm. D. Montalti).

The remains of an already long-dead emperor penguin (*Aptenodytes forsteri*) were found in the extreme north-west of the Fildes Peninsula in the 2008/09 season. An immature emperor penguin was present near Bellingshausen and Frei stations on 20.01.2011 and 06.01.2012. On 13.01.2010 a macaroni penguin (*Eudyptes chrysolophus*) was seen in the penguin colony on Ardley Island. Another individual of this species was seen on the northern coast of Drake Passage on 23.02.2012. A rockhopper penguin (*Eudyptes chrysocome*) also stayed in the colony on Ardley Island during moulting, remaining at least from 30.01.2010 to 04.02.2010. In addition, an immature rockhopper penguin was observed on 19.01.2011 in a small chinstrap penguin colony on the Drake Coast of the Fildes Peninsula. According to current knowledge, these are the first recorded observations of this species in the main study area; previously there had only been observations on King George Island from neighbouring Admiralty Bay (Trivelpiece et al., 1987).

Representatives of the tube-nosed marine birds, which do not breed in the Fildes Region but which pass through or are frequently washed up dead on the shore, include diverse *Pachyptila* species, blue petrel (*Halobaena cerula*) Antarctic petrel (*Thalassoica antarctica*), southern fulmar (*Fulmarus glacialoides*) and snow petrel (*Pagodroma nivea*). Living birds of the last three species are rarely observed (*F. glacialoides*: 08.12.2008; *P. nivea*: 10.11.2008, 08.02.2010, 20.11.2011 a single individual in each case, 21.11.2011 three individuals; *T. antarctica*: 18.11.2011 one individual, 30.11.2011 5-10 individuals). In addition, in 2009/10 the remains of three individuals were found, each of which was either a soft-plumaged petrel (*Pterodroma mollis*) or a Kerguelen petrel (*Pterodroma brevirostris*). Three dead birds found in December 2011 were probably Atlantic petrel (*Pterodroma incerta*). Fifteen other dead bird findings were identified as either *Pachyptila desolata* or *Halobaena caerula*.. For this last species, King George Island lies south of the known distribution area (Shirihai, 2002). Black-browed albatross (*Diomedea melanophris*) are known to follow ships at sea over long distances, so it is not surprising that on 05.12.2008, when a ship arrived, an individual of this species was observed in front of the neighbouring Korean station, King Sejong.

A dead diving-petrel (*Pelecanoides spp.*) was found on the beach of the Fildes Strait in 2008/09. As far as is known, this is the first recorded finding in the region. It should be included in the category "accidental vagrants", together with occasional cattle egret (*Bubulcus ibis*), of which two dead birds were found in 2008/09 and one each in 2009/10, 2010/11 and 2011/12). These birds perish on the Fildes Peninsula due to lack of food. Also in this category are two Chilöe wigeon (*Anas sibilatrix*), which were observed off the coast of Great Wall on 29.11.2008. Arctic terns (*Sterna paradisaea*) have been regularly observed in groups of up to 150 birds (Fig. 13, Tab. 3). White-rumped sandpiper (*Calidris fuscicollis*) are rare but regular guests in the study area (06.02.2009: three sightings, 26.01.2010: one sighting, 21.01.2011: one sighting). An overview of the spatial distribution of observations and findings of these species is provided in Fig. 14 a - d.

Fig. 14: Flock of Arctic terns (photo: M. Stelter, 17.12.2011).

Tab. 3: Sightings of Arctic terns in the study area in the seasons 2008/09 to 2011/12.

Date of observation	***Number of individuals***
05.11.2008	150
22.12.2008	1
06.01.2009	10
23.12.2009	7
08.01.2010	1
16.01.2011	3
24.11.2011	1
01.12.2011	1
17.12.2011	18
22.12.2011	1
23.12.2011	1
27.12.2011	5
02.01.2012	22
12.01.2012	6

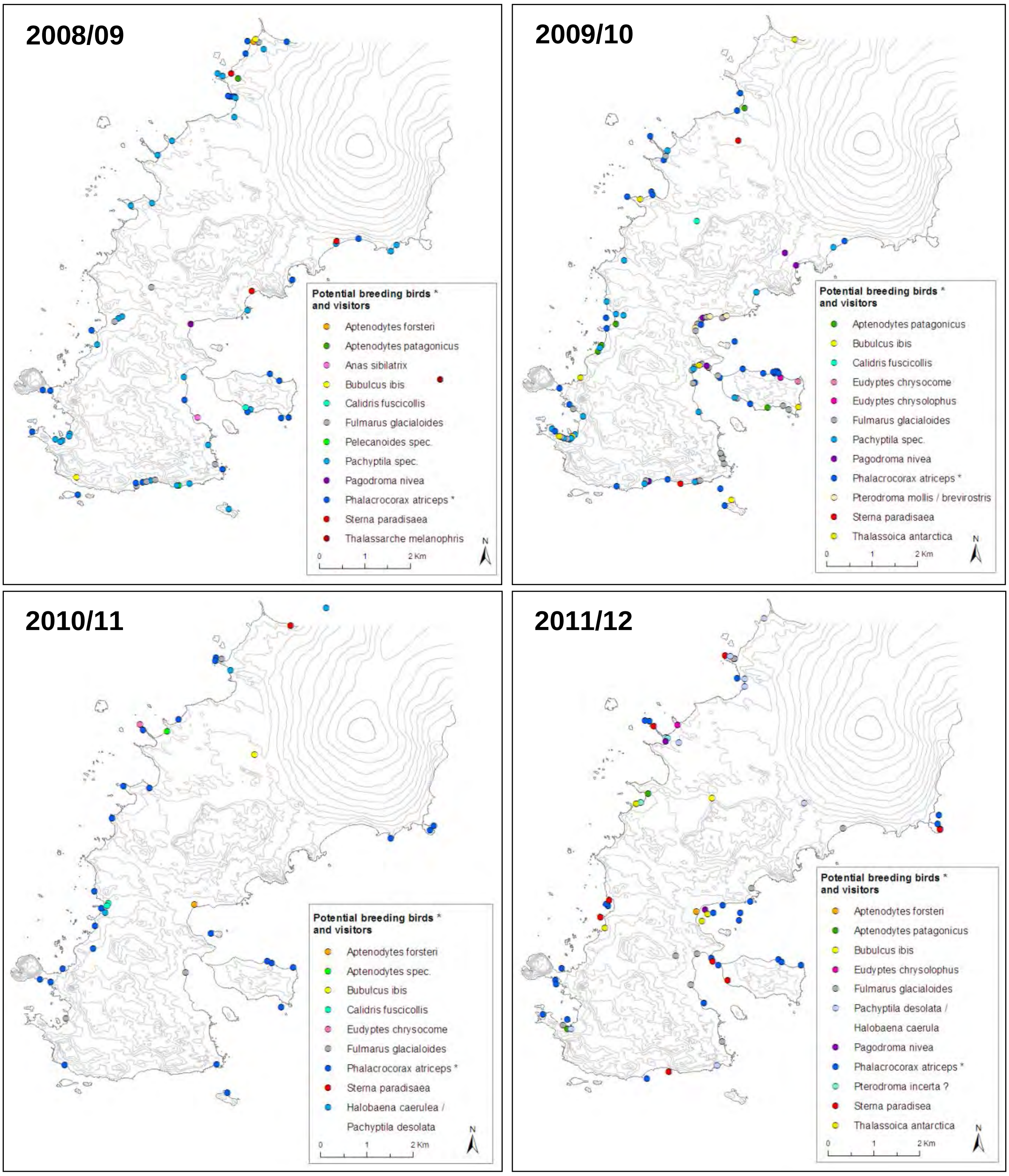


Fig. 15 a - d: Observations of potential breeding birds (*), migrants and visitors, and finds of dead birds in these categories in the Fildes Region in the seasons 2008/09 to 2011/12.

3.1.2 Seals

In accordance with the methodology described in Peter et al (2008), four monthly seal counts were carried out in 2008/09 and three in the 2009/10, 2010/11 and 2011/12 seasons along the entire coastline of the Fildes Peninsula and Ardley Island. The monthly totals are compared with those of previous years in Fig. 15 and in Tab. 7 in Appendix 1.

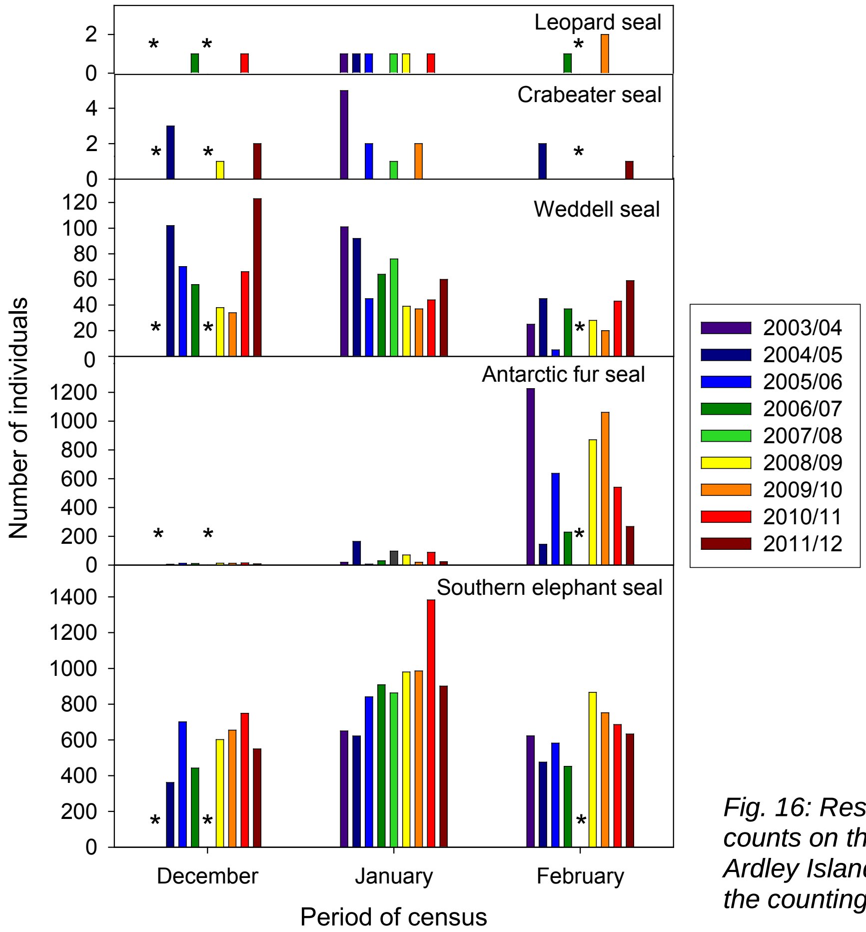


*Fig. 16: Results of the monthly seal counts on the Fildes Peninsula and Ardley Island. No data are available for the counting periods marked with *.*

More than 95 % of southern elephant seals (*Mirounga leonina*) recorded were found in the bays of the Drake Coast, where they come on shore in large numbers to moult and rest throughout the season. The haul-outs with at least 10 individuals mapped correspond to a great extent with those known from Peter et al. (2008, Fig. 16 a - d). In January 2012, the largest haul-out was recorded on the northern Drake Coast, with 255 elephant seals.

In comparison, Weddell seals (*Leptonychotes weddelli*) are to be found more regularly on the east coast, but always as single individuals and in far smaller numbers than elephant seals and Antarctic fur seals (*Arctocephalus gazella*). The number of Weddell seals recorded in the summer (December to February), was relatively low in the 2009/10 season, at 91 individuals. However, the number in 2009-2012 (91 to 242 individuals) were more or less in line with those of the 1980s (143 to 261 individuals,, Peter et al., 1988; Mönke & Bick, 1988) and of the research period of the previous project (2003-2006: 126 to 239 individuals, Peter et al., 2008, Chapter 4.5.11.).

Antarctic fur seals appear in large numbers in the region in February and March, with a considerable majority of males. Despite wide fluctuations in the numbers of this species, as numbers of this species fluctuate widely, only limited statements can be made about population trends. A substantial increase, such as that observed on the South Orkney Islands up to the mid-1990s (Waluda et al., 2010), can also be demonstrated for the Fildes Region over the long term. The largest increase was recorded in the 1980s. While there was a maximum of just 74 Antarctic fur seals in 1985 (Peter et al., 1988), this maximum rose to 176 in 1986 (Mönke & Bick, 1988) and to 481 in 1988 (Lange & Naumann, 1989).

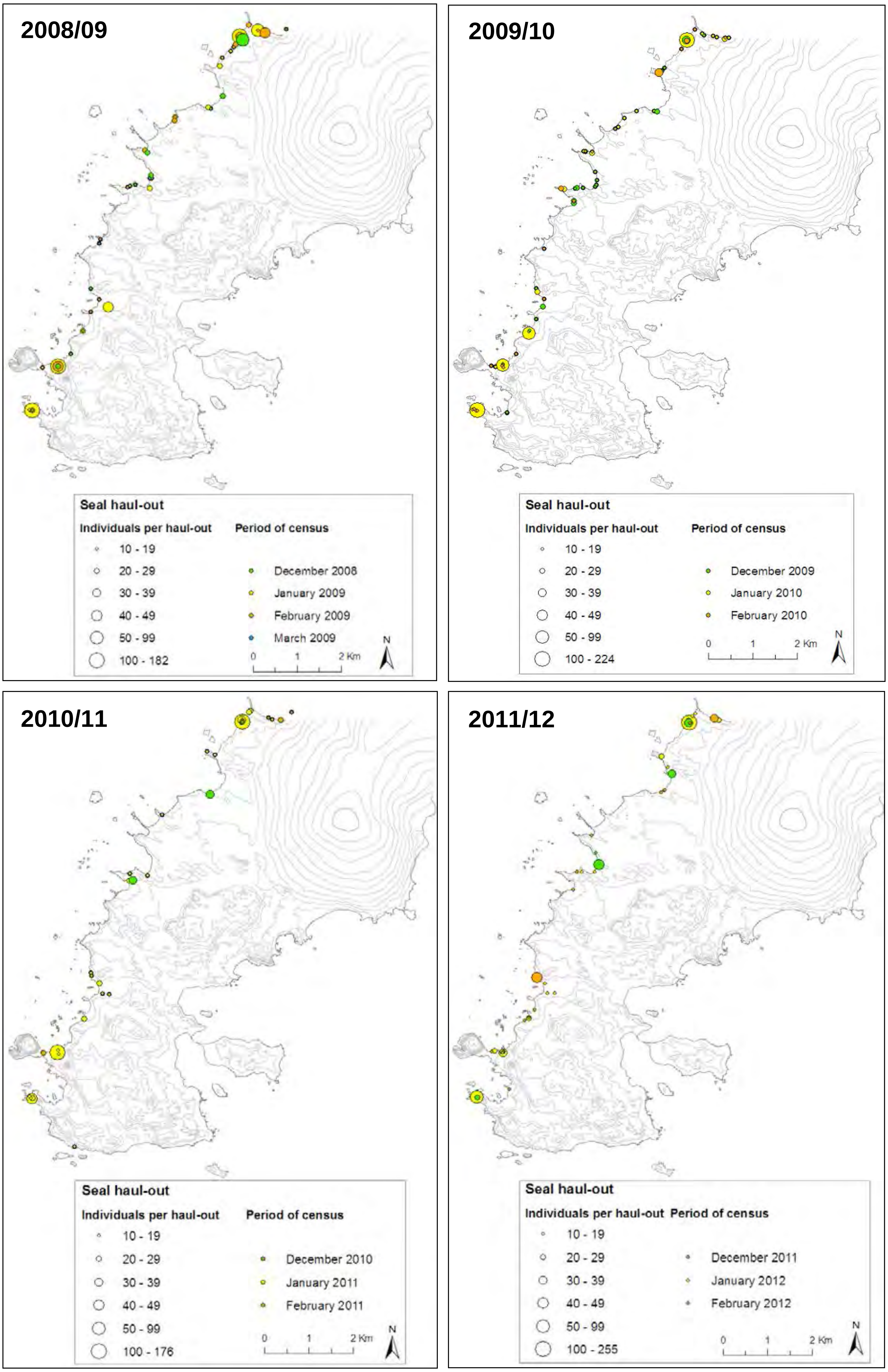


Fig. 17 a - d: Southern elephant seal haul-outs with at least ten individuals on the Fildes Peninsula in the Antarctic summers of 2008/09 to 2011/12.

Crabeater seals (*Lobodon carcinophagus*) and leopard seals (*Hydrurga leptonyx*) were only rarely observed in the study area in summer. The sporadic appearance of crabeater seals can be put down to their association with ice. The animals are present in much larger numbers in the Maxwell Bay area in September/October but there are no current data for this. In comparison, the leopard seal as top predator is usually only sparsely represented and most of the time single animals are seen. Noteworthy in this context was the observation of 10 leopard seals on the Ardley Isthmus on 25.08.2010 (pers. comm. B. Sazepin).

Births of elephant seals, Weddell seals, leopard seals, crabeater seals, and Antarctic fur seals are known to occur in the study area (Mönke & Bick, 1988; Nadler & Mix, 1989; Peter et al., 2008). However, except in the case of Antarctic fur seals, pupping usually takes place outside the study period, with the result that no systematic records could be made. At least 13 (2008), seven (2009), 22 (2010) and 10 (2011) new-born Weddell seals, as well as six (2008) and nine (2010) elephant seals were observed in winter or spring on the beaches very close to the Bellingshausen and Great Wall stations, and on the Drake Coast (pers. comm. S. Lisovski, V. Sjomin and B. Sazepin, Fig. 17). The same pupping places were used as in previous years but because there was no systematic recording of seal births, no conclusions can be drawn as to trends. The possibility of anthropogenic influences, for example from visits by station members in their free time, cannot be excluded, as is shown in a study by Chwedorzewka & Korczak (2010) from neighbouring Admiralty Bay.

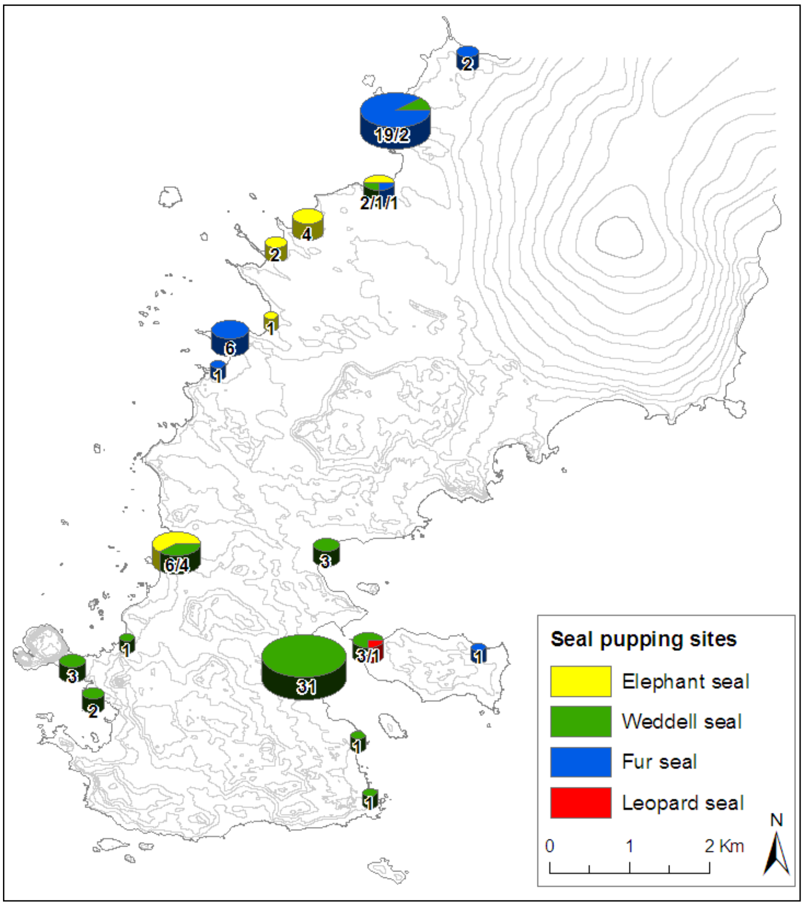


Fig. 18: Seal pupping places and numbers of juveniles in specific bays of the Fildes Region coast from 2008 to 2012.

In contrast, it became clear that Antarctic fur seal pupping areas continued to grow. Juveniles were recorded in all the seasons studied at known Antarctic fur seal pupping places near the Russian field hut Priroda (2008/09: 7 juveniles, 2009/10: 4, 2010/11: 5, 2011/12: 3). In addition, five juvenile Antarctic fur seals were observed on the Drake Coast north of the runway in 2010/11 and one in 2011/12. In the 2008/09 season an Antarctic fur seal pupping place was recorded for the first time on Ardley Island (pers. comm. S. Lisovski). A new-born leopard seal was also seen there in 2011/12 (pers. comm. A. Contreras and R. Eliseev).

The dumping of anthropogenic waste in the sea continues to represent a threat to Antarctic fauna (Riddle, 2009). Just as in 2006 (Peter et al., 2008), an elephant eeal was found in 2008/09 with a deep throat wound, probably caused by strangulation by a fishing line (Fig. 18). The seal had apparently been able to free itself and the deep cut already showed signs of healing. An elephant seal observed in February 2012 was seen to have remnants of a fishing net on its neck.

Fig. 19: Young southern elephant seal with throat wound, probably caused by a fishing line (photo: C. Braun, 08.02.2009).

3.1.3 Vegetation and damage to vegetation

As a result of climate warming and changes in water availability, the two naturally occurring higher plant species, Antarctic pearlwort (*Colobanthus quitensis*) and Antarctic hair grass (*Deschampsia antarctica*), are at a particular advantage in the maritime Antarctic area (Fowbert & Smith, 1994; Lewis-Smith, 1994).

Fig. 20 a & b: The only known specimen of Colobanthus quitensis on the Fildes Peninsula, living (a) and dead (b) (photo: A. Nordt, 29.12.2009; T. Gütter, 12.12. 2010).

However, local conditions on the Fildes Peninsula appear not to be optimal for the colonisation of *C. quitensis*, although this species occurs to some extent in patches further afield (*e.g.* Potter Peninsula, Admiralty Bay, also King George Island). The only known specimen (Peter et al., 2008, Chapter 4.5.13.3.) has now died. Approximately 1 km north-east of this site, another cushion (3.5 x 4.5 cm) was found in the 2008/09 season (Fig. 19 a), which, however, was also discovered to be dead in the 2010/11 season (Fig. 19 b). The following year it could not be found.

The spread of *Deschampsia antarctica* on the Fildes Peninsula has been followed since 1984/85 (Gebauer et al., 1987). In addition, there are distribution maps for 2000/01 (Gerighausen et al., 2003) and 2004-06 (Peter et al., 2008). A planned repeat mapping in the context of this project could not be carried out due to long-lasting snow cover in the 2009/10 season. However, during the IPY data were recorded by an international student expedition in the 2007/08 season (*cf.* Peter & Huch, 2008).

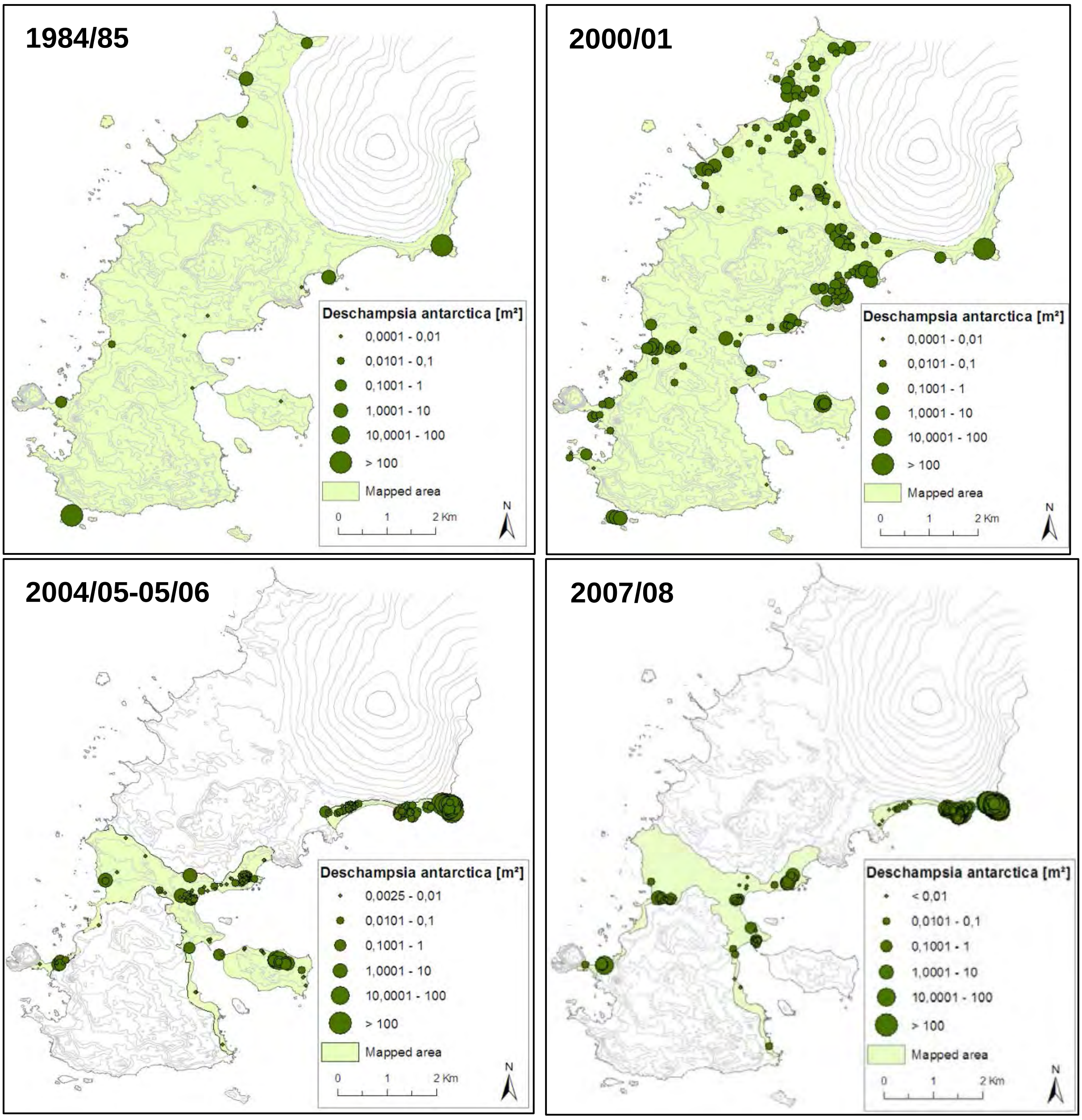


Fig. 20 a - d: Distribution and density of Deschampsia antarctica in the Fildes Region from 1984/85 to 2007/08.

During this latest investigation, Ardley Island was left out of the mapping due to the continuing snow cover. As can be seen in Fig. 20 a - d, *D. antarctica* has spread considerably at many known sites over 23 years and has additionally colonised further suitable areas. Nevertheless, this spread has also been reversed at some sites, which could be due to habitat destruction as a result of construction activity or general degradation through treading and other causes in the vicinity of stations.

There is evidence of damage to vegetation in many places in the Fildes Region due to the multitude of human activities. A major cause is driving over vegetation outside the existing road network (Sec. 3.3.3). In areas near stations that are more heavily walked on, and in particularly attractive regions, one can see numerous small areas of damage caused by repeated treading on the vegetation, which are, however, difficult to quantify. Moreover, areas of vegetation have suffered considerable damage from construction activities or the removal of building materials from inside and outside the grounds of stations (Sec. 3.2.1.2). One example of small-scale damage is the erection of a stone monument in a previously intact patch of moss (Fig. 21).

Fig. 21: Destruction of vegetation caused by the erection of a new monument by the road to Great Wall. The sharply-defined border with the moss bed can be seen clearly (photo: C. Braun, 17.12.2008).

3.1.4 Introduced, non-native species

The introduction of non-native species, which spread due to favourable environmental conditions and the lack of natural predators, and even drive out endemic species, represents a growing threat to the Antarctic ecosystem (Frenot et al., 2005; Hughes & Convey, 2010; Chown et al., 2012). Although it cannot be ruled out that species alien to the original Antarctic fauna and flora (Lewis-Smith & Richardson, 2011; Hughes & Convey, 2012) will naturally disperse into the region, introduction through human activities is much more likely. The IPY study "*Aliens in Antarctica*" found seeds or other plant material suitable for dispersal on the clothing or equipment of 30 % of all visitors to the Antarctic who were investigated. The proportion of plant material found on tourists and crew members of ships was considerably smaller than that found among participants in National Antarctic Programmes, *i.e.* scientists and logistical staff (SCAR, 2009a, 2010, 2012). Whereas IAATO and other cruise ships comply with high self-imposed standards with respect to cleaning and disinfecting equipment used on land, our information indicates that such security measures are hardly ever taken on research vessels, supply ships and aircraft.

A specimen of an introduced grass species (family: Poaceae), which could not be identified, was discovered in the immediate vicinity of the Russian station Bellingshausen in December 2008 (Fig. 22). Based on the size of the focus (diameter approx. 8 cm), it can be concluded that the plant had established itself on this site some years previously. No flower had formed at the time of discovery but it cannot be ruled out that there were already seeds from previous years present in the soil. As recommended by New Zealand (2006) and United Kingdom (2010), the plant, including the rhizome, was removed immediately after it had been discovered and documented, on 30.12.2008. Based on morphological similarities, we can assume that it is the same species as introduced plants recorded in Great Wall and Bellingshausen stations in 2004, or a related species (Peter et al., 2008, Chapter 4.5.15.). The sites where the grasses had been removed in February 2006 and December 2008 were repeatedly checked over the remaining study period and no evidence was found of new specimens. Since then, no more introduced plant species have been found on the Fildes Peninsula.

Fig. 22: Introduced grass not far from the Russian station Bellingshausen (photo: A. Nordt, December 2008).

Staff of the Chilean naval base reported repeated occurrences of moth-like insects (order: Lepidoptera). These were probably brought by sea (Barnes & Convey, 2005) together with deliveries of food or building materials, as they were present in the storeroom of the station and in adjacent living quarters. In the Chilean naval base and in the Chilean research station Escudero, there were several sightings of flies (order: Diptera), which were probably brought by sea. Station members also report the existence of mosquito larvae in the wastewater treatment system of the neighbouring Chilean station Frei since 2009/10 at least (pers. comm. V. Vallejos). According to the station manager, no counter measures are currently being taken. However, due to the prevailing climate, it is unlikely that mosquitoes will become established and spread beyond the confines of the station buildings.

In December 2011 a mosquito (suborder: Nematocera) of about 1 cm in size was found in a tuft of the locally-occurring *Deschampsia* grass on the northern Drake Coast (coordinates 62° 10' 2'' S, 58° 58' 19'' S) near the former Brazilian field hut Rambo (Peter et al., 2008, Chapter 4.2.11.), which was evidently different from the indigenous mosquito species *Parochlus steinenii* (Peter et al., 2008, Chapter 4.5.12.) This specimen belongs very likely to the same species *Trichocera maculipennis*, which was found in the wastewater treatment system and the surroundings of Artigas station and is classified by now as being persistent (Kingdom, 2012). The distance between the station and the locality of finding is about 4 km.

In samples of seawater from Ardley Cove, near the Russian and Chilean stations, non-native, human-associated microorganisms were found which showed resistance to antibiotics (Chile, 2012c; Hernández et al., 2012).

As part of a study by the Senckenberg Museum of Natural History Görlitz (Germany), on the introduction to the Antarctic of non-native soil organisms and the spread of native species within the Antarctic (Germany, 2010a, 2011), soil samples from the Fildes Region are also being investigated. Possible consequences for the Antarctic ecosystem of the introduction of non-native species for the Antarctic ecosystem form part of further investigations.

The various stations of the Fildes Peninsula currently take either no measures or limited measures to prevent the introduction of non-native species (Sec. 4.2). On the contrary, people still commonly keep house plants in a number of stations. To our knowledge, no measures are implemented to monitor non-native species.

3.2 Changes at Fildes Peninsula research stations

3.2.1 Station use and development of station populations

3.2.1.1 Stations and development of station populations

In the Fildes Region there are currently six stations, which are occupied year-round and are to a great extent independent of one another, together with one airport (Tab. 4, Fig. 23). The Chilean naval base "Capuerto" has been operating year-round since the 2005/06 season and is now listed by COMNAP as an independent station under the name Estación marítima Antártica.

Tab. 4: Stations of the Fildes Peninsula (source: http://www.comnap.aq/facilities, accessed: 10.06.2009, site no longer active).

Nation	Name of station	Situated	Operational since	Type
Chile	Escudero	Fildes Peninsula 62°12.07'S 058°57.75'W	1994	Year round
Chile	Estación Marítima Antártica ("Capuerto")	Fildes Peninsula 62°12.4'S 058°57.45'W	1987	Year round, since 2005/06
Chile	Frei	Fildes Peninsula 62°12.00'S 058°57.85'W	1969	Year round
Chile	Tte. Rodolfo Marsh (airport)	Fildes Peninsula 62°11.37'S 058°58.87'W	1969	Camp, Year round
China	Great Wall	Fildes Peninsula 62°12.98'S 058°57.73'W	1985	Year round
Russia	Bellingshausen	Fildes Peninsula 62°11.78'S 058°57.65'W	1968	Year round
Uruguay	Artigas	Fildes Peninsula 62°11.07'S 058°54.15'W	1984	Year round

In addition, there are seven field huts, which are not regularly used but which, to a greater or lesser extent, are made available to scientists and other station members.

Since the most recent records were made, in 2005/06 (Peter et al., 2008, Chapter 4.2.1.), developments in the numbers of station members on the Fildes Peninsula have been estimated using information published by COMNAP (from 25.03.2009) and by questioning the various station managers, which revealed that the COMNAP data was not up to date (http://www.comnap.aq/facilities, accessed: 10.06.2009 (site no longer active) & „Antarctic Facilities List Version 01 April 2012" at https://www.comnap.aq/Members/SitePages/Home.aspx, accessed: 02.07.2012).

According to the latest information, the average number of people living and working in the stations has risen since 2005/06 from 251 to 316 in the summer season (a 26 % rise) and from 95 to 126 in winter (a 33 % rise). Based on insights into the behaviour of station members in their free time, we can assume that the rise in the number of people living in the Fildes Region means a clear increase in the potential threat to the environment (Sec. 3.4.2).

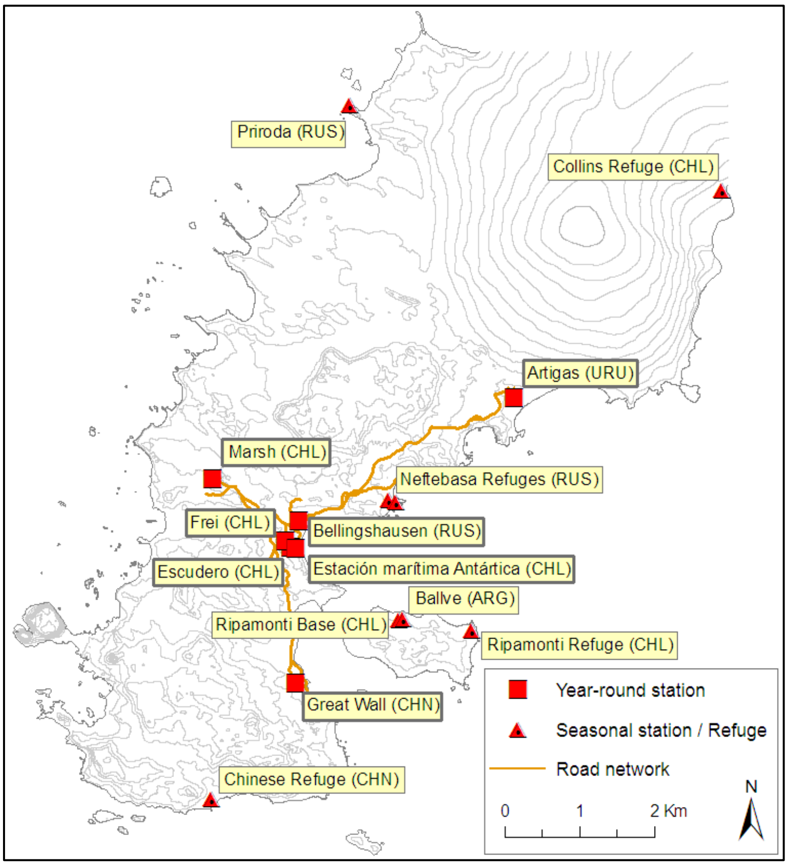


Fig. 23: Overview of the stations and field huts in the Fildes Region.

3.2.1.2 Construction activities in the study period and future plans

In recent years many Antarctic stations have been rebuilt or considerably extended, which can have a major effect on the local environment. Extending a station on the Fildes Peninsula brings improved living and working conditions but also increased accommodation, which in turn leads to higher fuel requirements for power generation, together with increased production of rubbish and wastewater. It is also frequently accompanied by increased scientific activity, vehicle use, and leisure activities outside the station grounds, which heighten the potential disturbance to flora and fauna.

On the Fildes Peninsula an old building was replaced by a new one at the Uruguayan research station Artigas in the 2005/06 season, thus expanding living and working facilities for scientists and station guests (Peter et al., 2008, Chapter 4.2.10.). At the same time, modest extensions were made to the Chilean research station Escudero. Since 2006 there has been construction activity at all the other stations of the Fildes Peninsula to extend the stations or to improve infrastructure. These activities were monitored for potential effects on the environment and significant observations were recorded.

a) Artigas

In the 2010/11 and 2011/12 seasons, workers began setting up eight new fuel tanks with a capacity of 8 x 32,000 litres, as replacements for the old fuel tanks and pipelines (Uruguay, 2011b, 2012c), which were affected by corrosion (pers. comm. E. Fiorelli). After the work has been completed, the old tanks will be dismantled and removed. The new steel tanks hold a year's supply of fuel, so that the use of a Neftebasa large fuel tank can be discontinued, together with the regular transportation of fuel from the tank to the station. This will probably considerably reduce the risk of oil contamination in this area (Sec. 3.2.5).

b) Bellingshausen

No major construction measures have been carried out at the Russian research station Bellingshausen in the last few years. Instead, the emphasis has been on interior work and on renovating the existing buildings, as well as installing three small wastewater treatment facilities (Sec. 3.2.4). To this end, during the 2008/09 season three insulated wastewater treatment systems were sunk into the ground and covered – one near the waste incineration plant and two near the diesel generator building. In addition, sleeping quarters were created in a storage building for Korean station members passing through**.**

On repeated occasions, several truckloads of gravel were removed from a stream bed in the shore area of the Neftebasa large fuel tank. These excavations affected an area of approximately 1,700 m^2. The gravel was used to improve a section of road (2008/09 and 2010/11 seasons) and to cover the area next to the generator building that had been contaminated with diesel fuel (2009/10 season, Sec. 3.2.5).

As part of an agreement with the non-governmental organisation "Inspire! a new small building, known as E-Base, was erected in February 2007 at the top of a hill on the north-western edge of the station grounds (ASOC, 2007; http://ebase.2041.com/2009/, accessed: 04.04.2012, Fig. 24). For this, an IEE was carried out by Russia (ATS, 2008). A station building that had existed at the same place some years previously had been pulled down. The E-Base is to be used as an education centre by "Inspire!", with reports about the Antarctic being sent to schools and universities live via the Internet. The first such reports were sent in March 2008 (http://www.2041.com/antarctic-expeditions/e-base/?phpMyAdmin=5sRPrOU96RYXGV% 2CTaBfCdM0eAJ4, accessed: 02.07.2012). As a special feature the building is to be operated exclusively with renewable energy sources in order to lead by example. A number of small wind turbines were installed and a few solar panels were put in place, but due to technical difficulties some of the solar panelshad to be repaired or replaced after a short time (http://www.2041.com/education/, accessed: 02.07.2012). So far the E-Base has only been used for a few weeks at the end of the summer season, but it was announced that in future it is to broadcast fully automated video messages about climate change all year round as part of the project "E-Base Live 365" (http://ebase.2041.com/2009/about-the-e-base/, accessed: 02.07.2012). Because the building has no independent water supply and wastewater treatment, the seven E-Base project members used the facilities of Bellingshausen and Frei stations during their stay in March 2011.

Fig. 24 The E-Base set up in February 2007 (photo: C. Braun, 26.12.2009).

c) Escudero

As a result of a gradual and limited extension of Escudero station since 2005/06, in which the size of two of the main buildings was first increased by a third and, subsequently (2011/12), the buildings were connected by a two-story building, the station can accommodate a larger number of scientists and other staff, and offer better working conditions. The extended station now offers summer living and working facilities for up to 40 people (pers. comm. V. Vallejos). According to INACH data, the built area increased by approximately 250 m^2 (http://www.inach.cl/wp-content/uploads/2011/12/PROCIEN-2012.pdf, accessed: 02.07.2012). In connection with this extension and the considerable expansion of the neighbouring Chilean naval base, a new, shared wastewater treatment facility was created in the 2008/09 season (see below & Sec. 3.2.4). In addition, a new garage building was constructed in the 2009/10 season. Negative environmental impact was limited mainly to small amounts of packaging material lying about.

d) Estación marítima Antártica

Since 1987 there has been a small Chilean naval base close to Frei station, called "Capitanía de Puerto de Bahía Fildes" – known locally simply as "Capuerto" – which initially had four staff in the summer and, from 2005/06, was occupied by five people all year round. In the 2008/09 season, the capacity of this base was considerably enlarged by the construction of a new building and up to 2012 it was listed by COMNAP as "Estación marítima Antártica" (https://www.comnap.aq/operations/facilities, accessed: 10.06.2009, site no longer active). The naval base is not included in the current COMNAP list („Antarctic Facilities List Version 01 April 2012" at https://www.comnap.aq/Members/SitePages/Home.aspx, accessed: 02.07.2012). However, due to its considerable independence we will continue to treat it as a separate station. The extension considerably increased the usable area of the station, while taking up only a moderate amount of additional land (Fig. 25 a & b). The original buildings are used as a storeroom, a garage and for the temporary accommodation of station members in the summer. The construction activities lasted from December 2008 to March 2009. All construction materials were brought from Chile in several ships.

Sand and gravel for the construction of the concrete foundations were washed before transport to the Antarctic, pursuant to the relevant IEE (http://www.e-seia.cl/portal/antarticos/archivos/RCA_ant_83.pdf, accessed: 02.07.2012), to prevent the introduction of non-native species. Additional stone needed was taken from an a rea immediately behind the existing station buildings, which has previously already been used for that purpose (Peter et al., 2008, Chapter 4.2.19.1.). The expansion of the station had no major impact on the local environment. The only visible negative consequence was a limited quantity of oil released into Maxwell Bay in December 2008, which was probably a result of excavation work for the foundations or work on pipelines.

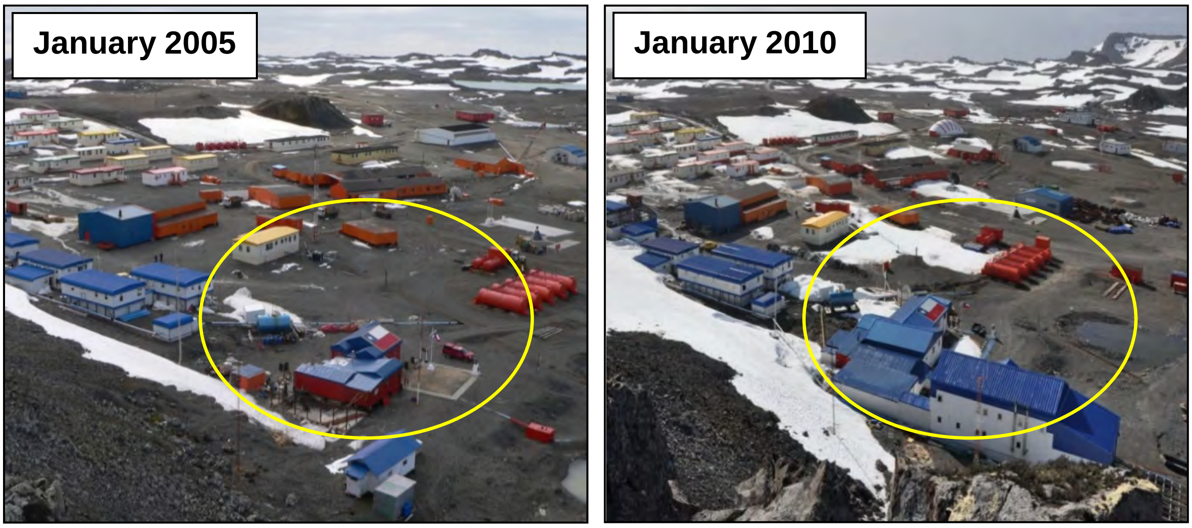


Fig. 25 a & b: Comparative views of the extended Chilean naval station in the seasons 2004/05 (a) and 2009/10 (b) (photos: C. Braun).

The extension was complemented by the creation of various elements of infrastructure, making the station to some extent independent from corresponding infrastructure at Frei station. These include a modern wastewater treatment system, which is operated jointly with neighbouring Escudero station (Sec. 3.2.4). All the work involved was carried out by construction staff from the naval base, as part of the station extension project. Furthermore, the feasibility will be as sessed of a seawater desalination plant to produce drinking water (source: IEE, see below). Frei station continues to provide electricity, though the naval station has its own generator for emergencies. Fuel for the generator is stored in three double wall tanks, in accordance with IEE, with a total capacity of 3,400 litres. Diesel is delivered by sea once a year in 200-litre drums and pumped into the tanks. A sealed concrete basin should catch the fuel in case of accidental leaks. (see for IEE: http://www.e-seia.cl/portal/antarticos/archivos/ant_83.zip, accessed: 02.07.2012, and personal observations).

The extended station opened at the beginning of April 2009. The crew now comprises up to 15 navy personnel in summer and nine in winter (https://www.comnap.aq/operations/facilities, accessed: 12.06.2009(site no longer active), pers. comm. station manager). In addition, there are plans to build a pier for landing passengers and freight (see below) – probably in conjunction with Frei Station.

e) Frei

During the study period there were several small construction projects at Frei station, which is run by the Chilean air force. For example, the drinking water lake fed by Kitezh Lake, at the north-western edge of Bellingshausen, was dredged in February 2009 and in March 2011 (Sec. 3.2.3). Moreover, fuel pipelines between Frei station and Tte. Marsh airport were renewed, which involved very limited excavations close to the road. No negative impact could be determined as a result of these measures.

Following the destruction by fire of the station's gymnasium in April 2009, a domed construction reinforced with steel joists was erected on the existing foundations before the start of the Antarctic summer in 2009/10 (Fig. 26). This building, which was initially intended to be a temporary solution, remained there in spite of stability problems, and was destroyed in April 2012 by strong winds. A new gymnasium will be built within the station grounds in the near future (pers. comm. station manager C. Madina).

Fig. 26: Domed construction as temporary replacement for Frei Station's gymnasium, which was destroyed by fire (photo: C. Braun, 03.01.2010).

In the past, it was frequently impossible to land at the Chilean Tte. Marsh airport due to bad visibility, which made local air transport operations difficult. Many flights had to be postponed or cancelled. Particularly problematic were landings by aircraft that were already airborne but, having passed the "point of no return", did not have enough fuel to return to the airport they had started from (Chile, 2008).

For this reason, a technical landing support system, known as a Transponder Landing System (TLS), was set up between the runway and the airport hotel between December 2009 and March 2010 (Fig. 26). This system should in future allow airplanes to land even when there is limited visibility (http://www.e-seia.cl/portal/antarticos/archivos/ant_96.pdf, accessed: 02.07.2012). This is likely to lead to a considerable increase in air traffic. However, to our knowledge this system has so far been very rarely used by the pilots due to technical problems (Sec. 3.3.1). The system was funded by the Brazilian air force as part of a cooperation agreement with Chile. The facility is operated and maintained by civilian staff of the Chilean air force authority DGAC (source: IEE, see above). The system consists of various aerials and a container that houses the system's electronic components. For the construction of the foundation, material from an area of around 0.8 ha was removed from a previously-used quarrying site at the eastern end of the runway. During the work, cables were also laid alongside the runway. Two construction vehicles that had been delivered specifically for the project remained in Frei station after completion of the building work (source: IEE, see above). As far as could be ascertained, these construction activities had no significant negative effects on the local flora and fauna, as the work was carried out in a very limited area already strongly marked by human activity and with no vegetation of any significance (Fig. 27). In addition, the distance to skuas and terns nesting nearby was virtually always more than 100 m.

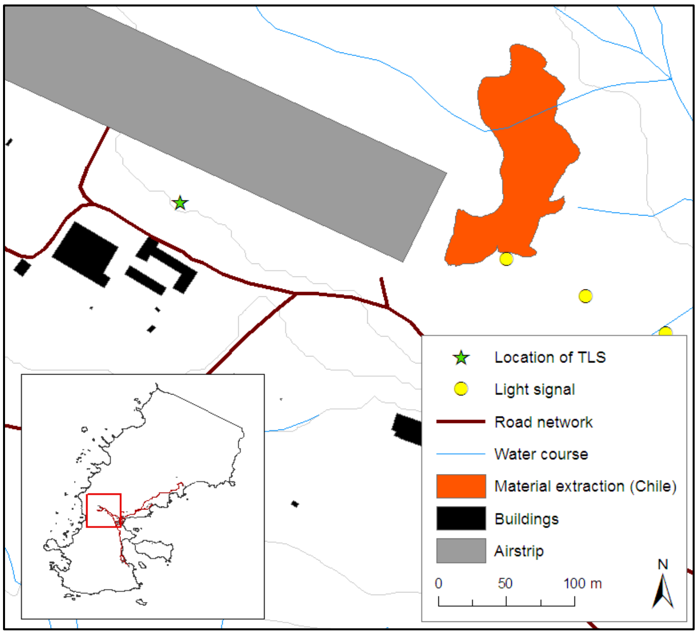


Fig. 27: Site of the new TLS landing support system and quarrying site.

Additionally, a system for treating wastewater from the airport hotel was installed in May 2010 (source: http://www.aprchile.cl/modules.php?name=News&file=article&sid=1064, accessed: 02.09.2010 (site no longer active), Sec. 3.2.4).

According to the station manager, there are plans for comprehensive refurbishment of large parts of Frei station and the erection of a number of wind turbines in order to reduce fuel consumption in the near future (pers. comm. C. Madina, Chile, 2009b). In the 2011/12 season some of the station's fuel tanks were replaced with double-wall steel tanks. In addition, maintenance work was carried out on the fuel pipeline between the airport and the large fuel tank belonging to it. This has contributed greatly to reducing the risk of oil contamination in the region.

According to information in the press, five large-scale Chilean construction projects will be implemented in the Antarctic over the next few years (source: http://www.cronica.cl/noticias/site/artic/20100210/pags/20100210164655.php, accessed: 27.04.2010, site no longer active). Four of these directly affect the Fildes Region and are aimed at improving the infrastructure of the Chilean stations. The plans are for:

i. Improving the infrastructure of Tte. Marsh airport, in particular the lighting, radio and visual aids, evening out the embankment and the surface of the runway, possibly lengthening the runway, levelling the edges of the runway and the hard shoulders, and improving and extending the parking platform;

   There are also plans to build a new hangar for an emergency vehicle (see below) and to purchase a larger emergency vehicle. In January 2011, Chilean architects and planners were on site for this purpose. In addition, there are plans to build a terminal next to the parking platform to receive passengers, together with a connecting road to the airport;

ii. Improving harbour infrastructure by constructing a pier or a dock for large ships such as the icebreaker Oscar Viel (90 m long) as well as medium-sized cruise ships with a length of up to 125 m and other ships operating in the region;

iii. Improving the living conditions of station members through better connection between the station sector Villa Las Estrellas and the airport, by extending or widening the 1.5-km-long connecting road (including drainage work);

iv. Improving drinking water provision (see below). Because the existing source of water freezes in winter, which makes it difficult to ensure a regular supply and causes damage to the distribution network. In future, water will be taken directly from Kitezh Lake (implies construction of new pipe network).

It is noticeable that some project descriptions relate particularly to tourism (airport terminal for tourists, cruise ships, etc.).

It will only be possible to estimate the potential environmental impact of the planned projects once the relevant IEE or CEE has been published. However, an extension to the runway in particular, which Chilean station staff say will be approximately 300 m long, will require very large amounts of building materials due to the local topography. It is to be expected that this will at least have similar effects on the environment as the airport extension in the 2004/05 season (Peter et al., 2008, Chapter 4.2.19.). Detailed topographic measurements were made during the 2009/10 season. However, there has so far been no discernible construction activity in connection with this project. It is not known whether an extended runway, such as the one planned, could lead to the use of larger aircraft than have been used up to now.

It is not clear to what extent the planned construction of a pier to allow larger ships to dock will impact on the environment and shipping in Maxwell Bay. According to press reports, the timetable for this project calls for a feasibility study in 2011/12, followed by a project design in 2012/13. The start of construction is said to be planned for 2014 (source: http://www.elpinguino.com/2010/02/58053/mop-presento-plan-antartico/, accessed: 02.07.2012).

During the study period only minor improvements were carried out on the road connecting the stations Bellingshausen and Frei to the airport.

In order to obtain water directly from Kitezh Lake, there are plans to build a new pumping system to replace the entire main water network and to extend it to the lake. The corresponding IEE drawn up for this purpose (http://www.e-seia.cl/portal/busquedas/antarticos.php, project No. 102, accessed: 02.07.2012) was based partly on outdated information and incorrect data, for example with respect to the status of the protected areas of the Fildes Region, existing roads or the presence of breeding birds in the project area (*cf.* Peter et al., 2008). In November 2010, approval for the project was published, together with the quarrying areas selected for the construction work (http://www.e-seia.cl/portal/busquedas/antarticos.php, project No. 102, accessed: 02.07.2012). However, construction work (planned for 2010/11) has not yet begun.

An IEE was published for a construction project planned for 2012 to improve airport infrastructure (ATS, 2012;

http://www.ats.aq/documents/EIA/01328spEIIA%20Cuartel%20SEI%202011.pdf, accessed: 02.07.2012). According to the plans, the building will contain a hangar for firefighting, emergency and other vehicles, together with offices for airport staff. The location for the building is indicated to be a site 250 m south-east of the airport, where a vehicle hangar stood before it was destroyed by fire in 2005. The floor space of the planned building will only be slightly larger than that of the previous building. For this reason, the planned construction activities are not expected to cause any serious disturbance to fauna and flora. No increased negative impact is expected on the two locally-occurring species of storm petrel (Sec. 3.1.1.4) that breed in the immediate vicinity (distance approx. 20 m). These species are nocturnal and appear to a great extent to tolerate daytime human activity, as long as their burrows are not destroyed. According to the IEE, the intention is to extract materials locally. It does not specify the amount of material that might be quarried. As a quarrying site it names an area of the Südpassage/Windbach (see below) which is north of the Chinese station Great Wall and is already heavily quarried. Energy will be provided by generators. Fuel for the generators and for vehicles will be transported in drums and stored in a 1,000 litre tank. Drinking water will be obtained from a small lake near the airport hotel. According to the IEE, wastewater will be treated in a multi-stage purification system using an activated filter bed. The purified wastewater will be discharged into a nearby lake. According to our information, this is probably the same discharge point as the one used for wastewater produced by the airport hotel. Any deficiencies in wastewater purification could therefore lead to a further increase in the release of nutrients, and possibly also harmful substances, into the Biologenbucht (Sec. 3.2.4).

f) Great Wall

The 2007/08 season saw the start of a major expansion of Great Wall station. At the same time the Chinese Arctic and Antarctic Administration (CAA) prepared an IEE (China, 2008). The IEE included the construction of a building for scientific purposes, a multifunction building, a building for wastewater treatment, as well as the laying of foundations for fuel tanks and a fuel pipeline.

Building materials were delivered by the Chinese ship “Xuelong” in January 2008 (pers. comm. M. Kopp). Between the 2007/08 and 2008/09 seasons, two three-storey buildings and three smaller buildings were constructed within the station grounds (Fig. 28 a & b). The buildings were connected to the drinking water and wastewater systems with new, above-ground pipes. Parts of the insulation around these pipes soon showed signs of damage caused by skuas, among other things (Sec. 3.2.2.3 & 3.2.2.5).

The precise increase in usable floor space as a result of the new buildings is not known but, based on the size of the buildings, the floor area is likely to be many times more what it was before (Sec. 3.2.1.4).

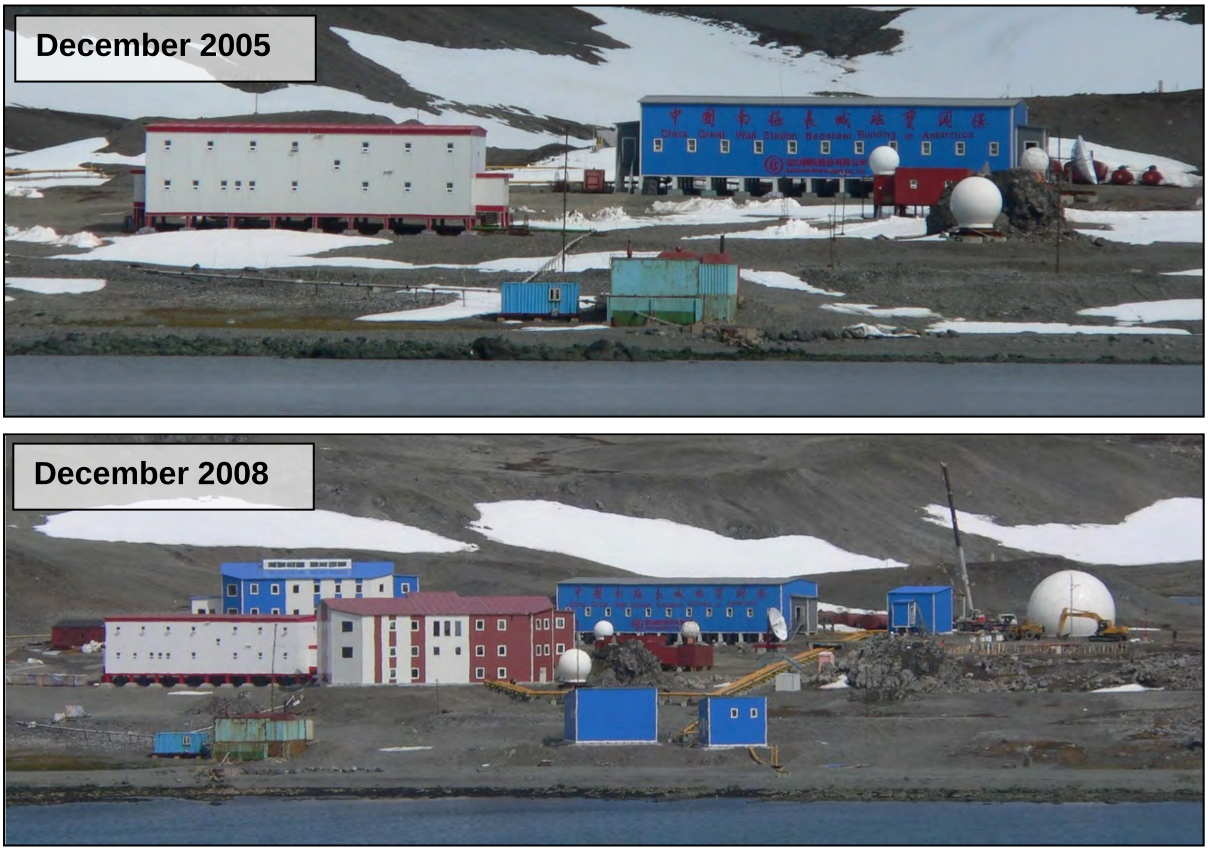


Fig. 28 a & b: Comparative views of the extended Great Wall Station in the seasons 2005/06 (a) and 2008/09 (b) (photos: C. Braun).

In the 2009/10 season, the single-wall tanks, which were seriously corroded, were replaced with more resistant steel tanks of the same capacity (8 x 50,000 litres, Fig. 29). It is not known whether these are double-wall tanks. Sealed basins, recommended during station inspections and by COMNAP, for example (Australia et al., 2005; United States, 2007; COMNAP, 2008a), were not installed. Next to the tanks, an above-ground, permanent pipeline, including housing for the electric cable necessary for the pumping system, was installed, running between the tanks and the station (Fig. 30). This removes the need to transport fuel by lorry from the fuel storage tanks and the generator station.

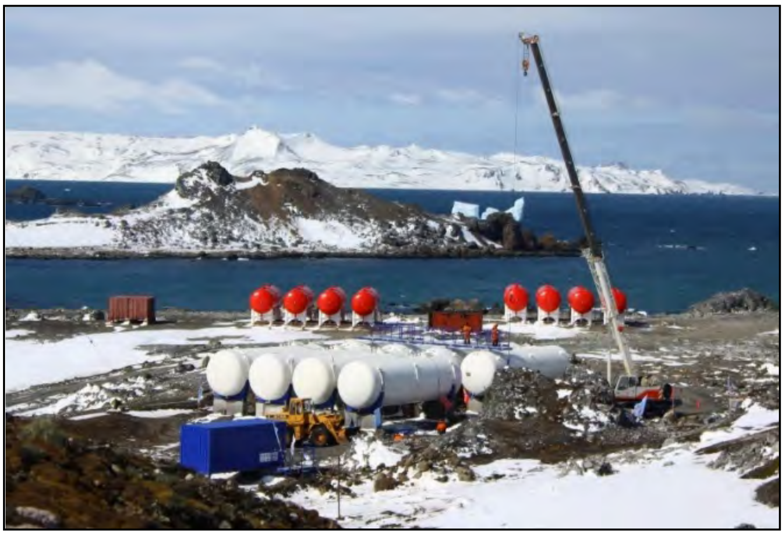


Fig. 29: New fuel tanks belonging to Great Wall Station, set up in the 2009/10 season (white, in foreground) and old tanks to be replaced (red, in background; photo: A. Nordt, 06.02.2010).

Fig. 30: New fuel pipelines connecting the fuel storage tanks with the station (photo: A. Nordt, 27.02.2010).

Both measures should be judged as being extremely positive, as the poor state of the old tanks and the earlier method of transferring fuel from the tanks to the station carried a high risk of oil contamination. In the past there had been repeated calls in a number of published inspections for this risk to be minimised in accordance with Article 7 of the Antarctic Treaty (Australia et al., 2005; United States, 2007). However, one must criticise both the lack of sealed basins under the tanks and the large-scale removal of local building material, such as sand and gravel.

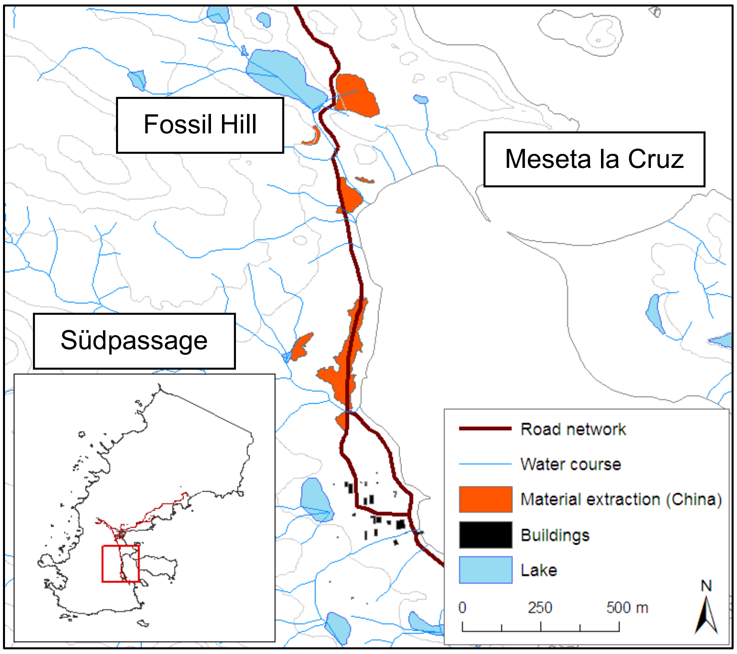


Fig. 31: Overview of areas affected by Chinese quarrying activities north of Great Wall Station.

At least throughout the 2008/09 and 2009/10 seasons and at the start of the 2010/2011 season, considerable quantities of sand and gravel were transported from the surrounding area to the station, to be used for all the various construction activities. The material was not removed in a concentrated manner but rather repeatedly from many different sites and always in small quantities. According to a statement by the manager of the Chinese station, this measure was not the subject of an IEE (conversation on 19. 12.2008). The bulk of quarrying took place in the area north of the station, along the road east of Fossil Hill and the Südpassage/Windbach (Fig. 31). A site at the Meseta la Cruz was also used, where large quantities of material had already been removed for the use of the airport extension (Peter et al., 2008, Chapter 4.2.19.). In the 2011/12 season material was taken from areas on both sides of the road and used for road repairs. The area was then levelled. A GPS/GIS study of the sites affected by Chinese quarrying revealed an area of more than 5 ha.

Both quarrying and driving heavy construction vehicles seriously damaged or completely destroyed vegetation in many places inside and outside the station grounds (Sec. 3.1.3). Thickly-growing moss patches were also affected, especially in the coastal area along the road (Fig. 32), as were lichen-rich areas, for example immediately north of Great Wall station (Peter et al., 2008, Chapter 4.5.13.1.).

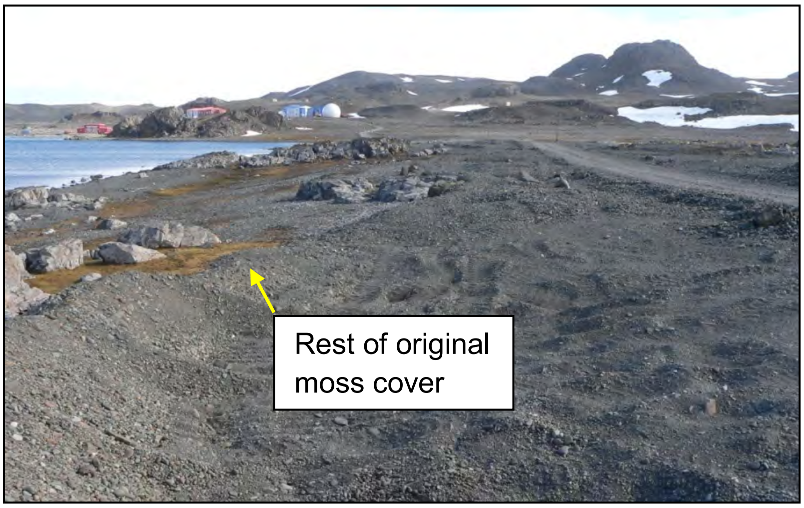


Fig. 32: Area formerly thickly covered with moss, destroyed by quarrying; Great Wall Station is in the background (photo: C. Braun, 25.12.2008).

Breeding sites of terns, storm petrels, skuas and kelp gulls were also impaired (Sec. 3.1.1, Peter et al., 2008, Chapter 4.5.). These sites were affected by noise due to the construction activities and, in the case of the terns, they were completely destroyed over a wide area during the breeding period due to the removal of sand and gravel.

Peter et al. (2008, Chapter 4.4.2.) have already pointed out the threat to the fossil beach ridges at the eastern end of the Südpassage due to their potential suitability as construction material. The very distinctive beach ridges of this region have great scientific potential, for example for the study of palaeobiology and palaeoecology, the palaeoclimate or hydrology (Barsch et al., 1985; Flügel, 1985, 1990; Mäusbacher, 1991; Berkman et al., 1998; Peter et al., 2008). Quarrying these beach ridges continued in all three seasons of the study period (Fig. 33). The loss to science from the total excavation of these areas must be considered to be very great.

Further effects of the construction activities on behalf of the station extension consisted of a significant amount of rubbish due to the open storage of large amounts of construction and packaging materials (Sec. 3.2.2.3 & 3.2.2.5), continuing oil contamination of all areas where construction vehicles had been driven (Sec. 3.2.5), as well as multiple violations by station staff (Sec. 3.4.2.3) of the applicable regulations of the EP (Annex II, EP).

Taken as a whole, the considerable improvements to living and working conditions, and the reduced risk of oil contamination, contrast with a multitude of negative effects on the environment.

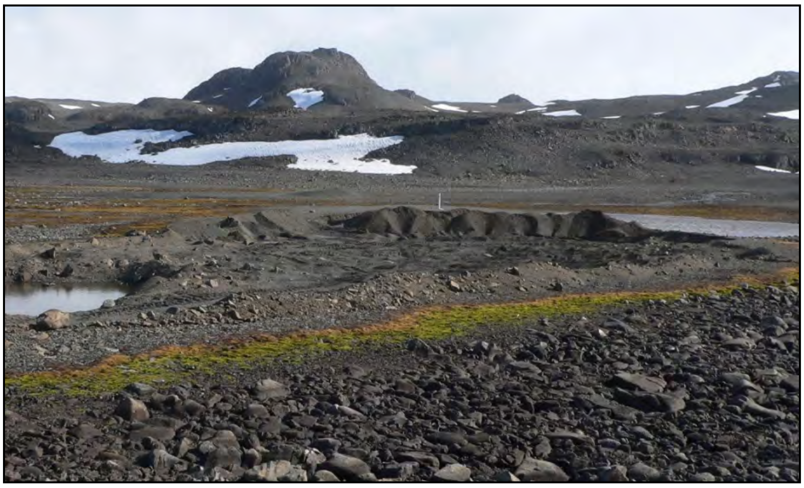


Fig. 33: Beach ridge that has been removed, in the eastern area of the Südpassage (photo: A. Nordt, 25.12.2008); in the 2009/10 and 2010/11 seasons, this quarried area was substantially extended and deepened.

3.2.1.3 Field huts and their use

In addition to the field huts that have already been extensively described in Peter et al. (2008), two further accommodation units for scientists (Chinese Container on the Fildes Strait and Chilean Refugio Collins) have been set up in the Fildes Region or in the immediate vicinity since the 2005/06 Antarctic summer (Fig. 23). During the study period, we visited all the field huts in the Fildes Region and recorded their condition.

The maritime climate that prevails in the region is the factor that has the greatest effect on the condition of the field huts (Peter et al., 2008, Chapter 2.5.1.), especially the constant high atmospheric humidity. In the case of deficient construction or a lack of maintenance, such as protective coats of paint or sealing, the field huts can become so badly dilapidated within a very short time that they are unusable. Signs of such damage can be found in nearly all field huts of the Fildes Region that are currently in use. In particular, severe mould infestations inside the huts present a serious health risk to visitors in the case of longer stays.

a) Refugio Naval Teniente Ballve (Argentina)

The Argentinian Refugio Ballve on Ardley Island consists of an accommodation hut and a refuge hut. Both buildings are in a relatively good state of repair but have not been in regular use for many years. In the 2008/09, 2009/10 and 2010/11 seasons they occasionally served as a refuge for scientists in bad weather.

b) Base Julio Ripamonti (Chile)

Despite increasing damp inside, the field station Base Julio Ripamonti on Ardley Island is in good condition. However, it has not been used regularly for many years.

c) Refugio Julio Ripamonti (Chile)

The Ripamonti field hut in the north-east of Ardley Island has a gas heater and can supply its own energy by means of a photovoltaic array. Because of these special facilities, its good state of repair and its close proximity to a penguin colony, this hut is regularly visited and sometimes used for overnight stays in summer by Chilean, German and Chinese scientists working on Ardley Island.

d) Priroda (Russia)

Priroda field hut was renovated by Russian station members in the 2008/09 season, including comprehensive sealing against damp.

As the hut is in a good state of repair and is well-equipped, including a gas heater, it offers good accommodation to scientists and v isitors. In particular because of its attractive surroundings, the Priroda hut is regularly visited by station staff in their spare time (Fig. 34, Peter et al., 2008). Russian station members have built a wooden table and benches next to the hut. The majority of outings continue to be made using motor vehicles (four-wheel-drive vehicles, tracked vehicles and trucks), which means that the Valle Klotz on the way to the hut, which is rich in vegetation, is crossed along many different paths (Sec. 3.3.3).

Fig. 34: Outing by station members to the Priroda field hut in the 2008/09 season (photo: C. Braun, 18.01.2009).

The frequency of use of the Priroda hut and the minimum number of visitors can be estimated from the entries in the log book. There were a total of 290 entries from the first log book entries in October 1998 to February 2012. The number of visitors (without scientists) to the Priroda hut that can be verified totals 956 (including 188 scientists) and has more than trebled since March 2006 (Fig. 35, Peter et al., 2008, Chapter 4.2.11.).

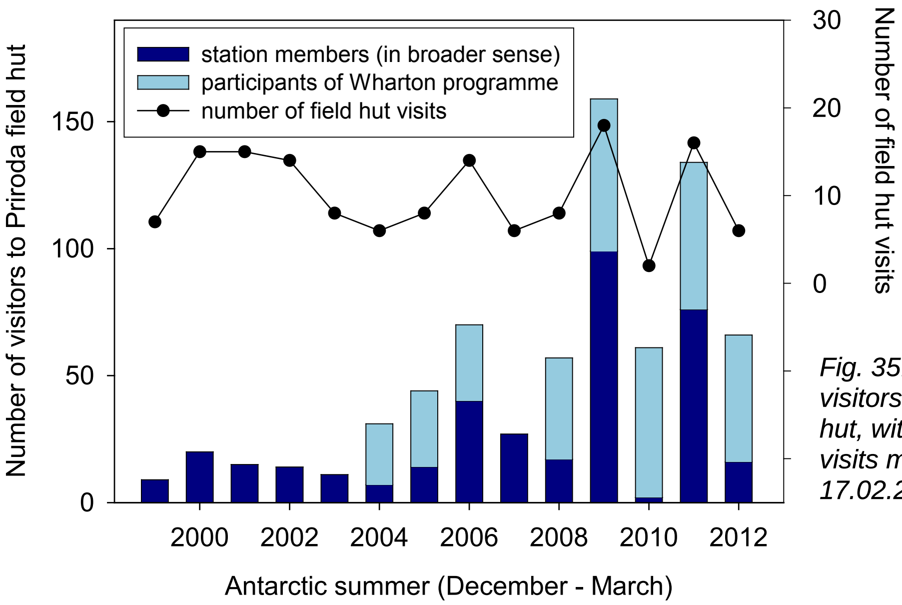


Fig. 35: Number of summer visitors to the Priroda field hut, with the number of visits made (records up to 17.02.2012).

As already shown for the period 2003-2006 (Peter et al., 2008, Chapter 4.2.11.), the majority of leisure visits (approx. 74 %) took place during the Antarctic summer, *i.e.* between December and March, when snow and ground conditions make motorised outings possible. This is also the reproduction period for seabirds and seals, which means that a serious threat to wildlife exists, especially for southern giant petrel, which breed nearby and are known to be very easily disturbed (Peter et al., 2008, Chapter 4.2.11.). Pressure of visitors, comparatively speaking, was very high during this period, with at least 639 individuals (approx. 83 % of all visitors recorded).

Next we look at the numbers of station members during leisure outings and tourists during the summer season (December to March). The frequency of visits to the Priroda hut during the Antarctic summer fluctuates considerably (Fig. 35). Bellingshausen station staff account for 26 % of visitors and Artigas staff for 19 %. The largest single group of visitors (up to 63 people in the 2010/11 season) could be attributed to the Wharton Programme (Peter et al., 2008, Chapter 4.2.11.).

The regular summer visits of the hut and its surroundings by station staff appear to play a greater role in influencing birds and seals than the annual visit of a larger group.

e) Refugio Collins

For many years, Chilean scientists have been carrying out studies of *Deschampsia antarctica* in the area of the Collins Glacier (e.g. INACH, 2006, 2007; INACH, 2008). A field camp was sometimes set up for this purpose. In order to improve conditions, the Chilean Antarctic Institute INACH put up the Refugio Collins field hut in the Collins Harbour area in the north-eastern part of Maxwell Bay in 2006 (Fig. 36, coordinates: 62°09'40'' S, 58°50'58'' W, source: https://www.comnap.aq/facilities, accessed: 28.04.2010, site no longer active). This hut, erected on ice-free ground, is built on metal stilts and is in good condition. It can accommodate up to three people and is used exclusively during the summer. It is located in the north-eastern part of the study area (Fig. 23).

Fig. 34: Refugio Collins (photo: A. Nordt, 28.12.2010).

f) Chinese Container on the Fildes Strait

In the extreme south of the Fildes Peninsula, a container was installed towards the end of the 2008/09 Antarctic summer (coordinates: 62°1'49,73'' S, 58°59'6,28'' W, Fig. 23) as a refuge for scientists working in that area. No official name is known for this refuge, which is 2-3 km from the Chinese research station, depending on the route. In this area there are Weddell seal pupping areas and haul-outs (Peter et al., 2008, Chapter 4.5.11.), as well as areas thickly carpeted with mosses, in the middle of which stands the container (Fig. 37). The refuge has sleeping places for two people, a desk and a small quantity of food and drinking water. According to the entries in the log book – and despite there already being serious damage from damp on the ceiling, as well as mould (Fig. 38 a & b) – the container is used regularly by Chinese station members and to some extent also by expedition members from the private "Overnational Ecobase Nelson". Repeated disturbance of seals cannot be ruled out if the container is frequently used.

Fig. 35: Chinese container in the south of the Fildes Peninsula (photo: C. Braun, 16.01.2010).

Fig. 36 a & b: Water damage inside the Chinese container (photos: C. Braun, 23.12. 2009 (a) and 16.01.2010 (b)).

g) Refuge huts near Neftebasa

Near the large oil tank farm, Neftebasa, are two relatively intact refuge huts without names (Peter et al., 2008, Chapter 4.2.11.). Following a long period without use, the hut located furthest to the east (Fig. 39 a) was completely renovated in the winter of 2010. Spare parts (valves, cables, etc.) are occasionally stored in the second hut (Fig. 39 b). The door was replaced in the 2009/10 season after a lot of snow got into the hut.

Fig. 39 a & b: (a) Renovated and (b) largely unused huts at the large fuel tank farm Neftebasa (photos: A. Nordt, 15.02.2011; C. Braun, 20.01.2010).

h) Unused field huts and containers

All unused huts in the Fildes Region are continuing to deteriorate. A clear example of this is the hut at Kitezh Lake, which had already slipped from its foundations constructed from barrels in December 2008 and had completely collapsed in December 2009 (Fig. 40 a & b). Various materials such as wood or rubber matting were blown around the area in the process.

Fig. 40 a & b: Progressive decay of the hut at Kitezh Lake, (a) in December 2008 and (b) in December 2009 (photos: A. Nordt, C. Braun).

The Russian observation hut in Biologenbucht is also decaying further (Fig. 41 a). This section of beach continues to be used very frequently by resting seals.The condition of the hut was last described in the 2005/06 season (Peter et al., 2008, Chapter 4.2.11.) and since then the whole front part has come away. The missing wooden pieces of the hut have not been removed, but have been partially buried by drifting sand. At the end of the 2011/12 season the remains of the hut were collected together by Russian station members. They planned to remove the material using a Skidoo, as soon as there was sufficient snow, to avoid damaging the rich vegetation of neighbouring Valle Grande valley (pers. comm. B. Machmudov).

Fig. 41 a & b: Decaying huts, (a) hut in the Biologenbucht (07.12.2008), (b) container on the beach south of Great Wall (photos: C. Braun, 23.12.2009).

Increasing corrosion is causing the unused Chinese container on the beach south of Great Wall station to decay further (Fig. 41 b). As was already observed in 2005/06 (Peter et al., 2008, Chapter 4.2.11.), rubbish apparently resulting from outings, such as plastic bottles, continues to be dumped in or around the container (Sec. 3.2.2.3 & 3.2.2.5). Numerous new footprints and tyre tracks (Sec. 3.3.3), which lead over the beach ridge, testify to regular visits by station members. For the last few years, attempts at breeding by southern giant petrel have been noted. These birds abandoned the area following construction of Great Wall station in the 1984/85 season but are apparently now attempting to resettle there (Peter et al., 2008, Chapter 4.5.2.).

i) Padre Balduino Rambo (Brazil)

The Brazilian field hut, Rambo, was dismantled in December 2004 (Peter et al., 2008, Chapter 4.2.11.). The place where it had stood was examined for evidence of remaining materials, which might have been revealed by soil movements, for example. No changes were found from the situation described in 2005/06 (visible remains of foundations).

3.2.1.4 Surface area used by station buildings

The current number of buildings and other constructions in the Fildes Region was compared with the data set from Peter et al. (2008). New buildings, installations and larger sealed surfaces, which have been created since February 2006, were measured by GPS, and buildings that no longer existed were deleted from the data set.

The total number of buildings rose from 159 to 187 between the 2005/06 and 2011/12 seasons. The bulk of this increase was made up of a few large new buildings (Sec. 3.2.1.2). The number of edifices on record was also increased by the addition of various constructions already in existence for some time, such as fuel tanks or hard helicopter landing pads, which are not included in the SCAR KGIS data set (Vogt et al., 2004).

Land consumption by buildings and other constructions in the Fildes Region totals at least 23,000 m^2 (Fig. 42) and has thus increased by around a fifth from the surface area recorded in 2006 (Peter et al., 2008, Chapter 4.2.10.). More than the half of the total area covered by buildings belongs to Chile, which is thus still responsible for the largest proportion of the built-up area, followed by China (23 %), Russia (20 %), and Uruguay (5 %).

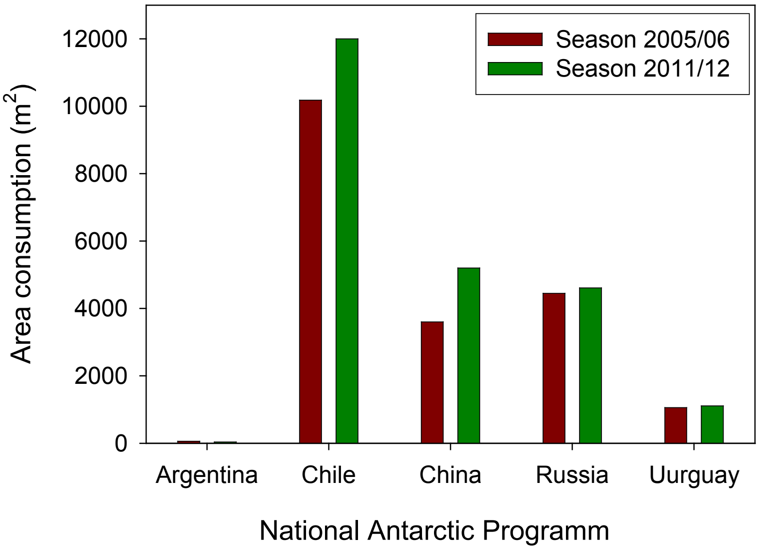


Fig. 37: Comparison of land surface use by buildings belonging to the different operators in the Fildes Region.

3.2.1.5 Other installations

Installations outside station grounds, such as aerials, lighthouses and other lighting facilities, or navigational aids, were added to the data set. Fig. 43 shows that west of the Chilean station Frei there are some aerials, for mobile telephony amongst other things, which are clearly outside the station grounds. Numerous tyre tracks are evidence that people regularly drive there (Sec. 3.3.3, Fig. 74). It should be noted that, contrary to official Uruguayan information (Germany, 2010b), the solar-powered Uruguayan navigational aid is not at Suffield Point but rather at Jasper Point (Baliza Uruguaya, reference number 15227, source: SCAR Composite Gazetteer of Antarctica).

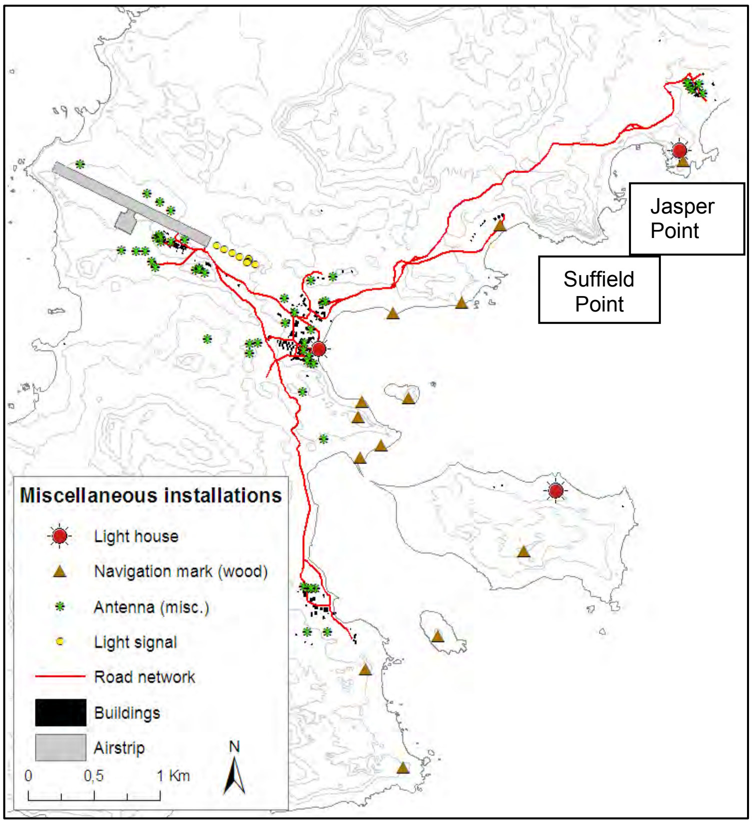


Fig. 38: Distribution of aerials, lighting facilities, navigational aids, etc. in the Fildes Region.

3.2.2 Documenting the waste situation in the Fildes Region

3.2.2.1 General

Since the Protocol on Environmental Protection to the Antarctic Treaty (EP) came into force in 1998 and was integrated into national law (*e.g.* the AUG – act for the implementation of the EP – in Germany), there are guidelines aimed at minimising potentially negative influences of human activity on the Antarctic environment. The extent to which these regulations are implemented in the stations of the Fildes Peninsula varies very widely.

Based on the results obtained in the years 2003-2006 (Peter et al., 2008), all relevant changes to the waste situation in the Fildes Region and to the waste management of the stations based there were researched and recorded in the seasons 2008/09 to 2011/12. This included an update of old waste dumps and a supplementary mapping of waste outside the stations. In this survey all findings of waste that were clearly new were recorded using the methodology applied in 2003-2006 (Peter et al., 2008, Chapter 3.1.2.). Marine debris was only recorded if the origin was clear, for example if there was a definite link to local stations or to ships, or if it was hazardous waste. The registration of hazardous materials or containers with potentially harmful substances was carried out independently of the age of the objects or of the way in which they had ended up in the environment. All findings of fresh food waste ("compostable waste") were additionally documented. Alongside deficiencies in waste management at the stations of the Fildes Peninsula, some of which have existed for a number of years, there are diverse improvements. For the first time, however, it was demonstrated that the Fildes Region is directly influenced – albeit to a limited extent – by the current waste management of other stations, ships and yachts on King George Island.

3.2.2.2 Old waste dumps

Many areas near the stations are marked by the methods used routinely to deal with station waste in the past. Some sites near to stations show increasing evidence of having been used as waste dumps in the past due to signs of progressive cryoturbation and solifluction.

During the latest study period, four more old waste dumps were found (Fig. 44) in addition to those already mapped during the previous project (Peter et al., 2008, Chapter 4.2.1.). The latest findings can be attributed to Bellingshausen station and raise the number of dumps that have been identified so far to 46. This took the total surface area of all known waste dumps in the Fildes Region to approximately 51,000 m^2, an increase of some 23 %.

The waste dumps known to date were overwhelmingly (90 %) sites that had been used for waste disposal into the 1990s. A number of sites described in Peter et al., (2008, Chapter 4.2.1.) as being in use have been cleared since the last count in 2005/06. South of the Chinese research station Great Wall, on a former waste dump that had already been covered with earth and levelled in the 2003/04 season, a large amount of station waste was once again deposited in the open and also burnt in the 2008/09 season (see below). Altogether during the study period, waste was found dumped in the open at three sites with a combined surface area of approximately 5,200 m^2.

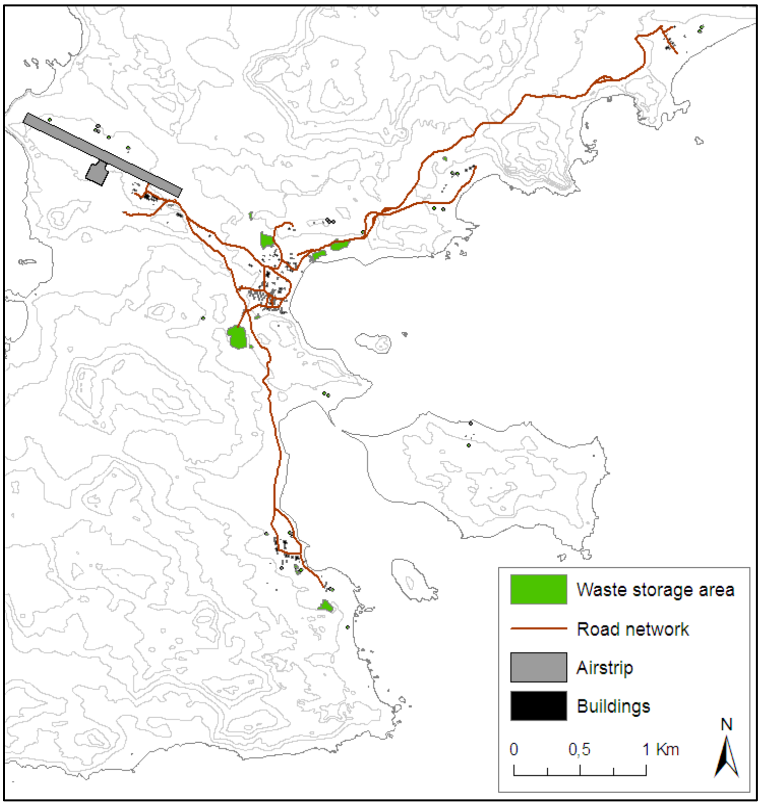


Fig. 39: Update of all waste dumps mapped on the Fildes Peninsula and Ardley Island.

The share of the total area where waste had been buried in the past rose from approximately 5 % (Peter et al., 2008, Chapter 4.2.1.) to around 22 %. Furthermore, the respective shares of the stations responsible for the waste changed considerably in some cases (Fig. 45).

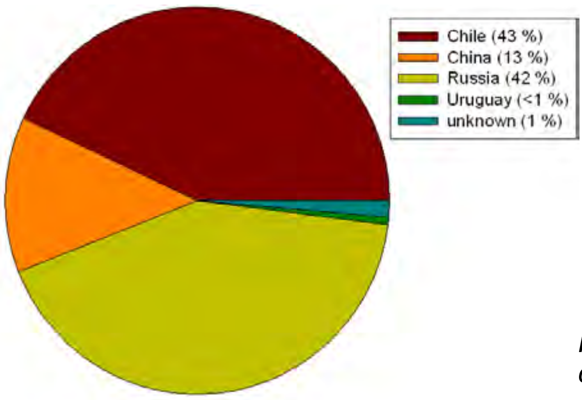


Fig. 40: Shares of the surface area covered by waste dumps, by station.

In many places where soil movements brings waste to light again, there are increasing signs of objects classified as hazardous material, such as batteries, pharmaceuticals, containers with remains of chemicals, oil barrels, and oily vehicle parts. These often lead to local contamination of the soil (Sec. 3.2.5). Remains of hazardous material were recorded at about a third of the listed waste dumps, which make up appr oximately 75 % of the total area covered by the dumps.

Some old waste dumps are located very near to, or even inside, protected areas (ASPA No. 125 and ASPA No. 150), which must be taken into account if waste is to be removed in the future. One example is an area with increasing oil contamination, which is in the middle of the southern section of ASPA No. 125b.

The proven existence of a number of active waste dumps and the fact that waste is still occasionally burnt in the open can be put down to deficiencies in the waste management practices of individual stations (see below). Such practices are inconsistent with currently applicable regulations (Section 2, Art. 3, Annex III, EP).

3.2.2.3 Waste distribution

During the investigation of the current waste situation in the Fildes Region, a total of 220 waste findings were mapped, which were clearly classified as being in use and which had appeared in the area since the 2005/06 season.

The main cause of waste entering the environment was dispersal by the wind (approx. 63 %), followed by what we call active dumping, *i.e.* actively bringing waste into the environment (approx. 22 %) and casting on shore of marine debris (approx. 15 %). The spread of waste was clearly concentrated around the Chinese research station Great Wall (Fig. 46). Moreover, 60 % of waste findings mapped in the seasons 2008/09 to 2011/12 could be attributed to Great Wall station. Here, the open storage of materials likely to be blown around (see below) was the reason for this unusually high proportion of new waste present in the environment.

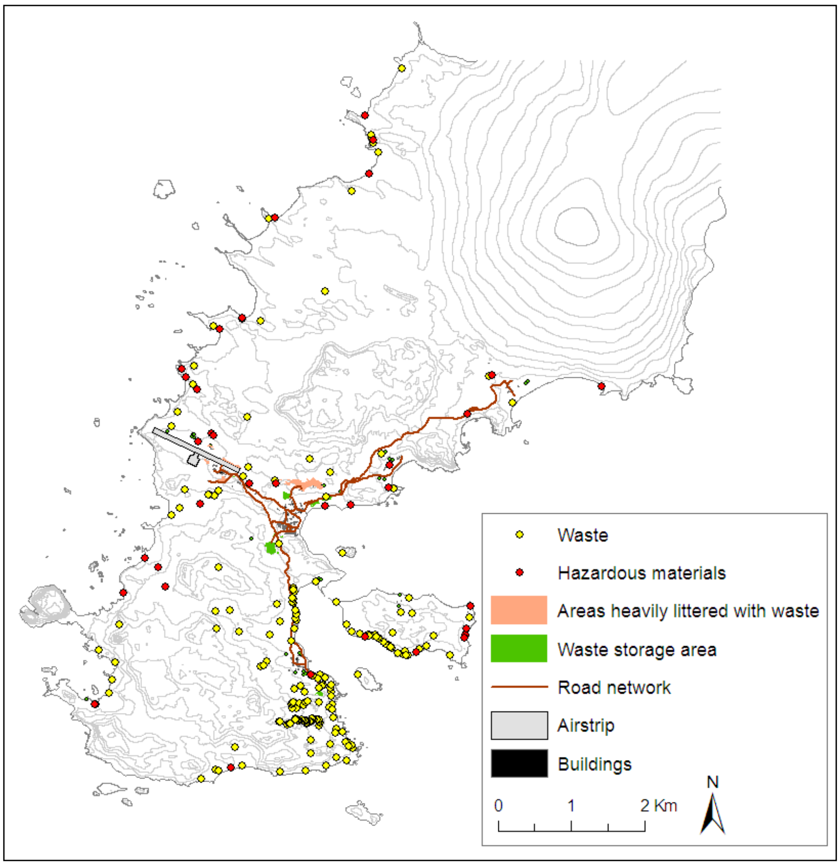


Fig. 41: Waste distribution in the Fildes Peninsula Region in the seasons 2008/09 to 2011/12; data on areas with large amounts of waste are from Peter et al. (2008).

Noticeable were several findings of objects with Korean writing on them, which were mainly washed up on the east coast of the Fildes Peninsula and Ardley Island. These included various hazardous materials such as a number of fuel drums, some of which were still leaking fuel (Sec. 3.4.3). During the previous project there were many findings of marine debris of Korean and Japanese origin, but these were principally on the west coast of the Fildes Peninsula and probably originated from fishing vessels (unpublished data from the previous project). However, some objects originate from King Sejong station, such as two fuel drums with the name of the Korean Antarctic Institute. This indicates deficiencies in the current waste management of the neighbouring Korean research station King Sejong, which have an impact on the Fildes Region.

Drifting of Polystyrene, which according to Article 7, Annex III, EP may not be introduced into the Antarctic environment, is common in the whole Fildes Region. Polystyrene granules (ø < 1 cm), for example, were recorded even on remote beaches in the extreme north-west of the Fildes Peninsula.

The new finding of a long-line hook on the Drake Coast in January 2009, another finding of a young elephant seal entangled in a lost fishing line, and another discovery of a young elephant seal with a deep throat wound, probably caused by a loop of very fine material, once again demonstrate the threat to seabirds and marine mammals posed by fishing activities in the Southern Ocean and the South Atlantic (Sec. 3.1.1 & 3.1.2).

Many findings of hazardous materials recorded in 2003-2006 (Peter et al., 2008) could no longer be seen in the season of the latest study period as these were often items cast on shore, which were later washed away again. The 34 findings of the current mapping survey are nearly exclusively hazardous materials, which found their way into the countryside after February 2006 and whose contents or adhesions are already contaminating the area or could contaminate it in the future. The only exceptions were a motor vehicle battery, which had already been discovered in the 2003/04 season, paint and varnish containers in a rubbish heap near the runway, and a fuel drum from the Chilean air force, found in a stream bed at Kitezh Lake. Several station managers of Frei station have promised to remove the fuel drum but this has clearly not yet been done.

The overwhelming majority of hazardous material findings were 200-litre drums (13 findings) that had been "lost" in the countryside, as well as canisters or jerry cans of various sizes (12 findings), which still had traces of their contents. According to the labelling, which was mostly still legible, the contents ranged from aircraft fuel to disinfectant and antifreeze. Somewhat less than half of the hazardous material found, mainly smaller plastic canisters and bottles but also fuel drums, was classified as marine debris. The circumstances in which the other findings were discovered suggest that they were actively brought to the sites and dumped there.

The records made of current waste findings show clearly that, as a result of deficiencies in waste management at the stations of the Fildes Region and in violation of the guidelines contained in Annex III of the EP, waste is continuing to be discharged into the environment, including potentially dangerous substances. Further causes for the spread of waste in the Fildes Region are the insufficient securing of packaging or insulation materials during logistical operations, and the decay of buildings or other facilities (Peter et al., 2008, Chapter 4.2.2.). Thus, unsuitable materials continue to be used as pipes or to sheath electric cables (Sec. 3.2.1.2). These materials cannot withstand local conditions and in some cases they quickly fall apart.

3.2.2.4 Discharge of organic material

As already shown in the previous project (Peter et al., 2008, Chapter 4.2.3.), skuas still have access to anthropogenic food. Active feeding of the birds by station members was again observed at all stations of the Fildes Peninsula, without exception, and also at the frequently-visited field hut Priroda (Sec. 3.2.1.3). Amongst other things, bits of poultry were fed to the birds. In line with these observations, fresh bones of domestic animals with obvious cut marks were found over wide areas of the Fildes Peninsula, as well as pellets containing food remnants (Fig. 47 a).

In addition, in a number of stations, organic waste was not consistently kept in closed rooms or outdoors in closed containers, so that skuas and gulls were still able to use such waste as a food source (Fig. 47 b).

Fig. 47 a & b: (a) Regurgitated skua food consisting exclusively of chillies (photo: A. Nordt, 24.02.2009) and (b) organic waste in the beach area, both found near Great Wall station (photo: C. Braun, 16.01.2010).

Also in the 2009/10 season, washed-up waste, including the remains of fruit, was repeatedly recorded on the coast of Ardley Cove, near Bellingshausen and Frei stations. On the Brazilian yacht "Mar Sem Fim" (Sec. 3.3.2), skuas were directly fed with fruit and the waste was stored in the open on deck in unsealed rubbish bags (pers. comm. from a crew member), so that skuas were able to spread it around the area (Sec. 3.2.2.5). A further finding of a substantial quantity of fresh organic waste (apple cores, orange peel, etc.) on the same section of the coast was probably from one of the supply ships that had been present on previous days. In addition, in the 2011/12 season skuas were fed on the deck of an Argentinian patrol ship. Based on all these observations, we can conclude that since the previous project there have been no significant improvements with respect to the discharge of organic substances into the environment. The continuing availability to skuas and gulls of anthropogenic food waste, including bits of poultry and eggs, as has been shown, continues to run counter to the legal requirements (Art. 4, Annex II, EP and Art. 2, Annex III, EP). These practices bring with them a multitude of risks for local seabird populations, such as the introduction of diseases or negative consequences for chick growth (Parmelee et al., 1979; Hemmings, 1990; Gardner et al., 1997; Australia, 2001a; Peter et al., 2002; Bonnedahl et al., 2005; Leotta et al., 2006; Peter et al., 2008, Chapter 4.2.4.).

Furthermore, regular feeding of skuas threatened an ongoing scientific study of skua nutrition. These observations show that station staffs knowledge about this problem and understanding of it is not sufficient. Better education is therefore also to be recommended in this regard. Greater effort should be made to comply strictly with the legal requirements for waste management at the stations.

3.2.2.5 Current deficiencies in waste management

In addition to the aforementioned observations regarding waste management on yachts, supply and patrol ships, and also in a neighbouring station, there are still deficiencies in waste management in some stations of the Fildes Peninsula.

a) Artigas

No significant changes could be seen at the Uruguayan research station Artigas. The waste that had been stored for a number of years at the edge of the station, mainly consisting of construction material and scrap (see Peter et al., 2008, Chapter 4.2.3.), was all removed by sea at the end of the 2008/09 season. However, by the end of the study period more waste had collected at the same spot. The CCAMLR-standard monitoring of marine debris washed up on a section of the Drake Coast, which has been carried out annually since 2001, was continued in the seasons 2008/09 to 2011/12 (*e.g.* http://www.iau.gub.uy/noticias/2009/com-prensa-iau-activ-medio-ambiente-25mar09.pdf, accessed: 02.07.2012; Uruguay, 2010b, 2012a).

b) Bellingshausen

In the seasons 2008/09 to 2011/12, various efforts to improve the waste situation were noted at the Russian research station Bellingshausen. For example, in 2008/09 and again in 2011/12 as part of a clean-up operation by all station members, a large amount of the waste spread around the station grounds was collected up. Additionally, an area east of the station, where large amounts of waste had been buried in the past and then exposed in the last few years over a large area due to soil movement processes, was cleared of scrap metal and other materials on the surface. The material was sorted and some was disposed of in the station's waste incinerator or transported to the Neftebasa large oil tank farm. There the waste was roughly sorted and then stored, together with other mixed waste that had been mentioned in the last inspection report (United States, 2007) and which had been stored in a disorganised fashion for years. In February 2010, part of the waste was taken away by the Russian supply ship. However, a considerable amount of scrap and all the waste from inside the tank remained.

At the Neftebasa tank farm, in all four seasons studied, combustible materials, including household waste, insulating material, used oil, and remains of oil-contaminated snow (Sec. 3.2.5), were incinerated unfiltered in an improvised oven inside an unused large oil tank. In the 2010/11 season all station waste was burnt in this way (pers. comm. V. Powaschnui). In the other seasons the waste incineration facility within the station was used. In both processes the resulting emissions were not filtered in any way. As far as the emission of harmful substances is concerned, this constitutes open waste incineration, as no efforts were made to avoid harmful emissions in line with Art. 3, Annex III, EP.

c) Escudero

No relevant changes in waste management could be discerned at the Chilean research station Escudero. Waste was already entering the area from the remains of a disused and increasingly dilapidated water supply facility (including the pump house, platform and water pipes) bringing water from nearby Laguna Las Estrellas. More waste is to be expected as no counter measures are being taken.

In the 2011/12 season a Chilean school group removed waste from a section of beach for the first time. The group was in the Fildes Region as part of an annual education programme ("Fería Antártica Escolar", http://www.inach.cl/2012/expedicion-antartica-escolar-participa-en-primera-limpieza-de-playa-en-el-continente-blanco/, accessed: 02.07.2012).

d) Frei

In recent years, the remains of two buildings belonging to the Chilean station Frei have been removed from the Antarctic. Firstly there were the remains of a fire service building, which stood just outside the station grounds. It burned down in February 2005 and then suffered further collapse. The ruins of the building stood untouched until at least March 2006, with the result that, for some considerable time, parts of the structure were blown into the surrounding area by the wind. Some of these items were quite large, such as pieces of corrugated iron. In the 2007/08 season, the remains of the building were gathered together and made ready for transport (pers. comm. M. Kopp). Up to December 2008, a large amount of unsorted rubbish and scrap was provisionally stored in the station grounds. From mid-December 2008 the material at both locations was sorted, loaded onto pallets and suitably secured against the wind. Towards the end of the 2008/09 season, all this material (approx. 80 tonnes), together with 220 drums of used oil and sewage sludge from the wastewater treatment system, was transported by sea to Chile (pers. comm. Frei station manager).

The second building was a gymnasium destroyed by fire in April 2009. The remains, according to information from the station manager, were immediately pulled down and the larger pieces broken up to make them suitable for transport, then packed into suitable containers. These were then stored near the beach (Chile, 2009b; own observations). This material was taken to Chile by sea towards the end of the 2009/10 season and in March 2012 (Chile, 2012d)

In addition, there were special collections of rubbish and building renovation at the station. Most of these occurred in advance of visits by delegations.

In contrast to the improvements mentioned above, there had been no real change in the state of the Chilean rubbish dump north of the landing strip, first documented in December 2003 (Peter et al., 2008, Chapter 4.2.1.). It has remained in a very similar state to what it was when first documented (Fig. 48 a & b). It was hard therefore to confirm the designation of this rubbish dump as temporary.

Conversations with the station manager at Frei in January 2009 clearly showed that he had no knowledge at all of the waste situation around the station. Following a description of the existing situation, the rubbish strewn around was immediately collected together at six locations in the Valle Grande south of the airport. In the 2011/12 season, remaining rubbish was found to be still at the same locations and some of it had again been strewn around again by the strong winds that occur locally. In February 2011 the new station manager was again apprised of the situation and promised to remove the rubbish. However, in the 2011/12 season we found no change in the waste situation, either in Valle Grande or north of the runway.

Fig. 42 a & b: Comparison of the state of the Chilean waste dump north of the runway in the seasons 2003/04 (a) and 2011/12 (b) (photos: C. Braun, M. Stelter).

In recent years there have been several occasions on which the wind has blown off parts of the roofs of living quarters at the part of the Chilean station called Villa Las Estrellas and scattered them in the surrounding environment (pers. comm. M. Kopp). These roof sections and insulation material from them have been found along the north-eastern coast of Ardley Island and at the beach north-east of the Chinese research station. The material had not been removed, even though this last named location can easily be seen from the road and it is easy to see where the material comes from. In addition, there are a large number of broken plastic pipes, usually used to shield electrical cables, around the airport. These examples reflect the problem of dilapidated facilities as well as inappropriate material that is not being removed and contributes continually to the rubbish present in the environment.

The technical standards of Frei station's waste incinerator are not known. Noticeable, however, was a sometimes very strong smell, together with the production of a lot of soot (Sec. 3.2.6), which also settled very obviously on the exterior wall of the building.

e) Great Wall

With respect to waste management at the Chinese research station Great Wall, Peter et al. (2008) has already described the open storage of material produced by the demolition of old buildings and the resulting wind drift. This practice is in conflict with the legal requirements of Art. 6, Annex III, EP and was also criticised during an international inspection by a delegation of Antarctic Treaty Parties in November 2006 (United States, 2007). Nevertheless, the practice of unsecured, open waste storage was apparently continued, without appropriate measures being taken to contain the threats to the environment. As a result, parts of the station grounds and the surrounding area were strewn with wind-blown waste. Moreover, in the 2011/12 season the disorderly storage of waste from the demolition of old buildings had caused considerable local contamination of the soil and the runoff of meltwater.

The waste situation was particularly serious in the 2008/09 season. Although there was the subjective impression that a large amount of building waste had already been transported to China, building rubble and construction materials were also stored in the open, and in some cases unsecured, within the station and in the surrounding area. The cushioning material used in transporting new pipes, for example, was left completely loose in the frames in which the pipes were carried. In consequence, large quantities of this material were spread around the Fildes Region by wind drift, in an area several kilometres wide over the entire Chinese station grounds, large parts of Ardley Island and Geologists Island, as far as the north coast of the Fildes Strait and Geographers Cove (Fig. 49).

In addition, in the course of the station expansion (Sec. 3.2.1.2) at the end of the 2007/08 season, a great amount of station and building waste was dumped in the open and without being secured in any way, on a site south of the station (Peter et al., 2008, Chapter 4.2.3.), which had previously already been used to discharge waste (pers. comm. M. Kopp, S. Lisovski, A. Contreras, Fig. 50).

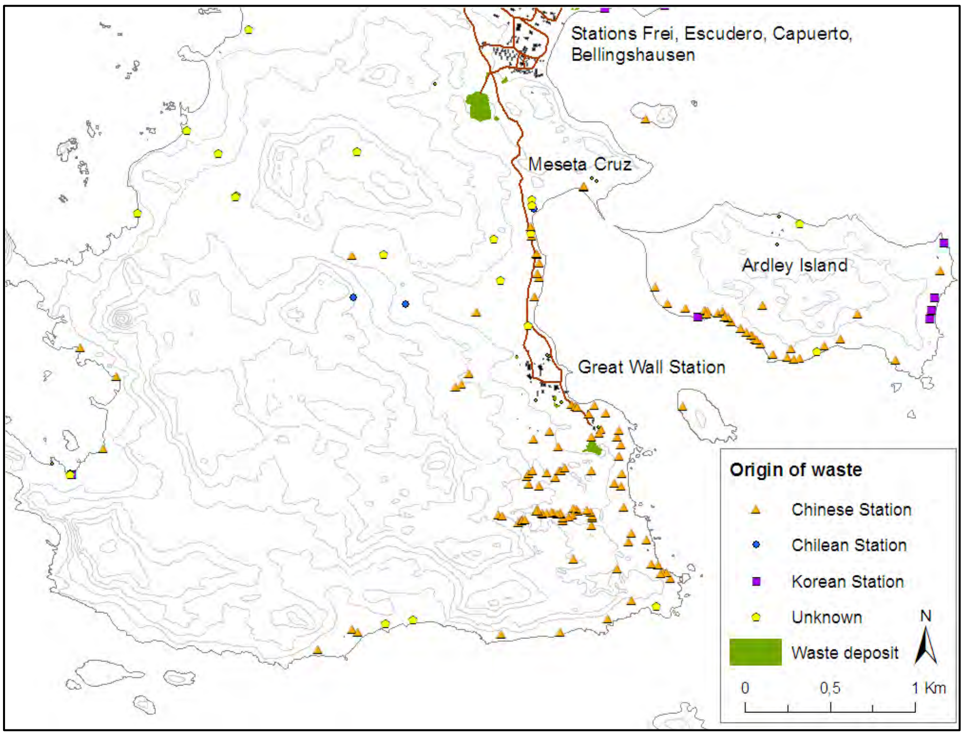


Fig. 43: Waste distribution in the southern Fildes Region, by station responsible. Only items recorded after 2006 are presented.

Fig. 44: Chinese waste storage site in the 2008/09 season; Great Wall Station can be distinguished in the background (photo: A. Nordt, 13.02.2009).

From mid-December 2008 and for a number of months, this waste dump was the constant source of a considerable amount of material, mainly plastic and wood pulp board, spread around the area by the wind. According to the station manager, this was a temporary and completely unproblematic transitional storage of building waste, which posed no threat to the environment (conversation on 19.12.2008). However, this statement is in conflict with the fact that, alongside conventional station waste, numerous objects were found which were to be classified as hazardous waste. These included batteries, fire extinguishers, leaking paint containers and solvent containers with very strong-smelling residues. After this practice was made known, some initial measures were introduced. Around mid-March all the waste was put into containers (pers. comm. A. Contreras). There was, however, no comprehensive clean-up of the large quantity of small particles of waste (principally cold foam, wood pulp board, and plastic sheeting, Fig. 51) still covering the ground at the site. Instead, as had happened in the past (Peter et al., 2008, Chapter 4.2.3.), the site was covered with soil and levelled.

Fig. 45: Surface of the ground covered in pieces of wood and plastic after the start of waste removal (photo: A. Nordt, 06.03.2009).

The total distribution area of waste that is of Chinese origin is presented in Fig. 49. The high concentration of findings south and east of Great Wall station fits with the main westerly and northerly wind directions. An even greater accumulation of waste was only prevented in most areas by the continuous shifting of material by the wind and tides (Fig. 49).

In the 2011/12 season some of the rubbish stored in the station grounds was taken away on the Chinese ship “Xuelong”. However, a large amount of waste remained on site.

As in the 2005/06 season (Peter et al., 2008, Chapter 4.2.3.), people continued to burn waste in the open in subsequent years . Thus, at various times in the 2008/09 season, remains were found of small-scale waste incineration at the above-mentioned Chinese waste dump. It was apparent that plastics, paint cans and fire extinguishers in particular were deliberately burnt there (Fig. 52 a & b).

Fig. 52 a & b: Traces of waste incineration in the open: (a) insulation material and paint cans, 15.01.2009 and (b) a fire extinguisher, 03.01.2009 (photo: C. Braun).

At the western and southern edges of the station, there are a number of small buildings of unknown function, which are in a bad state of repair and are progressively decaying. As a result, parts of the outer cladding as well as the underlying insulation material (polystyrene!) had already been spread around the surrounding area (Fig. 53 a & b). One of the huts was removed in the 2009/10 season, leaving behind some remnants of the building and waste spread around the grounds.

Fig. 53 a & b: Decaying huts at the edge of the Chinese station (photo: M. Stelter, 23.01.2012).

Skuas continue to damage insulation material on water pipes (Peter et al., 2008, Chapter 4.2.3.) and spread it around. This damage also affected pipes that had only been installed in 2008/09 in the course of the station expansion.

f) Estación Marítima Antártica

Waste management at the Chilean naval base is in line with current standards in the Fildes Region, that is to say that all station waste is sorted. Part of the waste is taken to the waste incineration facility at Frei station. The remainder is transported by sea to Chile and disposed of there.

In the shore area of the station there are a large number of metal pipes and struts, which probably come from a collapsed pier construction and are visible at low tide. However, it is not known whether this scrap metal is the responsibility of the Chilean naval base or Frei station.

3.2.3 Sources of drinking water and threats to those sources

All the stations of the Fildes Peninsula obtain their drinking and domestic water throughout the year from nearby meltwater lakes (Peter et al., 2008, Chapter 4.4.3.).

Bellingshausen and Frei stations and the Chilean naval base all currently extract their drinking and domestic water from a fairly small lake that lies inside the grounds of Bellingshausen station. This lake is fed by an inflow from Kitezh Lake. In 2009 plans were published to obtain drinking water for Frei station directly from Kitezh Lake through a system of new, above-ground water pipes (Sec. 3.2.1.2 & IEE: http://www.e-seia.cl/portal/busquedas/antarticos.php, accessed: 02.07.2012). Bellingshausen station continues to obtain its water supply from the above-mentioned lake, although there are occasional water shortages in winter due to frozen pipes, a suspected leak in the dam, the drying-up of the inflow from Kitezh Lake, and the high water consumption of the Chilean station (pers. comm. V. Powaschnui). For this reason, the drinking water lake was dredged in March 2011, as had been done some years before, to remove sediment and to make the lake deeper. In January 2011 the dam was also repaired.

Escudero station previously extracted its drinking and domestic water from nearby Laguna Las Estrellas lake. Following repeated problems with water extraction from the lake (Chile, 2002a), the station was connected to Frei station’s water supply network in the 2007/08 season. Kitezh Lake in the centre of the Fildes Peninsula thus plays an even more important role in the stations’ water provision. However, the lake is near oil-contaminated areas and areas with high concentrations of waste, or waste-filled sites where there have been many findings classified as hazardous waste (Peter et al., 2008, Chapter 4.4.3.; Sec. 3.2.5 & 3.2.2.3). Risks from this include harmful substances leaching out from contaminated soil at waste dumps and tank farms (*cf.* Goldsworthy et al., 2003). In addition, gas emissions produced by waste incineration, power generation, motor vehicles, and air and sea operations can pose a serious threat to bodies of water (Gasparon & Burgess, 2000; Gasparon & Matschullat, 2006; Smykla et al., 2005; Osyczka et al., 2007; Lim et al., 2009; Yogui & Sericano, 2008; Sec. 3.2.6). In February 2011, the unnamed lake in the airport grounds, from which drinking water for the airport was supposed to be obtained (Fig. 89), was pumped completely empty and refilled with water from Kitezh Lake, because of oil contamination. However, the emptying and cleaning of the lake was stopped for reasons of cost and the water can still only be used as domestic water, and not drinking water (Sec. 3.2.5).

3.2.4 Wastewater treatment

Since a short time ago, all stations of the Fildes Peninsula have been equipped with wastewater purification facilities, however, with widely varying technical standards. This is evidence that station operators are currently making an effort to meet the applicable legal requirements for wastewater treatment.

As part of the study of the environmental situation in the Fildes Region, in the seasons 2008/09 to 2011/12 we visited the places where wastewater from the stations was discharged into the environment and recorded any striking features or differences compared with the results from earlier seasons (Peter et al., 2008).

a) Artigas

There had been no changes since 2006 (Peter et al., 2008, Chapter 4.3.1.2.) as to the amount of wastewater produced by the station and its treatment (pers. comm. station manager, 13.02.2011). However, due to the construction of a new building in the 2005/06 season, providing both living quarters for the temporary accommodation of station visitors (*cf.* Sec. 3.4.2) and rooms for scientists to work and live in, and which are used above all during the summer, an increase in water use and in the amount of wastewater from the station are to be expected.

b) Bellingshausen

So far, all wastewater from the Russian station Bellingshausen has been pumped out of the tanks of the individual buildings and discharged untreated into the adjacent stream or into the sea (Peter et al., 2008, Chapter 4.3.1.2.). As the number of station members regularly exceeds 30 in summer (mean of 34 people in the seasons 2003/04-2005/06 and 2008/09-2011/12: own unpublished data and Peter et al., 2008, Chapter 4.3.1.1.), this is obviously inconsistent with the EP (para. 1b, Art. 5, Annex III).Installation of a wastewater purification system at Bellingshausen was announced for the 2007/08 season (United States, 2007) and the work was carried out in the 2008/09 and 2009/10 seasons. A wastewater treatment system of the type Astra 20® from First Water Pro Company was installed at each of three buildings (Tarasenko, 2009; Sec. 3.2 & 3.2.1.2). According to the station manager, wastewater is purified by an aerobic biofilter and two subsequent treatment stages, including UV sterilisation. The capacity of this type of system is said by the manufacturer to be 850 litres, or the wastewater produced by 20 people (source: http://www.firstwaterpro.com/?page_id=36, accessed: 09.09.2010, site no longer active). At the moment no regular wastewater monitoring is carried out. A one-off investigation of the purified water, however, revealed high ammonium and phosphate concentrations. It is essential that wastewater purification eliminate phosphorus as it increases the level of nutrients in water and leads to eutrophication. As the purification process runs according to a programme, it is at present unclear whether and how the purification cycle can be altered in order to solve the current problem (pers. comm. V. Powaschnui, 03.02.2010). The adjacent stream, which carries the treated wastewater to the sea, showed very strong algae growth in the 2010/11 season (Fig. 54). This increased algae growth could be due to a higher water temperature, caused by station operations, or it could also be due to increased nutrient concentrations in the water, in this case mainly phosphorus. A similar occurrence was noted, for example, at the Polish research station Arctowski (Krzyszowska, 1990).

Fig. 46: Strong algae growth in the Kiteshbach, which carries the partly untreated wastewater from Bellingshausen Station to Maxwell Bay (photo: S. Janowski, January 2011).

c) Escudero & Estación Marítima Antártica

Since its opening in the 1994/95 season, the Chilean station Escudero has had a system for purifying its wastewater. Following a breakdown of the original system due to materials wearing out with age, a new biological system was installed in 2002 (Chile, 2002b; Peter et al., 2008, Chapter 4.3.1.2.), which was in operation up to the 2008/09 season. When the station expanded its accommodation capacity, and also in connection with the extension of neighbouring Chilean naval base, which had been occupied throughout the year from 2005/06, this wastewater purification system was replaced with a shared system in the 2008/09 season (Sec. 3.2 & 3.2.1.2). The system was planned in cooperation with the Universidad de Magallanes and the INACH, and was set up in place of the previous facility (see for IEE: http://www.e-seia.cl/portal/busquedas/antarticos.php, project No. 83, accessed: 02.07.2012). It has the capacity to treat the wastewater from 60 people (pers. comm. V. Vallejos). Wastewater purification is now based on the principle of biological treatment using an activated filter bed in a prefabricated small wastewater purification system of the type Micro-Step®, made by ROTH Industry GmbH. It consists of three insulated polyethylene tanks, each of 1,500 litres, and the purification process is in three steps (see IEE). Both the solids produced by an integral grease separator and the sewage sludge are transported to Chile and disposed of there. Samples of treated wastewater are taken regularly to test the efficiency of the wastewater purification system (pers. comm. V. Vallejos).

d) Frei / Tte. Marsh

Peter et al. (2008) described how wastewater from the airport hotel Hostería was discharged into a nearby unnamed stream that rises by the airport buildings and flows south to the Biologenbucht. This process was again documented in the seasons 2008/09 to 2011/12. Parts of the stream bed were covered in foam and the entire length of the stream bed, up to where it flows into the adjacent valley, Valle Grande, and the Biologenbucht, was coated with a very obvious grey film and was also marked by accumulations of rubbish. These included many small particles of polystyrene or other plastics, together with larger sheets of plastic, remains of pipes and empty plastic containers. The larger objects had ended up in the stream due to the nature of the terrain and not through the pipes. It was noticeable that every summer there was considerably increased algae growth along the course of the stream, which continued into the Valle Grande (Fig. 55).

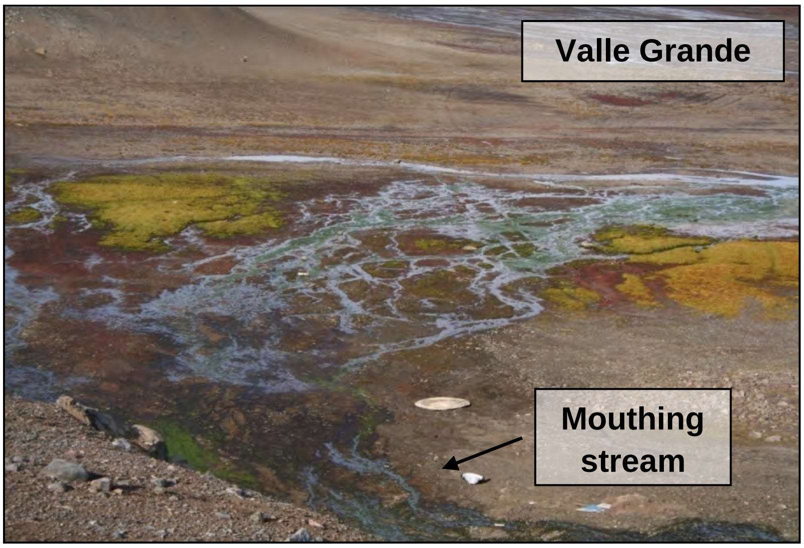


Fig. 47: Mouth of the stream that carries wastewater in the Valle Grande, with clearly recognisable local algae growth (photo: A. Nordt, 01.03.2009).

In May 2010 a modern biological wastewater treatment system was installed in order to purify the wastewater from the airport sector better than had previously been the case (http://www.aprchile.cl/modules.php?name=News&file=article&sid=1064, accessed: 02.09.2010, site no longer active). The facility in question is a small wastewater treatment system from ROTH Industry GmbH. Here, black water is purified by the above-mentioned system of the type Micro-Step® and it is possible to reuse grey water (system of the type Eco-Step® model B 075, see product specifications: http://www.ibericadelcalor.com/spip/IMG/ pdf/Aguas_grises_Reutiliz.pdf, accessed: 02.09.2010, site no longer active). Black water is purified in three steps (anaerobic, aerobic and final purification) in tanks with a volume of 4,000 litres (anaerobic, aerobic) and 2,000 litres (final purification). A grease separator is an integral part of the system. The treated grey water is chlorinated and coloured, and then used for flushing toilets.

The complete wastewater treatment facility is housed in a 20-foot container that is installed above the ground and is insulated against the cold. Depending on the source, its capacity is given as being the amount of water used by 100 people or 150 people, which allows treatment of either 200 litres (Chile, 2009b) or 50 litres (http://www.aprchile.cl/modules.php?name=News&file=article&sid=1064, accessed: 02.09.2010, site no longer active) of wastewater per person per day. This includes disinfection by UV radiation. According to the available information, the system can be expanded if necessary, but also allows for operation at a minimal level if the building is not in use.

We do not know whether the functioning of the wastewater treatment facility is regularly checked. However, in the 2011/12 season there was again an unpleasant smell and a build up of foam at the place where treated wastewater is discharged into the stream.

Wastewater produced in the area of the airport control tower is purified separately in a small treatment facility and is then apparently discharged directly into the soil. Moreover, the sewage container shows signs of exterior damage. A very noticeable thick algae growth can be seen all around the treatment facility (Fig. 56 a & b).

In the airport area as a whole, the point of discharge of wastewater into the nearby stream or into the soil presents a problem as, contrary to EP requirements, it does not guarantee either a rapid initial dilution in the sea or a rapid dispersal of the wastewater. This could lead, for example, to a rise in nutrient levels that would cause increased algae growth.

Fig. 56 a & b: Situation at the wastewater treatment facility behind the airport tower: (a) damaged sewage container (photo: A. Nordt, January 2011); (b) noticeably vigorous growth of algae (e.g. Prasiola crispa) and moss in the immediate vicinity of the sewage system (photo: S. Janowski, January 2011).

e) Great Wall

As already described in Peter et al. (2008, Chapter 4.3.1.2.), treatment of wastewater from Great Wall station was clearly still in need of improvement in the 2008/09 and 2009/10 seasons. This was apparent from a strong and unpleasant smell at the point where the wastewater is discharged into the sea, and from a marked grey colouring of the water discharged there. In addition, over the intervening years the condition of the wastewater pipe network, which had been deteriorating for years (Peter et al., 2008, Chapter 4.3.1.2.), had worsened considerably. As a result, wastewater escaping from a broken section of the wastewater pipe leading into the sea entered the water above the intended discharge point. Over a certain area here, a biofilm in the form of a red or green coating could clearly be seen (Fig. 57 a). The adjacent intertidal zone was marked by strong algae growth over a clearly defined area. Noticeably strong algae growth was seen in the 2008/09 season in a watercourse that crosses the southern part of the station grounds (Fig. 57 b). However, in the other seasons there was no longer any conspicuous algae growth to be seen in this stream.

Fig. 57 a & b: Wastewater situation at Great Wall station: (a) clearly-visible biofilm at the wastewater discharge point (photo: C. Braun, 25.12.2009); (b) strong algae growth in a watercourse crossing the station grounds (photo: C. Braun, 15.01.2009).

During the extension of the station (Sec. 3.2 & 3.2.1.2), the existing wastewater treatment system was replaced in the 2009/10 season by a new chemical treatment system. As before, wastewater is discharged in the shore area in front of the station, above sea level. In addition, a device was installed to measure diverse parameters of the wastewater being discharged. Since the new system went into operation there has been no noticeable clouding or smell in the discharged wastewater, from which we can conclude that the wastewater purification is considerably improved.

There is recognisable progress in wastewater management in most stations. In line with the EP (Art. 5, Annex III), substantial volumes of wastewater and liquid household waste, which are produced during the operations of a station accommodating more than 30 people during the Antarctic summer, may only be discharged directly into the sea if they are first thoroughly liquidised. The conditions necessary for a rapid initial dilution and dispersal in the sea must also be ensured. The stations comply with these regulations, although the discharge of wastewater into the soil in the area of the airport hotel Hostería and the air control tower, which comes from fewer than 30 people, should be considered very questionable. Many of the methods employed to prevent the release of potentially harmful microorganisms, as currently found in the stations' small-scale wastewater treatment systems, are not efficient enough, according to diverse studies (Hughes, 2004; Gröndahl et al., 2009; Hernández et al., 2012). Due to the high seasonal variability in the number of people staying in the stations and the low ambient temperatures, problems can also arise with the effectiveness of the wastewater purification (Gröndahl et al., 2009). A clear sign of this is the finding of higher concentrations of human-associated microorganisms near wastewater discharge points than in the surrounding area (Hernández et al., 2012; MacKenzie, 2012). Comprehensive and continual wastewater monitoring in all stations is essential for preventing the introduction of additional nutrients, harmful substances and non-native microorganisms into the environment through station wastewater (Sec. 6; Chile, 2012c).

3.2.5 Oil contamination

Oil contamination is one of the most common causes of local contamination in and around stations in the Antarctic (Bargagli, 2008). Areas affected in this way are increasingly colonised by microorganisms that break down hydrocarbons, while the biodiversity of the soil microbe community is greatly reduced (Aislabie et al., 2004). In the marine environment diesel fuel prevents the growth of microalgae during the entire period of ice coverage (Fiala & Delille, 1999). Because krill, the basic food source for seabirds, seals and baleen whales, grazes on these diatoms, extensive pollution could have serious consequences for the Antarctic food web.

Mapping in the study area was limited to recording visible oil contamination of the soil and water surfaces (Peter et al., 2008, Chapter 3.1.5.), as it turned out to be impractical to obtain qualitative evidence using oil test paper (REF 907 60, Macherey-Nagel) and more extensive analyses of water and soil samples would have exceeded the limits of the project.

3.2.5.1 Oil contamination within station grounds

The situation found in the study area indicates that contamination by oil and diesel fuel of the Fildes Peninsula is undiminished (see also Peter et al., 2008, Chapter 4.2.6.2.). Particularly affected are places where aircraft and motor vehicles are filled with fuel, places where fuel is stored, and the road network that links the stations and the airport. All station grounds, with the exception of Artigas station, show clear signs of serious pollution by oil and fuel. The cause of numerous, mostly small patches of contamination is the frequently occurring oil loss due to insufficient maintenance of vehicles used by the stations, together with a lack of care when handling fuel. In addition, the repeated transfer of fuel between various supply and daily service tanks increases the risk of oil contamination.

In the 2009/10 season a large number of drums with used oil and fuel residues waiting for transport by sea were stored in the shore area of the Chilean station. At some time, a few of these drums had fallen over and fuel was leaking out of holes.

The contamination of a meltwater pond behind the Russian generator building can be blamed on unsuitable storage of machine parts. Hydraulic fluid and lubricants that leaked out or were washed out contaminated the soil and water in the immediate vicinity.

A further instance of oil contamination was found at the Chinese station. This appeared to be connected with storage of waste material from demolished buildings.

Frequent instances of oil contamination due to loss of oil from construction vehicles were observed at Great Wall station in all seasons. These were the result of the construction activity and the constant traffic it caused at the station and in the surrounding area.

Particularly in the immediate vicinity of the various fuel tanks, the soil is visibly badly contaminated with oil. In the 2009/10 season, at one of the large fuel tanks on the way to the airport, which is used by Frei station, there were recognisable traces of a diesel leak from winter/spring 2009, as well as some waxy adhesive substance. In winter 2009 approximately 4,000 litres of fuel apparently leaked out of another tank behind the airport hangar (pers. comm. station staff). A new valve and a small amount of the above-mentioned waxy substance around the tank are indications of such a fuel leak. In addition, there is evidence of two incidents concerning Frei station’s undersea fuel pipeline but as these occurred outside the study period, in August 2007 and November 2008, no further details are known.

On 17.12.2008, during excavations connected with construction work in the shore area below the Chilean naval base, an oil-mud mixture was discharged into Maxwell Bay. It could not be clarified whether a digger had damaged a pipeline or whether contaminated soil had been washed out.

There was another occurrence of large-scale oil contamination at Bellingshausen station, following a similar incident in 2005 (Peter et al., 2008, Chapter 4.2.6). Due to a fault in a valve that had obviously been very worn for some time, there was a leak in a fuel line at the station’s generator building in September 2009. An estimated 3,000 to 5,000 litres of diesel fuel leaked out, initially unnoticed, into the snow and soil beneath the building and the fuel tanks. After the leak was discovered, small amounts of contaminated snow were removed. In mid-December 2009 the thaw led to a substantial amount of the fuel entering Ardley Cove, the part of Maxwell Bay nearest the station. The fuel, which was transported by the Kiteshbach into the bay, was visible, depending on the speed and direction of the wind, as an elongated oil film stretching well past Diomedea Island in the direction of ASPA No. 150 Ardley Island (Fig. 58), or was washed against the south-west shore of the bay by a north-easterly wind.

Fig. 48: The diesel film in Ardley Cove is visible as a reflective area on the surface and stretches a long way in the direction of Ardley Island (photo: C. Braun, 21.12.2009).

Measures to contain the fuel were limited to members of the Chilean naval station placing between two and five fairly small oil absorbent booms in the mouth of the Kiteshbach and replacing them at irregular intervals (Fig. 59 a). They also put an approximately 300-metre-long oil barrier in the sea near the mouth of the stream. However, both types of oil barrier were limited in their ability to contain or absorb the oil, as evidenced by the clearly visible oil films (Fig. 59 a). The marine barrier was taken away again after just two days. From 17.12.2009 to 21.12.2009 Chilean zodiacs set out regularly during the daytime to stir up the diesel film in the bay and thus accelerate the evaporation of the fuel by mechanical means. Instead of taking the contaminated snow away and disposing of it properly, it was pushed into the sea on 21.12.2009 with the help of a tracked vehicle (Fig. 59 b). Only a limited amount of the remaining, highly contaminated snow from the area immediately around the leak, was put into five used fuel barrels. These drums were taken to a large fuel tank in Neftebasa, which was used for storing unsorted rubbish and burning it in a small oven (Sec. 3.2.2.5). There the oil residues were burnt.

Fig. 59 a & b: (a) Absorbent oil barriers in the mouth of Kiteshbach; on the right the oil film is recognisable behind the oil barriers (photo: C. Braun, 31.12.2009), (b) snow contaminated with diesel fuel is pushed into the sea on 21.12.2009 (photo: A. Nordt).

Reports of the oil leak appeared in the Chilean press (*e.g.* http://www.elpinguino.com/2009/12/51360/derrame-de-petroleo-en-la-antartica/, accessed: 25.12.2009, site no longer active), apparently on the initiative of Chilean station members. The incident was then reported to the CEP on 22.12.2009, although a time limit of 30 days is recommended in the COMNAP Fuel Manual (COMNAP, 2008a). Furthermore, the Russian station manager said that he had neither an emergency plan for oil leaks, as is required according to the EP, nor the knowledge and means necessary for taking measures to contain fuel leaks. During an inspection of Bellingshausen by representatives of the Antarctic Treaty Parties in November 2006, an emergency plan in Russian was presented and a limited quantity of materials to absorb and contain oil were recorded as being available at the station (United States, 2007).

In the 2010/11 season renewed melting of contaminated snow left over from the previous year led to more fuel running into Kiteshbach and thus into Maxwell Bay (Fig. 60 a). In December 2010, some days after the oil started to enter the water, a few oil absorbent mats were deployed for a few days and an oil barrier was laid in the stream, which stayed there until the end of February 2011. This barrier had only a very limited effect. After the snow in the affected areas had melted, the visible oil film on the surface of the stream decreased in size. However, affected areas of soil in close proximity to the stream were still clearly visible (Fig. 60 b).

Fig. 60: (a) Oil barrier after contaminated snow has melted (photo: A. Nordt, 23.12.2010), (b) visible oil contamination of the shore of Kitesh stream (photo: A. Nordt, 29.12.2010).

3.2.5.2 Oil contamination outside stations

There was a continuous discharge of fuel into the soil and the sea in several areas of the Fildes Peninsula, including outside stations, for example at the Neftebasa large oil tank farm (Fig. 61). Fuel came out of leaking valves, pipes and tanks, as well as from the connection of the hose that was used to transfer fuel from the supply ship into the tanks. The fuel either seeped in the ground or was carried in rivulets of meltwater to reach Maxwell Bay, where a clear oil film was visible for a time.

A considerable amount of oil still flows regularly via a stream, which rises behind the airport buildings, into the Valle Grande and the Biologenbucht, and subsequently into the sea (Fig. 62 a; Peter et al., 2008, Chapter 4.2.6.1.). Melted snow and ice, and precipitation, now wash the oil out of the heavily contaminated ground (Fig. 63 a), probably as a result of a larger spillage in the past. For example, after continuous rainfall at the end of January 2009, the amount of oil being washed out distinctly increased. On the advice of a project member, Chilean station staff placed absorption mats in the discharge of the stream to filter the oil floating on the surface from the water, to limit pollution of the Valle Grande. However, the mats were subsequently weighed down with stones to prevent the wind from blowing them away. As a result, the oil flowed away almost unhindered over the mats.

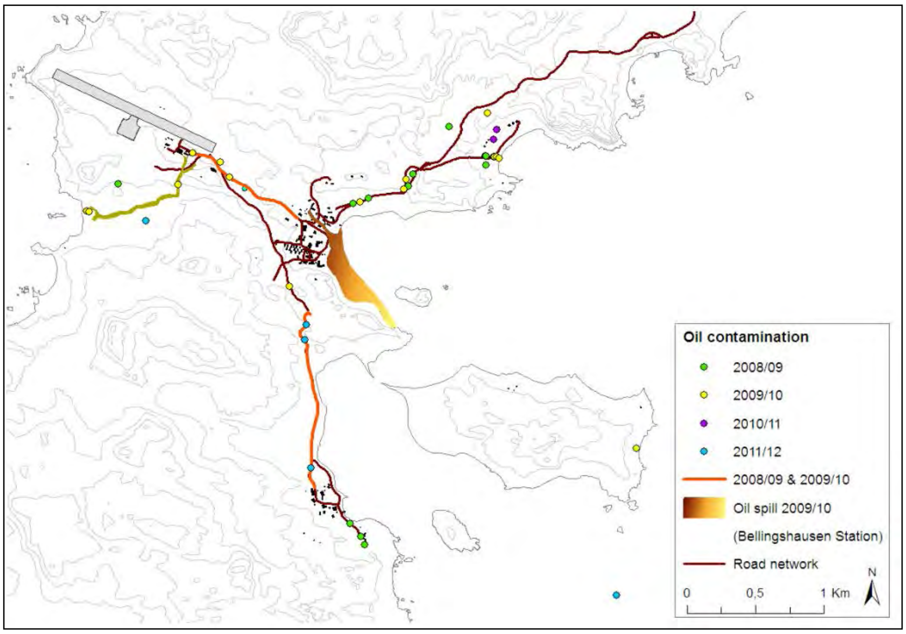


Fig. 49: Oil and diesel contamination of soil and water on the Fildes Peninsula. Contamination within station grounds is not represented.

In February 2011, the contaminated drinking water lake of the airport was pumped dry and the water was also fed unfiltered into the Valle Grande (Fig. 62 a & b).

Fig. 62 a & b: Oil contamination outside stations: (a) oil film on the Biologenbach on 29.01.2009 (photo: A. Nordt), (b) oil discharge into the Valle Grande caused by pumping out the oil-contaminated airport lake (photo: A. Nordt, 09.02.2011).

At two places to the north-east of Bellingshausen station, oil contamination in the ground was recorded, caused by waste or scrap buried many years ago. In the first case, this concerns a Russian vehicle, which leaks small amounts of oil (Peter et al., 2008). In the second case, an area of approximately 340 m^2 of soil is clearly soaked with oil (Fig. 63 b). As a result of soil movement caused by frost, old waste buried here has become increasingly visible, and is now clearly recognisable as oil drums, vehicle parts and domestic waste (tins, crockery and bits of bones) (Sec. 3.2.2).

There is no explanation for the origin of several small oil patches that were found in mud puddles in the northern Valle Grande. The fuel drum in the inflow of Kitezh Lake mentioned in Peter et al. (2008, Chapter 4.2.6.1.) is still there. Two empty fuel drums from the neighbouring Korean King Sejong station represented an increased potential threat (Sec. 3.2.2). Fuel residues still contained in them emptied into the ASPA No. 150 in the immediate vicinity of the penguin colony (Sec. 3.4.3).

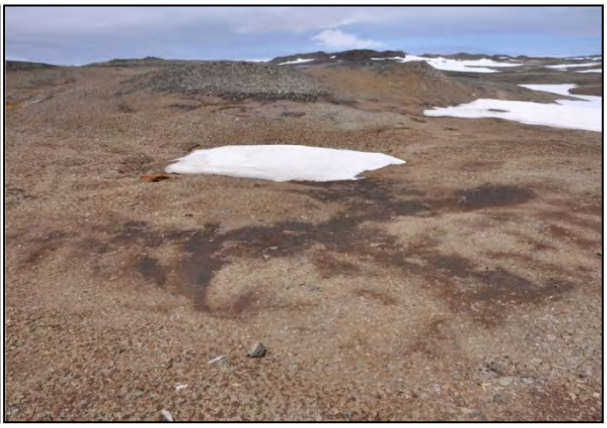


Fig. 63 a & b: (a) Oil-contaminated soil behind the Hostería (photo: A. Nordt, 02.01.2011), (b) oil contaminated ground in the area of an old waste dump (photo: A. Nordt, 07.01.2010).

On 28 January 2011 a lorry had an accident outside the Uruguayan station Artigas, in which it plunged into Lago Uruguay lake, which is used by the station as a reservoir for drinking water. This led to oil or fuel leaking from the vehicle, which created a film that was blown by the wind along the north-east coast of the lake (Fig. 64). No measures were introduced to remove the oil (pers. comm. E. Fiorelli). In January 2012, as the Chinese icebreaker was being unloaded with the help of a number of boats, an oil slick measuring around 100 m^2 was seen (Fig. 61).

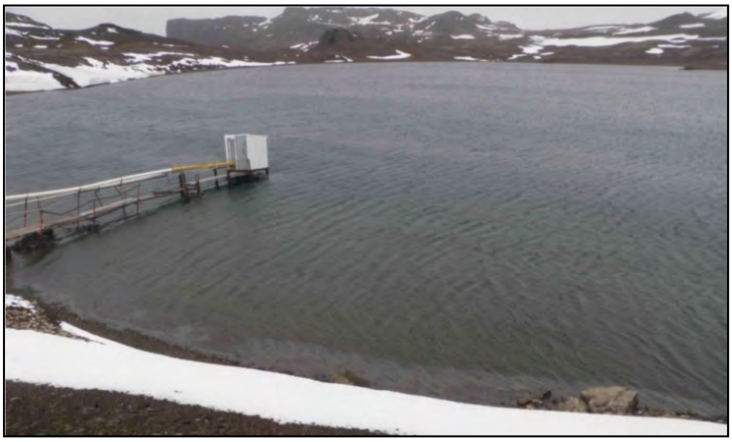


Fig. 50: Oil film at the edge of Lago Uruguay lake following an accident involving a lorry (photo: J. Esefeld, 28.01.2011).

The continuing contamination with oil stands in contrast to a few improvements. Fuel is now transported from the Neftebasa oil tank farm to the Bellingshausen and Artigas stations by a Russian lorry with a tank mounted on it, which significantly reduces oil contamination on this section of road (*cf.* Peter et al., 2008, Chapter 4.2.6.1.). Storage of the Russian and Chinese hoses, which are used to transfer fuel from supply vessels to the tanks or between the tank and the station, was also improved. During the construction of the Chinese station extension and the installation of eight new fuel tanks, a permanent overground pipe was installed in February 2010 to connect the station and the tanks (Sec. 3.2.1.2). A further improvement will result from the installation of eight new fuel tanks in the Uruguayan Artigas station, so that fuel transport from the Neftebasa large oil tank farm will no longer be required. The completion and commissioning of the new tanks are planned for 2013 (Sec. 3.2.1.2).

3.2.6 Noise and gaseous emissions

As comprehensively reported in Peter et al. (2008), both permanent and temporary noise can cause stress reactions such as increased heart rate and behavioural changes such as reduced fertility and immune resistance in animals (Algers et al., 1978; Culik et al., 1990; Pfeiffer, 2005). In this respect, moulting penguin chicks are more endangered than adults, because their energy expenditure rises to two or three times the normal level when they are disturbed by low helicopter overflights, for example. The chicks cannot compensate for this by increased searching for food themselves, but are reliant on care from their parents (Regel & Pütz, 1995). Extreme cases such as the death of around 7,000 king penguins on Macquarie Island after mass panic, caused by the low flight of a Hercules C-130, show the potential danger of such overflights (Rounsevell & Binns, 1991). Nevertheless, if the disturbance is continuous or recurrent, habituation effects can reduce the stress reaction (Pfeiffer, 2005; Viblanc et al., 2012). For instance, this explains why southern giant petrels are breeding again on Diomedea Island (Sec. 3.1.1), although the island lies in the main approach route to the runway and is thus exposed to a comparatively high amount of noise (Fig. 65).

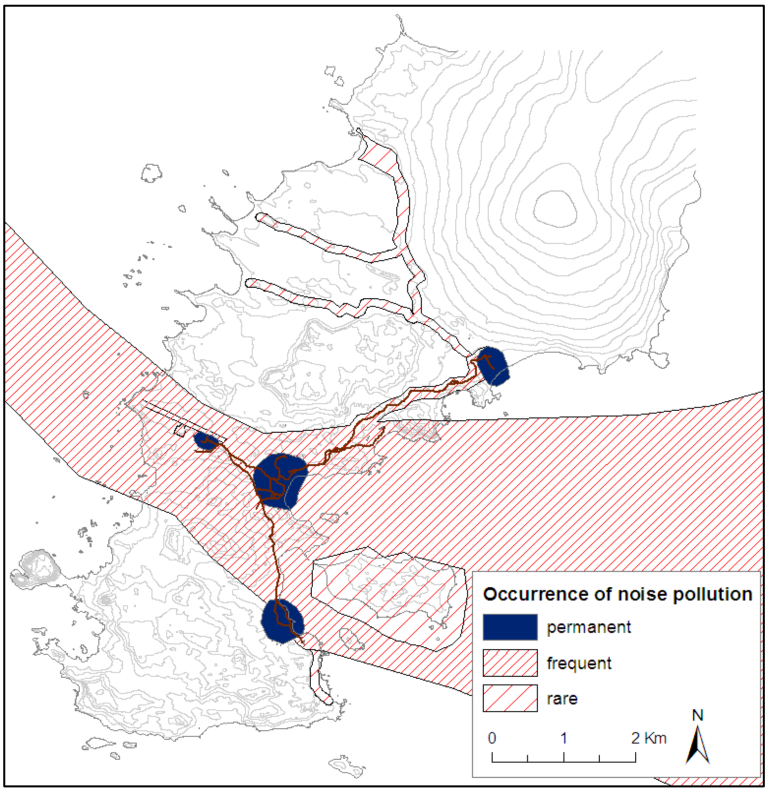


Fig. 51: Simplified representation of the varying frequencies of the occurrence of noise disturbance in the Fildes Region, based on the distribution of the stations, the road network, additional tyre tracks in the countryside, and the most heavily-used flight routes.

The impact caused by flight noise is not uniformly distributed over the season, but increases on days with suitable flying conditions (Sec. 3.1.1). An increase in helicopter flights can occur in particular during the unloading of supply vessels and may last for several days. This forms a serious problem because of the preferred anchorage (Peter et al., 2008, Chapter 4.2.17.) in Ardley Cove. This cove is in the immediate vicinity of ASPA No. 150 (Ardley Island) and the associated penguin and southern giant petrel colonies. An additional increased stress factor is represented by training flights, which have so far been observed in every season. Here, pilots steer towards the runway and oversHoots it at low altitudes. This manoeuvre is sometimes repeated more than ten times over a short period.

A positive aspect that deserves special attention is that the flight and engine noises of the "Aerovías DAP" BAE-146 passenger jets that have been used frequently since the 2007/08 season are subjectively considerably quieter than the DASH-7 propeller aircraft (Sec. 3.1.1) which are no longer used, thus contributing to the reduction of general flight noise. In contrast, there is a clear increase in vehicle use on the Fildes Peninsula (Sec. 3.3.3). During the construction work on the Chinese station, the section of road between Great Wall station and Meseta La Cruz was noticeably more frequently used by large construction vehicles in the 2008/09 and 2009/10 seasons. The close proximity of this section of road to the shore can potentially be interfering, because seals occasionally rest here and can be disturbed by vehicles driving by.

Vehicle use beyond the established road network is usually extremely problematic for breeding birds and seals resting on the beach, as well as seabirds. During these excursions – usually for leisure – areas are visited that are not normally damaged by vehicle traffic and in which the animals are thus not habituated to the noise.

Noise and gaseous emissions can only be considered to be partially separate, because noise sources such as vehicles, airplanes, ships and generators also emit exhaust fumes. Especially with regard to the operation of diesel generators, there is a clear potential for saving on power generation on the Fildes Peninsula. For example, it is quite common practice that station buildings are overheated and the relevant rooms are subsequently ventilated for cooling. The Uruguayan station Artigas has made some initial efforts to improve energy efficiency (Uruguay, 2012b). Furthermore, station waste incineration plants contribute to pollution in the Fildes Region because of bad filtering of the associated fumes and the continuing practice of burning waste in the open (Sec. 3.2.2.5). Various studies (Smykla et al., 2005; Osyczka et al., 2007; Lim et al., 2009) showed that heavy metals concentrate in lichens and mosses in the immediate surroundings of stations on King George Island and the concentration can be as high as 3,800 times that of control samples that are not affected by humans. In addition, Yogui & Sericano (2008) showed that there were Polybrominated Diphenyl Ethers (PBDEs) in Antarctic lichens and mosses. These are probably not directly connected with stations, however, but are transported in the atmosphere.

3.3 Traffic

3.3.1 Air traffic

The Chilean airport Tte. Marsh is the logistical centre of the Fildes Region. In the seasons 2008/09 to 2011/12, all take-offs and landings in the Fildes Region were most extensively registered, including the information required for identification (date, time and aircraft type; methodology: *cf.* Peter et al., 2008). However, because of the size of the area and the limited number of observers on site, these are minimum figures. This is particularly the case for the 2011/12 season, when observers did not consistently distinguish between station and ship helicopters. Special observations, such as flying below the specified flight heights or approaches to breeding bird colonies or seal haul-outs, were thoroughly documented. Flight movements in the vicinity of or directly over Ardley Island were given special attention due to the protected status of the island as an ASPA. Here, the corresponding flight routes were noted as far as possible in maps that the observers took with them and digitised afterwards by means of GIS. To be able to compare the air traffic with the data of the 2003-2006 period

(Peter et al., 2008, Chapter 4.2.16.), only the completely recorded periods in all six seasons between 10 December and 26 February (79 days) were included. For statements about the possible development of air traffic in the Fildes Region, statistics published by the Chilean air traffic authority DGAC were used.

3.3.1.1 Flight statistics and comparison with the previous project

From Fig. 66, we can clearly see the relatively constant number of days with flight activity of airplanes and helicopters (on average, 53 ± 4 flight days, or 68 % of all days) during the seven seasons investigated (2008/09 – 2011/12: R^2 = 0.07, p = 0.57). A similar picture results from the examination of available data from the seasons 2000/01 to 2005/06 and 2008/09 to 2011/12, from the time window between 20 December and 20 January, in which a large part of the logistical and tourism activities take place. Here, the proportion of flight days in the 2008/09 to 2011/12 seasons ranged between 62 % and 70 % and was thus within the range of the values determined for 2000 to 2006 (average value: 69 %).

The different aircraft types had different shares of flight activity in the individual seasons. For example, the number of helicopter flight days during the seven seasons studied declined slightly as a whole (R^2 = 0.65, p = 0.03, Fig. 66) though helicopters (mainly ships' helicopters) used in particular for unloading generally completed numerous flights during the operation day (see below). The proportion of local air traffic represented by helicopters belonging to stations was high, just as before (Peter et al., 2008, Chapter 4.2.16.1.; Braun et al., 2012).

The number of flights by Hercules C-130 type aircraft fluctuated comparatively strongly during the seasons studied. These aircraft are mainly used to transport supplies, construction material and station members for different stations on King George Island. With regard to the number of flight days, small airplanes were most frequently used in the Fildes Region (Fig. 66).

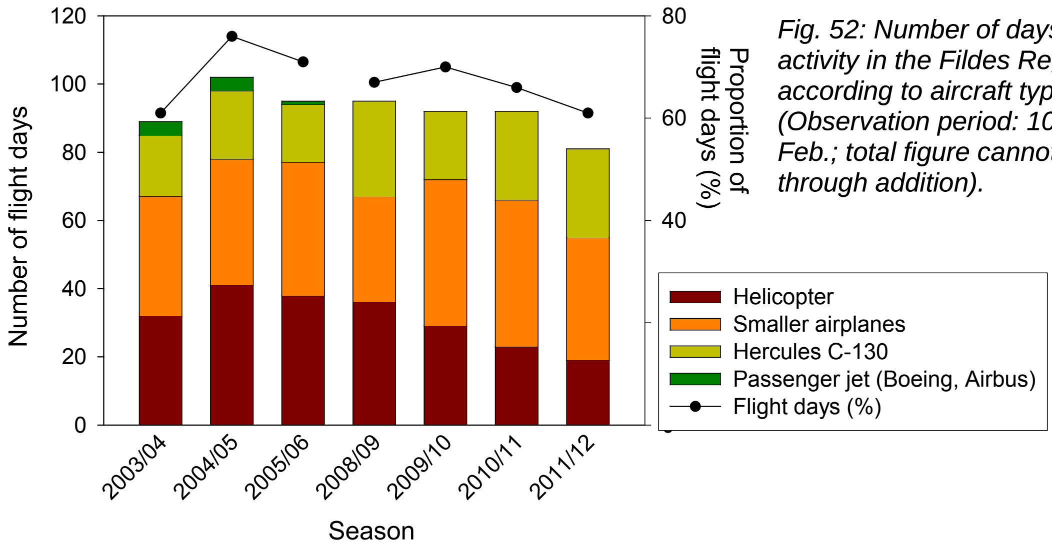


Fig. 52: Number of days with flight activity in the Fildes Region, listed according to aircraft type (Observation period: 10 Dec. - 26 Feb.; total figure cannot be obtained through addition).

3.3.1.2 Tourist flights

A large proportion of flight days with smaller airplanes can be at tributed to the Chilean “Aerovías DAP” company. “Aerovías DAP” predominantly carries out tourist flights (passenger exchange and programmes lasting one to several days, Sec. 3.3.2 & 3.4.2), starting from Punta Arenas, Chile. The company now also performs a substantial part of the logistical work for National Antarctic Programmes (*e.g.* INACH, RAE, KOPRI, CHINARE), as well as evacuations for medical reasons, between Punta Arenas, Chile, and Tte. Marsh airport. Of particular note was the fact that DAP flight activity in the 20010/11 season was the highest so far recorded, with 44 flights registered. Furthermore, in the 2011/12 season three DAP flights per day were recorded for the first time. This indicates a clear increase in tourism-based flight activity (Sec. 3.3.2 & 3.4.2).

Tourism-motivated overflights by passenger jets (Boeing 737-200, Airbus 319) that the Chilean airline “LAN Airlines” offers (Peter et al., 2008, Chapter 4.2.16.) no longer took place in the 2008/09 to 2010/11 seasons, despite having been announc ed beforehand (Fig. 66, IAATO, 2008, 2009, 2010). During 2003/04-2007/08, a steady decrease in the numbers of passengers transported in this way was recorded (Peter et al., 2008, Chapter 4.2.16.3.; IAATO, 2004, 2005, 2006, 2007, 2008).

According to IAATO information, no further such overflights are planned for the 2012/13 season (IAATO, 2012a).

3.3.1.3 Introduction of a TLS landing support system

In the 2009/10 season, a TLS landing support system was installed at Tte. Marsh airport to reduce the dependency of all take-offs and landings on locally-prevailing weather and visibility conditions. According to information from the pilots (pers. comm. one DAP employee, 21.03.2011), the TLS landing support system has so far been used only rarely. The consequence was that, even after the introduction of the system, there was still an accumulation of flights in the Fildes Region on days with good weather. This meant that up to eight different aircraft a day were occasionally flown (Fig. 67). Such peaks in activity are mostly closely related to ship traffic in Maxwell Bay (Sec. 3.3.2, Fig. 71) and ar e often connected with numerous flights of ships’ helicopters.

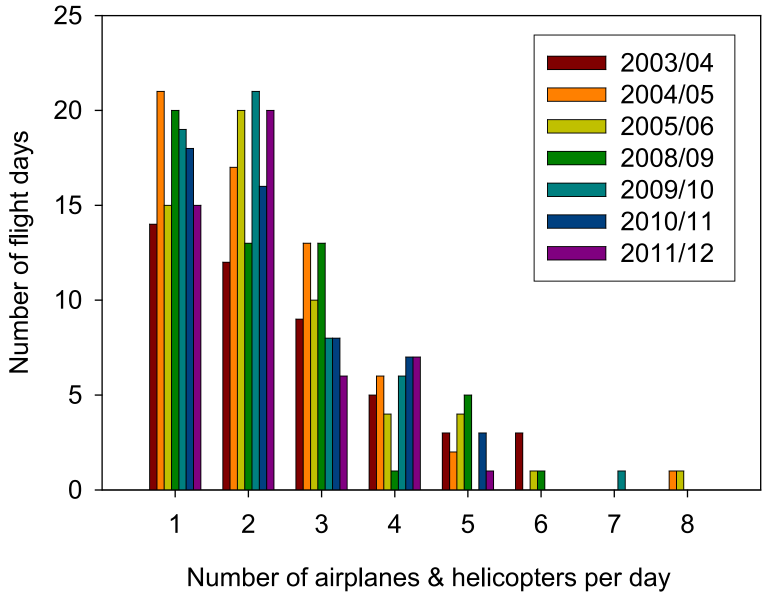


Fig. 53: Number of flight days with one or more active aircraft per day, as a percentage (N_{total} = 370 flight days).

3.3.1.4 Flight movements over Ardley Island and over the Fildes Strait

As observed in 2003-2006 (Peter et al., 2008, Chapter 4.2.16.5.), there were repeated overflights over Ardley Island in the seasons 2008/09 to 2011/12, in which the mandatory minimum distances of 610 m (vertical) and 460 m (horizontal) to bird colonies (ATS, 2009e) were not complied with. Compared to the very high number of overflights over Ardley Island in the past (Peter et al., 2008, Chapter 4.2.16.5.), there were a total of eight overflights or approaches in the 2008/09 season, 20 in the 2009/10 season, one in the 2010/11 season and ten overflights in the 2011/12 season, so that significantly less frequent and fewer violations of minimum distance were registered (number of flight days: $R^2 = 0.83$, $p < 0.05$, number of overflights: $R^2 = 0.792$, $p < 0.05$, Fig. 67). Here, both station and ships' helicopters were involved, as well as smaller (two engine) and large (four engine) airplanes of the types Twin Otter and Hercules C-130 (Fig. 68). In January 2011, an "Aerovías DAP" type BAE jet flew over at an extremely low height. A DAP employee later explained that the pilot had to cancel his attempt to land because of a sudden change in the wind and could no longer reach the required minimum distances when pulling up. The reasons for the other low overflights are unknown. In November 2011 (outside the 10 December-26 February research period) animals were observed reacting to an overflight at low altitude by a twin-engine airplane (a DASH-7 of the British Antarctic Survey on 22.11.2011). In response to the engine noise, southern giant petrels flew up from their nesting place in the north east of Ardley Island and seals resting nearby reacted very nervously.

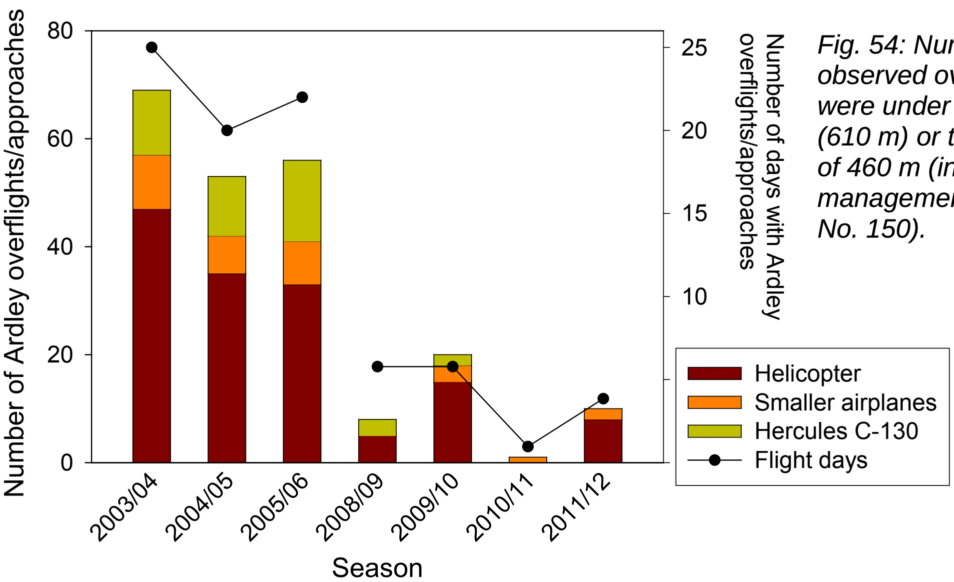


Fig. 54: Number of flights observed over Ardley Island that were under the prescribed altitude (610 m) or the horizontal distance of 460 m (in accordance with the management plan of ASPA No. 150).

It is to be hoped that the noticeable decrease in violations of the horizontal and vertical flight distances to Ardley Island is directly related to increased awareness on the part of the pilots and those responsible for the flights of the need to protect ASPA No. 150 and its values to be protected.

In the cartographic representation of flight routes in the 2009/10 season (Fig. 69 a & b), mention should be made of specific instances of repeated overflights or approaches at low height by ships' helicopters while loading and unloading supply vessels. For instance, on 23.01.2010, the helicopter of the Chilean supply vessel "Oscar Viel" transported fuel drums to Frei station and on every return flight to the ship (at least eleven times), it flew over or very close to the north-east coast of Ardley Island and thus nearby to the penguin colony there

(Fig. 69 a & b). There was, however, probably no operational necessity for such a flight pattern.

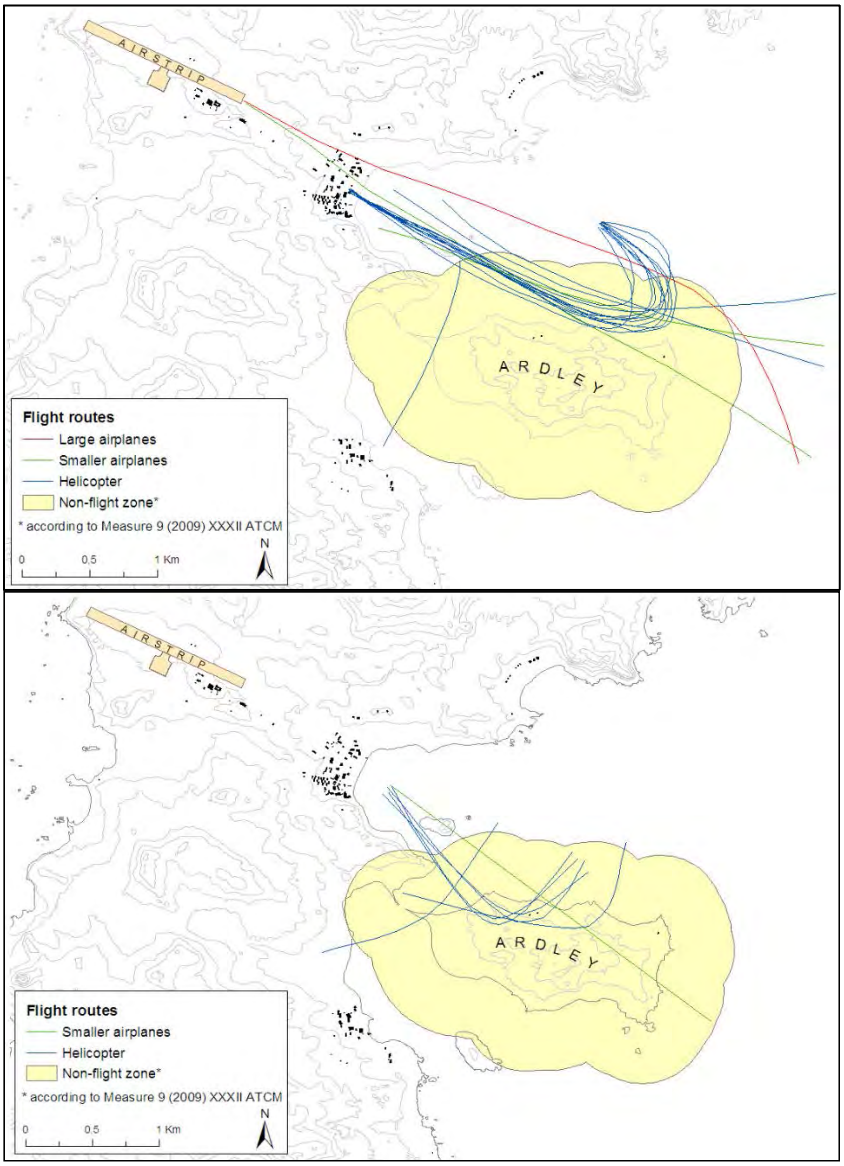


Fig. 55 a & b: Routes of flights observed over Ardley Island, which were under the height (610 m) or the horizontal distance of 460 m that are prescribed by the management plan of ASPA No. 150: a – Antarctic summer 2009/10, b - Antarctic summer 2011/12.

In contrast to the period of 2003/04 to 2005/06 (Peter et al., 2008, Chapter 4.2.16.4.), overflights over the Fildes Strait or helicopter landings outside regular landing sites or outside the airport were no longer observed in the seasons 2008/09 to 2011/12.

3.3.1.5 Published flight statistics

Data published by the Chilean air traffic authority DGAC on the all-year flight movements at the Tte. Marsh airport (http://www.dgac.cl/portal/page?_pageid=238,82566&_dad=portal&_schema=PORTAL, accessed: 02.07.2012) show a renewed increase in air traffic in 2006 to 2008, after a decrease up to 2005 (Fig. 70). Also, according to FACH information, both DAP flights and Hercules C-130 flights (FACH, FAB, FAU) increased, in some cases substantially, between 2007 and 2008 (Chile, 2009c). More up-to-date data has not yet been published. According to FACH information, both DAP flights and Hercules C-130 flights (FACH, FAB, FAU) increased, in some cases substantially, between 2007 and 2008 (Chile, 2009c). DGAC figures show that the number of take-offs and landings on the Fildes Peninsula apparently declined again from 2008. However, these figures are contradicted by published data that record a sharp rise in passenger numbers between 2009/10 (4,332 people transported) and summer 2010/11 (5,265 people), which represents an increase of more than 20 % (RAPAL, 2011).

The divergence of published DGAC statistics from our own records of air traffic during the Antarctic summer (Fig. 66) indicates possible increased flight activity outside the summer months.

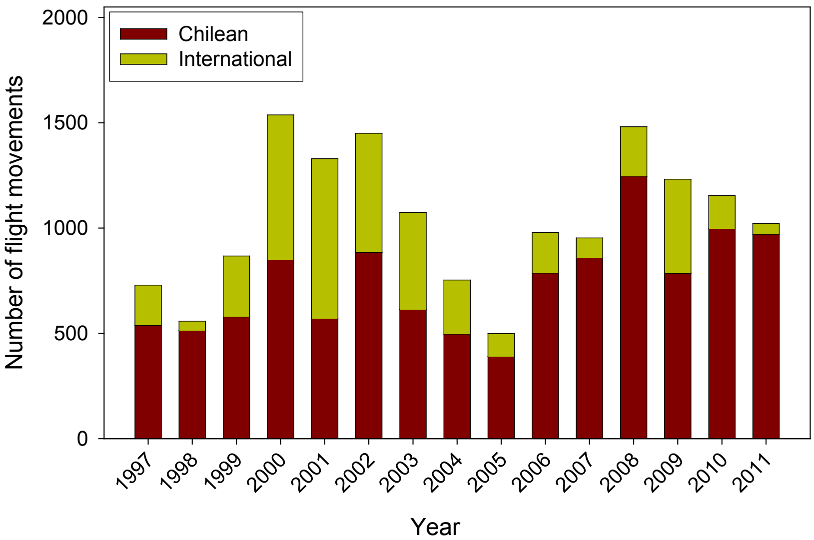


Fig. 56: Flight movements at Tte. Marsh airport between 1997 and 2011, divided according to the nationality of the operator (source: DGAC).

As already mentioned, we should reckon with a v ery probable further increase in flight activities in the Fildes Region in the coming years, as a further increase in tourist flights should be expected with, especially as a result of exchanges of cruise passengers (see for IEE: http://www.e-seia.cl/portal/antarticos/archivos/ant_96.pdf, accessed: 02.07.2012; IAATO, 2009, 2010, 2011, 2012a). It is as yet unclear to what extent increased use of the TLS landing support system, which is currently barely used, will affect the frequency of flights.

3.3.2 Ship traffic

In addition to flight activities, ship traffic in Maxwell Bay plays a major logistical role. In the study period, ships operating in the western part of Maxwell Bay were systematically recorded according to the methodology described in Peter et al. (2008). Because of the different recording periods in the seven comparable field seasons, the results presented relate to the period between 10 December and 26 February (79 days), for which there is a complete set of data for all the periods concerned.

Overall, ship traffic seems to have remained at consistently high levels in recent years (R^2 = 0.55, p = 0.056, Fig. 71). National supply and patrol ships form the largest share of these, with up to 72 % of ship arrivals in Maxwell Bay. Patrol ships have been used as part of the combined Chilean-Argentinian Antarctic navy patrol (Patrulla Antártica Naval Combinada – PANC) in the area (COMNAP, 2008b) since 1998 and often stay in Maxwell Bay between missions (*e.g.* transport of people or material, and security exercises). It is also striking to see the increase in the number of supply vessels arriving at Maxwell Bay. As a result of the absence of the large Argentinian ice-breaker “Almirante Irizar”, which ceased operation in

April 2007, and of the Chilean icebreaker “Oscar Viel” in the 2008/09 season, several smaller supply vessels were deployed in 2008/09 and 2009/10, including supply vessels of other nations. These icebreakers were previously responsible for a large share of station logistics because of their larger capacity for transporting freight and people. In addition, the Brazilian ship “Almirante Maximiano” came to Maxwell Bay in the 2009/10 season for the first time alongside t “Ary Rongel”, which has been used exclusively up to that time. Accordingly, the number of arrivals of supply vessels in Maxwell Bay rose from 19 in the 2003/04 season (four different ships) to 35 in the 2009/10 season (ten different ships). In the 2010/11 season (eleven different ships) and also in the 2011/12 season (eight different ships), the number of supply ship arrivals fell to 29.

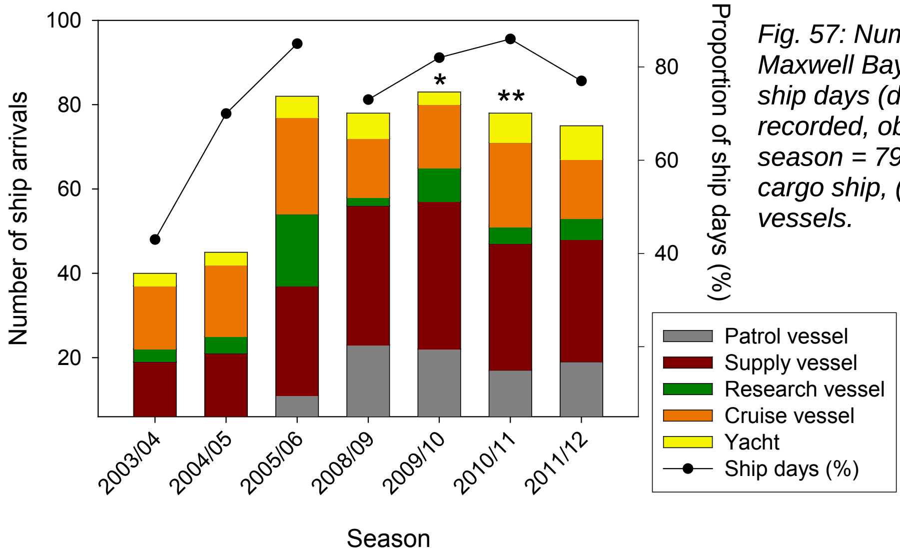


Fig. 57: Number of ship arrivals in Maxwell Bay by ship type and share of ship days (days with at least one ship recorded, observation period in each season = 79 days), (*) one additional cargo ship, (**) two additional fishing vessels.

Although a strong increase in ship-days, *i.e.* days with at least one ship present, was recorded between 2003/04 and 2005 /06 (Peter et al., 2008, Chapter 4.2.17.1.), the proportion of ship-days over all seven seasons investigated did not rise significantly (R^2 = 0.5, p = 0.075, Fig. 71). The same is true of the number of days (on average 58% of ship-days) in the seven seasons with more than one ship mooring in Maxwell Bay (R^2 = 0.57, p = 0.05, Fig. 72). This increase in ship traffic is closely connected with logistical and tourist flight activities. These have always depended greatly on weather conditions in the Fildes Region and occur significantly more frequently with suitable visibility conditions (Sec. 3.3.1). Especially in the 2005/06, 2008/09 and 2009/10 seasons, it was noticeable that there was often more than one ship in Maxwell Bay (Fig. 72), often accompanied by intensive airplane, helicopter and zodiac traffic.

Because this increase in ship traffic is regularly accompanied by a multitude of flights and various other activities (visits by ship crews and tourists to stations and their surroundings, freight unloading and transport, partly with heavy vehicles, Peter et al., 2008, Chapter 4.2.16.), we should expect negative effects on the environment. Our observations that ship crews and tourists of supply vessels not only caused increased noise emission in the surroundings of the stations and in the flight areas, but were also responsible for repeated direct disturbance of resting seals and penguins, correspond with observations in other Antarctic regions (Riffenburgh, 1998). It is to be expected that there will be cumulative effects on the environment, at least in the surroundings of the stations.

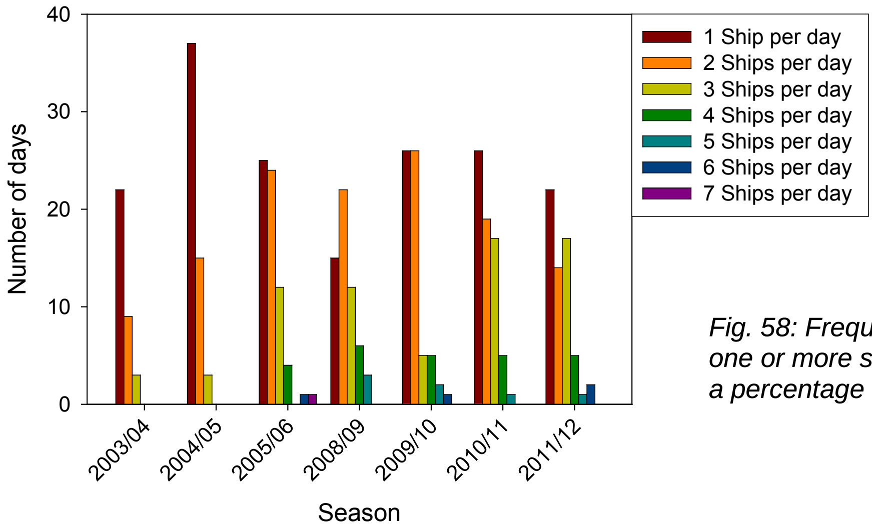


Fig. 58: Frequency of ship days with one or more ships in Maxwell Bay, as a percentage (N_{total} = 408 days).

The increase in the number of cruise ships arriving at Maxwell Bay observed in the period 2003 to 2006 (Peter et al., 2008, Chapter 4.2.17.1) did not continue in the seasons 2008/09 to 2011/12 (Fig. 71). This corresponds to the trend published by IAATO. IAATO information shows that the number of cruise ships sailing to the Antarctic Peninsula rose steadily up to the Antarctic summer of 2007/08, then fell by 39 % up to the 2011/12 season, with passenger numbers declining by as much as 41 % to 2010/11, followed by a slight increase by 11 % in 2011/12 (IAATO, 2012a). Possible causes could lie in the market saturation in this branch of tourism, combined with the continuing difficult world economic situation, which is negatively affecting tourism. IAATO predicts that, with favourable economic conditions, there could be renewed growth in Antarctic tourism (IAATO, 2010) from 2012/13.

However, there has been a significant increase in transfers of passengers from cruise ships and yachts to air travel (Sec. 3.3.1 & 3.4.2). While there was only one exchange with a yacht during 2003/04, there were nine exchanges with cruise ships and four with yachts (R^2 = 0.88, $p < 0.05$) in 2011/12. Whereas there were a total of five arrivals combined with a cruise passenger transfer in the 2003/04 and 2005/06 seasons, there were more than five times as many arrivals, with a total of 28 such combinations in the last four seasons. According to IAATO, the number of such passengers rose from 345 to 860 between the 2009/10 and 2011/12 seasons alone – a jump of some 150 % (IAATO, 2012a). This rise came about because the tour company that has been active in this region for 10 years doubled its level of activity, though for the first time the ship used for passenger exchanges left the Antarctic part-way through the season to take on supplies (IAATO, 2012a). In addition, two new companies tried out passenger exchanges (IAATO, 2012a). A further substantial rise to four tour operators and more than 2,000 passengers is forecast for the 2012/13 season (IAATO, 2012a).

Because the Fildes Peninsula has never been a favourite destination for cruise ships (with the exception of passenger exchanges), passenger landings predominantly took place for other reasons, such as medically-required evacuations through Tte. Marsh airport or the transport of scientists to or from the Fildes Peninsula. Virtually all cruise ship passengers landed in the area of the Frei or Bellingshausen stations. One exception was the arrival of the marathon runners in the 2008/09 season (Sec. 3.4.2.2). Also, a cruise ship called on the Chinese Great Wall station once in the 2009/10 season and again in 2011/12.

In addition, between two and six yachts sailed to Maxwell Bay in every season to visit the stations of the region, for example, or to let passengers fly in or out.

Due to high winds and ice compression, the Brazilian yacht "Mar Sem Fim" scuppered on 07.04.2012 in Ardley Cove, very close to Frei and Bellingshausen stations (Fig. 73). Before the yacht sank, the crew were evacuated by a Chilean patrol ship that was in the vicinity (Chile, 2012b). It is not known whether there was any oil contamination in connection with this incident. According to the published report, the yacht, which at the time had around 8,000 litres of fuel on board, would be salvaged during the following Antarctic summer (Brazil, 2012).

Fig. 59: Sinking yacht "Mar Sem Fim" (photo: R. Eliseev)

3.3.3 Land traffic

In almost all stations on the Fildes Peninsula, the vehicle fleet has considerably expanded in comparison to the last known figures (February 2006, *cf.* Peter et al., 2008). This includes cars as well as larger construction vehicles and towing vehicles. The Uruguayan Artigas station, which still operates with a comparatively low number of vehicles, is an exception to this tendency. In contrast, the Chinese Great Wall station now has a vehicle park of five four-wheel-drive vehicles (previously: one) as well as several heavy construction vehicles, such as wheel loaders or excavators, some of which were imported expressly for construction activities on the station extension and remained in the area. There was an evident lack of maintenance on several of these construction vehicles, causing a continuous oil loss during the entire study period (Sec. 3.2.5).

Four-wheel motorcycles (quad bikes) are a relatively new type of vehicle on the Fildes Peninsula. In the 2005/06 season only Artigas station and the employee of the Chilean Aerovías DAP tourism company stationed on Fildes had one quad bike each. Currently a total of ten vehicles of this type are used on the Fildes Peninsula: Artigas (1 quad bike), Chilean naval base (3), Escudero (2) and Frei (4). The very good driving characteristics in open terrain, especially of the ATV (All-Terrain Vehicle), appear to be an incentive for many station members to leave the existing road network (Peter et al., 2008). Thus, areas that are further away, which could previously only be reached by foot and were therefore not interesting for many visitors, are now also visited. Because of their comparatively low weight, quad bikes are likely to cause less damage to the vegetation than heavier vehicles, such as four-wheel-drive or tracked vehicles. However, frequent use outside the existing road network can be r egarded as problematic because of the cumulative effects. Generally speaking, every time the existing road network is left during the Antarctic summer, breeding birds are disturbed and vegetation is damaged to a greater or lesser degree (Sec. 3.1.1 & 3.1.3).

At a few places on the main road between Artigas and Bellingshausen stations, bad drainage of meltwater plus heavy vehicle traffic caused muddy and impassable stretches, which were subsequently widely avoided by most other vehicles. In the 2009/10 and 2010/11 seasons, new tracks were measured by means of GPS (Trimble GeoHX Handheld ®) (Fig. 74). Interruptions in the tracks displayed are the result of differing ground conditions as well as snow drifts, which caused difficulties in tracing the tracks.

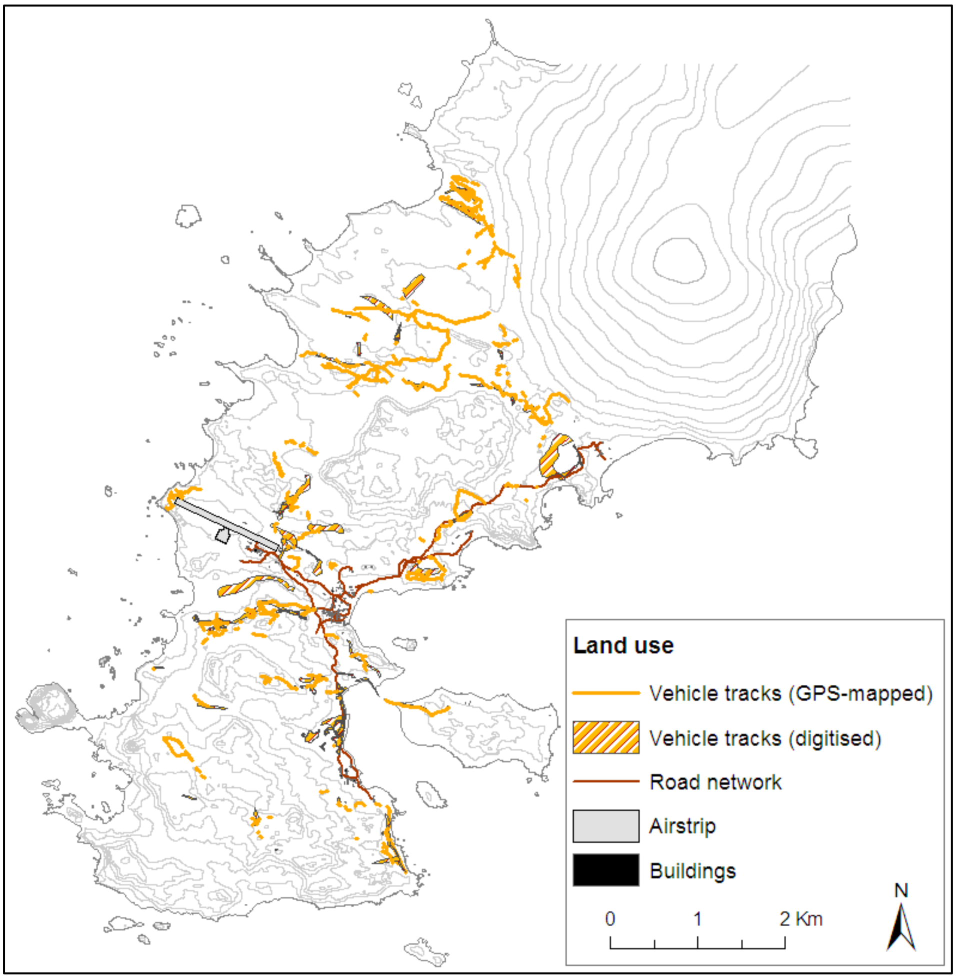


Fig. 60: Mapped vehicle tracks on the Fildes Peninsula and on Ardley Island 2008/09-2010/11.

The number of new vehicle tracks outside the established road network, *i.e.* those demonstrably caused after the 2005/06 season, was altogether surprisingly large. This development is especially alarming because driving just once over the sensitive vegetation can cause damage that requires decades to regenerate (*e.g.* de Leeuw, 1994). The vehicle tracks were caused above all by the leisure activities of station staff and c onstruction activities. However, they were also caused by scientists who prefer to visit their research sites using vehicles, even when the sites are within walking distance of the station. For example, numerous parallel quad bike tracks run to the south of the Biologenbucht, causing serious damage to the vegetation in places (Fig. 75 a & b).

During the expansion of the Chinese Great Wall station, large quantities of material (mainly gravel) were removed from the beach ridges to the north of the station and of Meseta la Cruz. This material was used, among other things, to extend various roads in the station grounds and near the station (Sec. 3.2.1.2). As a result, large areas with rich vegetation and the palaeoclimatically significant series of beach ridges at the eastern exit of the Südpassage were destroyed (Peter et al., 2008). This damage was caused by the almost daily use of heavy construction vehicles in the terrain and by the removal of the material.

Fig. 75 a & b: (a) Parallel quad bike tracks leading to a vegetation experiment, (b) damaged vegetation on this route (photos: C. Braun, 22.12.2008).

The majority of vehicle tracks recorded in the study area were caused by the leisure activities of station members, presumably because of ignorance and a lack of awareness with regard to the sensitive vegetation. As can be seen by the tracks left behind, places with a beautiful view (*e.g.* Meseta la Cruz, cliffs above Bays 10, 13 and 21c) or scenically attractive areas (Priroda field hut, southern north-west platform/Nordwestplattform, Bay 7, Südberge) were deliberately visited. A striking number of vehicle tracks from the tracked vehicles used in Artigas can be found in the north of the Fildes Peninsula between the Uruguayan station and the Drake Coast (previous site of the Rambo field hut), where extensive moss beds were also repeatedly driven over. In contrast, journeys to the Priroda hut in the extreme north-west of the Fildes Peninsula were made predominantly on the existing route (Peter et al., 2008). The last road section, which runs through Valle Klotz, is partly thickly covered in moss, which has been significantly damaged through being driven over regularly (*cf.* Peter et al., 2008, Chap. 4.5.14.). Only Davies Heights, which are practically inaccessible to vehicles, have so far not been damaged.

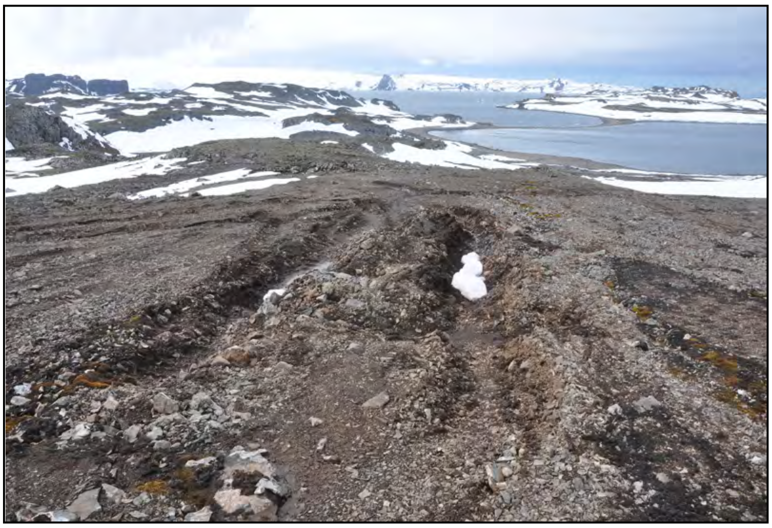


Fig. 61: Tyre tracks on the eastern slope of Fossil Hill, caused by four-wheel-drive vehicles (left of the photograph) and a larger vehicle (centre) (photo: C. Braun, 03.01.2010).

According to the existing guidelines for protecting ASPAs No. 125 and No. 150, driving on these areas is strictly prohibited (ATS, 2009d, e). These ASPA-regulations were, however, repeatedly massively violated. Both Ardley Island and the peripheral area of the Collins Glacier and Fossil Hill were repeatedly travelled on with four-wheel-drive and other vehicles (Fig. 76). For example, on 24.01.2009 two four-wheel-drive vehicles with several people from the Chinese Great Wall station drove over the Isthmus to Ardley Island (Sec. 3.4.3). Driving on ASPA No. 125 for leisure purposes and for private (unpermitted) fossil searching by non-authorised people can equally be classified as prohibited.

As a result of the long-lasting snow cover in the 2009/10 season, multiple tracks from skidoos and tracked vehicles were discovered away from the established road network in the entire study area. The areas that were driven on correspond with known winter usage (Peter et al., 2008, Chapter 4.2.15.). With sufficiently deep snow cover, these tracks do not represent a threat to vegetation. However, engine noise and approaching people can potentially disturb seals at their haul-outs and pupping places, as well as seabirds (Peter et al., 2008).

3.4 Further human activities

3.4.1 Scientific activities in the Fildes Region and their effects

Both tourism and scientific and logistical activities can potentially disturb the sensitive ecosystem of the Antarctic (*e.g.* Riffenburgh, 1998; SCAR, 2008). Investigations into the impact of people on flora and fauna frequently focus on the effects of tourism. However, various studies show that scientific activities can equally cause a decrease in animal populations (Wilson et al., 1990; Blackmer et al., 2004). These activities can thus have comparable (Giese, 1996) or even more serious effects than tourism (Fowler, 1999; Chwedorzewska & Korczak, 2010). Although the number of Antarctic tourists and the crew that accompany them greatly exceeds that of scientists and station staff (IAATO, 2010), the long stays on land of participants in National Antarctic Programmes have a significantly higher potential for damage (Indices „presence-days" and „person-days ashore", Headland, 1994; Jarbour, 2009; Riddle, 2010). Research in the Antarctic is of the greatest importance for understanding climatic and ecological relationships. Nevertheless, it must be carefully weighed against its negative effects and those of the supporting logistics (Bargagli, 2005). To minimise this impact, SCAR proposed certain behavioural guidelines for scientific activities (SCAR, 2009c, 2010, 2011b). These pointed out, among other things, the danger of importing non-native species, because the potential for doing this is especially high for participants of National Antarctic Programmes (Sec. 3.1.4; SCAR, 2009a, 2010). Invasive methods can nowadays often be replaced by less invasive ones. Furthermore, the knowledge gained through such non-invasive methods is considerably higher as they impact less on the relevant organism. If an invasive method is nevertheless used, it should only be carried out by trained and experienced people. Under normal environmental conditions, additional stress may only have a minimal effect on vertebrates. However, under unfavourable conditions (*e.g.* lack of food availability), this stress can become significant and can negatively affect survival (SCAR, 2008). This should be given special consideration in the context of climate change (see *e.g.* Sec. 3.1.1, Decline in numbers of Adélie penguins in the WAP Region, *cf.* Fraser & Trivelpiece, 1996; Smith et al., 2003).

The EP and its prescribed environmental impact assessments of scientific activities, together with the "best practice" stipulations of CCAMLR and SCAR, should guarantee a certain standard for the topics to be investigated and methods to be applied. In practice, however, there are large individual differences in the execution of projects. For instance, scientists of different nations, who were insufficiently informed about the subjects of their research and the study area, were repeatedly supported by project members in their research on vegetation or on birds. The absence of planning certainty and short-term decisions represent a further obstacle to efficient, resource-conserving research that also minimises effects on flora and fauna. It has been documented that scientific equipment is frequently left in the field.Almost all scientific activities affect the sensitive Antarctic ecosystem to a varying degree. However, the effects are very diverse (Harris, 1998) and, not least, also depend greatly on the personal attitude of those involved. The destruction of vegetation due to unnecessary vehicle use or due to recreational visits to ASPA No. 150 Ardley Island are merely two such examples. Experimental equipment in the field is often so poorly constructed that it does not survive the raw Antarctic conditions (Fig. 77 a & b). Equally, once projects are finished, there is a lack of an orderly dismantling and disposal of all markings and equipment. For example, numerous remains of scientific experimental equipment can be found over the entire Fildes Peninsula and the neighbouring Collins Glacier area, ranging from discarded measuring jugs and containers for chemicals to a metal structure approximately 2 m high (Fig. 78). Also, the destructive activity of animals, such as skuas, should be considered, and materials should be correspondingly secured. Especially colourful, fluttering marking tags arouse the attention of skuas and can be damaged or taken away by them.

The labelling recommended by SCAR for experimental equipment left in the field (stating country/station, responsible scientists, start and estimated end of the experiment, SCAR, 2009c) has up to now either not been implemented or has only partially been done, so that unambiguous identification is often not possible. The availability of information about current or planned projects at the level of the research scientists is likewise far from sufficient. The demand for international cooperation and coordination of scientific projects was laid down in the Antarctic Treaty of 1959 and has subsequently often been repeated (e.g. ATS, 1961, 1989; Australia et al., 2005; SCAR, 2009b). The information to be supplied to SCAR, COMNAP and ATCM about the research projects is, however, mostly very difficult to find for outsiders, is often not publicly accessible or is kept so general that coordination or initiation of cooperative projects turns out to be hardly possible on the basis of this information. To avoid overlapping of projects and the associated dangers of results being affected and of increased disturbance to flora and fauna, an agreement at short notice between the scientists on site is essential but not sufficient. Projects should be coordinated as long as possible before they start. The SCAR Action Group King George Island was originally regarded as the appropriate group to coordinate projects (see *e.g.* http://www.scar.org/researchgroups/crosslinkages/KGI_Workshop_Report-Jul08.pdf, accessed: 02.07.2012). However, this group showed little activity outside SCAR meetings and was finally disbanded in 2011 (http://www.scar.org/researchgroups/kgi.html, accessed 02.07.2012).

Fig. 62 a & b: Destroyed experimental equipment: (a) "open top chamber" with broken Plexiglas wall (02.01.2010), (b) fallen marker posts and frayed marking tape from a vegetation experiment (photos: A. Nordt, 12.01.2010).

Fig. 63: Part of an experimental rig, which has been standing in the field since the early 1980s (photo: A. Nordt, 09.01.2011).

Chile (INACH) referred to the APASI Platform (https://www.comnap.aq/projects, accessed 02.07.2012), which should, among other things, provide information about current and planned research projects in the Fildes Region. The provision of information is voluntary (pers. comm. V. Vallejos), and requirements for access are unclear. Hence, we shall have to wait and see to what extent APASI contributes to an improvement.

In the study area, researchers are working on a wide spectrum of scientific topics. However, various sources, and our own experiences, indicate that the scientific potential of most stations has not yet been exhausted (United Kingdom & Germany, 1999; Australia et al., 2005). It is still common practice for neighbouring stations to routinely collect similar, or even identical, data. This duplication of data collection should be scrutinised and the relevant projects should be made more efficient.

Up to now, scientific laboratory space has only been available in the Artigas and Escudero stations. Since the completion of its new laboratory building, Great Wall station has had approximately 25 laboratory places, a climate chamber and a separate computer room.

These have been available since the 2010/11 season and it is intended that they also be used by cooperation partners (pers. comm. Great Wall station manager). The planned creation of a laboratory on the basis of Russo-Korean cooperation in Bellingshausen station (United States, 2007) is being pursued (pers. comm. station manager). In February 2010, a receiving aerial for the Russian satellite navigation system GLONASS was put into operation at Bellingshausen Station (http://www.insidegnss.com/node/1898, accessed: 02.07.2012).

The registration of activities on Ardley Island by employees of Escudero station mentioned in Peter et al. (2008) has been discontinued. We recorded our own data of visitor and scientist traffic in ASPA No. 150 as far as possible. According to our subjective estimates, scientific projects on Ardley Island have increased during the past years compared to the period 2003-2006 (Peter et al., 2008). Effects of these projects that have been observed have so far been limited to vegetation damage (footprints and marks made by experimental equipment, Fig. 79). Because scientists are often accompanied by visitors (Sec. 3.4.2.3), additional damage cannot be separated from that caused by leisure visitors and will in some cases only be recognisable over the long term.

Fig. 64: Clearly-visible marks from experimental equipment for measuring soil gas and footprints in the moss, Ardley Island (photo: C. Braun, 12.01.2009).

3.4.2 Tourist activities

3.4.2.1 Spectrum of tourist activities

The term “visitor” or “visitor activities” is used below to portray adequately the multitude of different tourism forms as well as visitor and leisure activities in the Fildes Region. These terms cover tourists (including passengers and crews of ships and airplanes), station members (staff and scientists) during their leisure time, film crews and team of journalists, and, increasingly, government delegations that visit the region. The education programmes that have been increasingly conducted during the past few years, *e.g.* for groups of schoolchildren, represent a borderline case. However, in our experience, they can best be classified under tourism.

Tourism proper in the Fildes Region still takes place mainly in the form of organised ship and air tourism or a combination of the two. So far, hardly any direct negative effects could be observed on the Fildes Peninsula resulting from these forms of tourism.

The numbers of passengers landing from cruise ships did not increase in comparison with the period of 2003-2006 (Peter et al. 2008; IAATO, 2012b). However, in contrast, the transfer of cruise passengers to air travel increased continuously between November and March, according to IAATO information, from 37 passengers in the 2003/04 season to 860 in the 2011/12 season (Sec. 3.3.2; IAATO, 2004, 2012a).

It can be assumed that the number of passengers with the Chilean Aerovías DAP company will also increase, although no precise data are available on this. DAP has been using an airplane with a larger capacity (Type BAE 146, max. 99 passengers) since the 2007/08 season. In the 2010/11 season 44 flights were observed, more than in any previous season (Sec. 3.3.1). Since the 2011/12 season two airplanes of this type have been used for Antarctic flights. This made it possible for the first time to have three regular tourist flights on one day. Besides day trips, Aerovías DAP offers four excursions with one overnight stay on the Fildes Peninsula (http://www.aeroviasdap.cl/antartica_e.html, accessed: 02.07.12, data for the 2011/12 season). As a rule, tourists are accommodated in containers belonging to DAP, which were in the grounds of the Russian station Bellingshausen up to the 2008/09 season. They were subsequently installed at the edge of the Chilean station Escudero. The National Antarctic Programmes support tourist activities so some extent, providing logistical support and accommodation, for (*e.g.* in the 2010/11 and 2011/12 seasons in the Russian station Bellingshausen).

Passenger transfers from cruise ships to flights were also regularly supported by at least one station in the Fildes Region during the study period. This was done by making rooms available for tourists or accommodating a locally-based member of tour company staff.

In addition to cruise ships, private and chartered yachts also come to Maxwell Bay. Some of them do not fully inform their passengers about the regulations, and are badly prepared. In the 2009/10 season, for example, the crew members of the Brazilian yacht “Mar Sem Fim” had no knowledge of guidelines for behaviour in the Antarctic (Sec. 3.3.2). In the 2010/11 season the New Zealand yacht cruiser “Big Fish” had no suitable dinghy for planned landings, so that a Zodiak had to be flown in specially (pers. comm. A. Contreras). Crews of non-tourist vessels were also repeatedly observed engaging in tourist activities. In the 2008/09 season, for example, the Chilean Navy ship “Aquiles” started using its helicopter to carry out sightseeing flights for tourists on board. In January 2011, a large number of crew members of the same ship visited the Fildes Peninsula and ignored behavioural guidelines on flora and fauna (own observation). Also, other unaccompanied tourists travelling on supply or patrol ships were in some cases seen to infringe rules of behaviour.

The Fildes Region is also frequently visited by film crews and other groups of journalists, who in many cases have insufficient knowledge of the behavioural guidelines that apply in the Antarctic.

3.4.2.2 Fildes marathon

Since 1995, “Marathon Tours & Travel” has organised 13 marathons and half-marathons on the Fildes Peninsula (http://www.marathontours.com/index.cfm/page /Antarctica-Marathon-and-Half-Marathon/pid/10734, accessed: 02.07.2012). As far as possible, the marathons were documented in the 2008/09 and 2010/11 seasons.

In each case, the approximately 10.5-km-long stretch, which deviated only slightly from the route of the 2004/05 season, was prepared on the day before the run (Fig. 80, Peter et al., 2008, Chapter 4.6.2.2.). The northern stretch of the route led alongside the road between Artigas station and the Priroda field hut, and thus through an area that has been designated as site 125c of ASPA No. 125 (ATS, 2009d; Sec. 2). Because of the large number of participants in 2009 (189 runners), who arrived on two cruise ships, the runners were landed in two separate groups (94 and 95 peopl e) at two different landing points, the Artigas and Bellingshausen stations. These points were also the Start and Finish of the respective groups of runners. In this way, the limit of a maximum of 100 passengers per landing point was obeyed (ATS, 2009e).

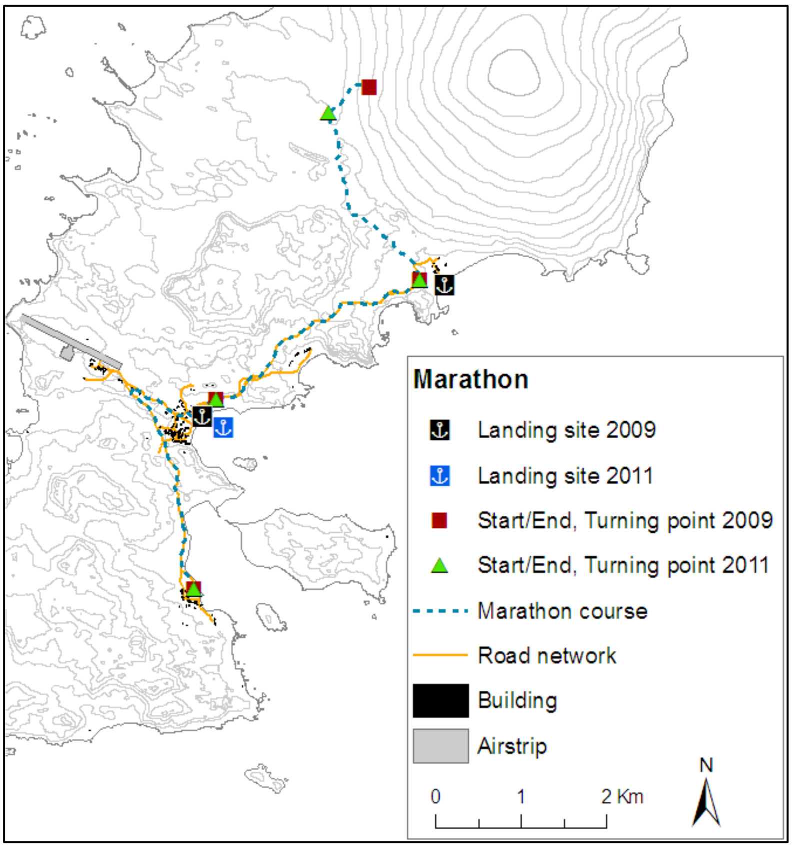


Fig. 65: Route of the Antarctic Marathon by "Marathon Tours & Travel" on the Fildes Peninsula in 2009 and 2011.

The marathon took place on 07.03.2010, on 28.02.2011 and on 09.03.2012 in the following seasons. In 2010 only 97 runners participated, in 2011 95 and in 2012 approx. 100 runners. In both cases, all the runners travelled on a single ship. This was possibly a reaction by the organisers to previous criticism of the event (Chile, 2009a).

During the marathon, personal possessions of the runners were deposited in red rubbish bags at both starting points. At these points, tents with camping toilets were also set up (Fig. 81 a), so that no station facilities had to be used. Only the four quad bikes that were expressly brought along were sometimes parked overnight in the hangar of the Russian station.

The runners kept overwhelmingly to the designated route. However, very muddy sections of road were circumvented. Here, some vegetation was trampled which had already been pre-damaged by station vehicles. In the 2008/09 season, the northern part of the route included a stretch that branched off to the glacier (Fig. 80). This stretch led approximately 30 m across an area with limited moss cover (degree of cover approx. 10 %), which was damaged by runners and q uad bikes (Fig. 81 b). In the 2010/11 season, this stretch was no longer included (pers. comm. T. Gilligan).

Fig. 81 a & b: (a) Starting point at the Uruguayan station Artigas, with red rubbish bags containing the runners' personal property items. In the background are the two tents with the toilets. (b) Detour from the main road to the Collins Glacier, with limited vegetation cover (photos: A. Nordt, 10.03.2009).

After the end of the 2009 marathon no abandoned objects were found, apart from four marking pennants. A positive aspect to be emphasised is the late date of the event, as at this time all breeding birds potentially affected by the route had already come to the end of their breeding season. There was also no evidence of damage to scientific projects. Altogether, the effects of the marathon on the Fildes Peninsula can be regarded as limited and very local.

It should be noted that in the 2010/11 season, as in 2005/06, in addition to the above-mentioned run in February 2011, a further marathon ("4 deserts") took place on 20.11.2010 on the Fildes Peninsula. This event was also staged without any stationary infrastructure. In this event, 55 runners had to complete a stretch of 125 km, which led along existing roads between the Chinese and the Uruguayan stations (http://www.4deserts.com/pressrelease.php?id=70, accessed: 02.07.2012, pers. comm. V. Powaschnui).

The sport events described are enjoying increasing popularity and are also planned for the coming years. In some cases they are already fully booked.

3.4.2.3 Leisure activities of station staff and scientists

The leisure behaviour of station members plays an important role with regard to potential negative effects on flora and fauna. In a representative survey of station staff and scientists, it became clear that 70 % of the people interviewed spend more than six hours a week (and thus a considerable part of their leisure time) in the open (Peter et al., 2008). Therefore, in the framework of the daily field work, the leisure behaviour of station members outside station grounds was registered.

All told, station members engaged in a wide range of leisure activities over large parts of the Fildes Region. Because of the large number of people living and working in the stations, and because of the size of the study area, these activities can only be presented in the form of examples. In this context, special attention was paid to ASPA No. 150 Ardley Island, which, according to the management plan (ATS, 2009e), may only be visited with a valid permit and only for scientific purposes or for reasons of essential management. Yet, in all three field seasons observations were made that clearly contradict the existing regulations for ASPA No. 150 (Sec. 3.4.3).

Above all, members of a neighbouring station frequently visited the island in groups of up to 19 people. It was not always possible to distinguish between scientific and tourist activities, among other things because scientists were often accompanied by other people. In some cases these people stayed in penguin colonies for a long time, to film and to photograph (Fig. 82). People were also observed moving so quickly in the middle of the colony that the animals clearly exhibited flight reactions. On a number of occasions, people also moved away from the existing path into areas with denser vegetation and thus disturbed breeding birds (skuas, gulls, and terns), sometimes even deliberately. Visitors from other stations moved either directly along the north coast of the island or along the existing path and were, in comparison, more careful with respect to minimum distances or general behaviour in the penguin colony.

Fig. 66: Station members as visitors in the penguin colony on Ardley Island (photo: C. Braun, 11.01.2009).

Furthermore, driving on Ardley Island with vehicles was documented in the 2007/08 and 2008/09 seasons for the first time in a number of years (pers. comm. M. Kopp) (Sec. 3.3.3), although all vehicle use is strictly forbidden in ASPA No. 150 (ATS, 2009e).

Fig. 67: Typical example of a station member posing for a photo (photo: C. Braun, 25.12.2009).

Members of all stations located there regularly go for walks in the Fildes Peninsula area. When doing this, they mainly use the existing road network. However, in the coastal area between the Ardley Isthmus and Great Wall station, and on the Drake Coast, we frequently observed definite disturbance of resting seals and penguins by visitors, who sometimes approached the animals very closely (Fig. 83). According to a subjective estimate by the project member, this leisure behaviour outside stations and existing roads increased considerably, especially in the 2008/09 season. Here again, it was not always possible to differentiate accurately between scientific and tourist activities. In January 2009, one person was observed on the summit of Flat Tops (pers. comm. A. Casanova-Katny). The reason for climbing this hard-to-reach rock, on the side of which light-mantled sooty albatross had been shown to be breeding (Sec. 3.1.1), is not known.

Furthermore, activities included motorised excursions by groups of people, sometimes large groups, to the Priroda field hut in the extreme north-west of the Fildes Peninsula, as well as the sport of snow kiting, which to our knowledge is new in the region. This was regularly practised, for example with the aid of skidoos in the winter and spring of 2008 on the frozen Kitezh Lake, and in the summer of 2008/09 as well as in the winter of 2010 on the Collins glacier (Fig. 84).

Fig. 68: Snowkiting on the Collins Glacier; in the foreground the Fildes Peninsula can be seen (front right: Lago Uruguay); in the centre is Ardley Island and in the background Nelson Island (photo: C. Braun, 13.12.2008).

Collecting fossils and minerals represents a further leisure activity. As already known, rich fossil areas, for example in the vicinity of the Collins glacier (site 125c of ASPA No. 125 since 2009) and Fossil Hill (site 125a of ASPA No. 125) have been intentionally visited with vehicles for this purpose (Sec. 3.3.3 & 3.4.3). This behaviour can be judged as problematic, particularly with regard to the scientific significance of the rich fossil areas on the Fildes Peninsula.

Fishing continues to be a favourite leisure activity during the summer months (Peter et al., 2008, Chapter 4.6.2.1.) and members of at least two stations engage in this pastime. However, it was never practised to the extent that it was in the 2008/09 season, either before or since. In that season almost every day with favourable weather conditions was used by members of a station for fishing trips in Maxwell Bay and the Fildes Strait. The only fish caught were of the Antarctic Cod (Nototheniidae) family, which are very easy to catch along shallow, rocky stretches of the coast. There were reports of daily catches of up to 100 kg of fish. The preferred sites were mainly the rocky areas on the east coast of the Fildes Peninsula and the offshore Diomedea and Geologist Islands. The coastal area of the Fildes Strait, including Two Summit and Dart islands, as well as the north of Nelson Island, was likewise repeatedly visited. These relatively frequent disturbances of distant breeding areas of southern giant petrels during the breeding season could to some extent be responsible for the partly seriously declining number of breeding pairs and for the lack of breeding success at the breeding sites mentioned (Sec. 3.1.1). The fish caught were generally gutted in the shore areas of the stations and the resulting fish cuttings were immediately fed to competing skuas and gulls. After this, skuas injured as a result of fighting for food were observed on a number of occasions in the vicinity of the stations (pers. comm. M. Kopp). Moreover, this feeding threatened an ongoing research project, which involved investigating the food of skuas by means of isotope analyses. There were thus obvious consequences related to the clearly expressed plea not to feed the birds with fish waste.

Furthermore, there are private photographs known on which station members can be seen immediately in front of southern giant petrel nests or touching seals and penguins, as well as catching skuas. Such pictures clearly demonstrate the frequent lack of awareness of station members (including scientists) with regard to disturbing animals or to damaging the local vegetation.

Management plans for both ASPA areas were frequently either not known by station members, were not available in some stations, or clearly met with little interest. The subjective impression that the staff of a number of stations on the Fildes Peninsula were not sufficiently well-informed was frequently confirmed by inquiries. Even scientists and seasoned overwinterers showed their ignorance with regard to the locally recommended behavioural guidelines. Many have not received appropriate training or education.

3.4.2.4 Effects on the Fildes Region

With increasing visitor pressure, possible negative effects on flora and fauna of the Fildes Region also increase. Generally speaking, however, the impact of guided tourism is substantially smaller than that of station logistics and personnel.

Tourists travel either by ship or airplane, or use the possibility of flying in and then transferring to a cruise ship or yacht. In all, the impact on the area is increasing as a result of air and ship traffic, which causes noise and gaseous emissions, and due to higher visitor pressure on certain parts of the region. These are largely restricted to the visitor zone on Ardley Island and areas close to stations or surrounding the road network on the Fildes Peninsula. Likewise, the danger of importing non-native species increases with an increase in tourism (SCAR, 2009a, 2010). Ignorance of behavioural regulations was repeatedly noted among the crews of yachts. If minimum distances to animals or regulations on waste management are not adhered to, this ignorance can have negative effects on the region. In addition to commercial tourism, visits by delegations from different nations in the summer months cause short-term increases in pressure on the region due to increased traffic resulting from motorised excursions to scenically attractive places and tours with helicopters or small airplanes. Even small groups of unguided visitors can have a comparatively high potential for disturbance. This is because they sometimes visit more sensitive areas outside stations and roads, and often do not have sufficient information about existing behavioural guidelines. This includes disturbing seals and breeding birds, as well as walking on vegetation. These actions can potentially pose a threat to scientific projects in those places.

Visits by large guided groups to the Fildes Peninsula, for example within the framework of educational programmes, can affect in particular sensitive breeding birds and vegetation because of the high number of people, although the participants of such programmes are generally informed about the behavioural guidelines (Sec. 3.2, 3.2.1.3 & 3.4.2.2). The occasional presence of tourists in the stations causes an increased use of infrastructure (vehicles, water/wastewater, fuel) and the associated impact on the Fildes Peninsula and on Maxwell Bay.

Among other things, the effects of station members' leisure behaviour are comparatively serious as a result of their using vehicles and zodiacs to visit areas far from the stations or more sensitive areas. In principle, all visitor activities can result in damage to the vegetation from driving or walking and can also disturb birds and seals. Temporary disturbance can cause additional energy expenditure (or something similar) by seals and birds, which can influence the survival of the animals due to the prevailing adverse environmental conditions (Riffenburgh, 2007). If brooding adult birds leave the nest, a further possible consequence is the loss of the eggs or young birds to predators (skuas). Chronic disturbance of breeding birds can, however, lead to them moving their breeding sites, or to a decrease in the population or a complete evacuation of the breeding areas. This has already been demonstrated in the past by substantial changes in the local populations of southern giant petrels (*Macronectes giganteus*) in the Fildes Region (Pfeiffer, 2005; Peter et al., 2008). The continued feeding of skuas that has been observed carries the danger of spreading diseases (Kerry et al., 1999) as well as potential negative effects on nestling development from food that is atypical for skuas or of inferior quality (Peter et al., 2002). Furthermore, there is a close relationship between frequent human activities and seals either moving or abandoning haul-outs and pupping sites (Chwedorzewska & Korczak, 2010).

3.4.3 Infraction of ASPA rules

According to the management plans for ASPAs No. 125 and No. 150, which came into force in 2009, these areas may only be entered in connection with management measures or for scientific objectives, with the appropriate permit from the national authorities responsible (ATS, 2009d, e).

With regard to ASPA No. 150 Ardley Island, this regulation aims especially at minimising the disturbance of breeding bird populations and protecting the vulnerable vegetation from damage through trampling. Nevertheless, members from almost all stations were repeatedly observed outside the visitor zone in the protected area, presumably for leisure activities (Sec. 3.4.2.3). The main destination of these visits was the penguin colony in the northern and north-eastern parts of Ardley Island. To reach these areas, breeding sites of southern giant petrels, skuas and Antarctic terns were crossed, as well as areas of dense vegetation. In the 2008/09 season, larger groups repeatedly visited the island, mainly on Sundays (*e.g.* on 28.12.2008). This was despite the fact that the management plan then in force (ATS, 1991) allowed groups of up to 20 people only in the visitor zone. In the revised management plan (ATS, 2009e), which has been in force since 2009, the maximum group size allowed is restricted to ten people outside the visitor zone in the sensitive period between October and January. However, in the following season, scientists who carried out research in the ASPA were often accompanied by up to six other people. These people generally left the investigation site after a short time to travel in the direction of the penguin colonies in the north and north-east of the island. By clearly violating the recommended minimum distances to the nest, staying for too long and crossing the colony quickly, they caused massive disturbance of the penguins. Because the numbers of Adélie penguin breeding pairs on Ardley Island have been declining for years (Sec. 3.1.1 & 3.1.1.1), such visits must be seen as problematic. For example, it has been shown that Adélie penguins appear to react far more sensitively to anthropogenic disturbance than gentoo penguins, which leads to a lower chance of hatching and reduced probability of the chicks surviving (Giese, 1996).

Vehicle use documented in ASPA No. 150 represents a further serious violation of the protected area regulations. For example, vehicles of the Chinese station Great Wall crossed the Isthmus connecting Ardley Island to the Fildes Peninsula, both in the 2007/08 season (on at least one day) and in the 2008/09 season (on at least three days). As an ex ample, Fig. 85 & Fig. 86 show two four-wheel-drive vehicles of the Chinese Great Wall station crossing the Isthmus to Ardley on 24.01.2009, to transport approximately 20 people to Ardley Island. The four-wheel-drive vehicles followed the former road to around 250 m before the Ripamonti/Ballve complex of huts. The people then left in the direction of the penguin colony. These observations and the presence of a film crew, which was making a commercial for the manufacturer of the four-wheel-drive vehicles, exclude the possibility of the visit to the island being for purely scientific purposes. In addition to the disturbance of breeding birds (*e.g.* southern giant petrels and skuas), the four-wheel-drive vehicles left clear tracks in the newly-grown moss cover of the former road, which clearly set back its regeneration. In the subsequent seasons, on several occasions new vehicle tracks reached all the way to the crossover to Ardley Island. However, no vehicle use was observed in the ASPA.

Fig. 70: Chinese vehicles crossing the Ardley Isthmus (photo: M. Kopp, 24.01.2009).

Fig. 69: Chinese vehicle on Ardley Island (photo: S. Lisovski, 24.01.2009).

The waste and oil discharge into Maxwell Bay caused by the stations on the Fildes Peninsula represent a great danger for the sensitive Ardley Island ecosystem (Sec. 3.2.5). It is known that oil-contaminated soil has a significantly reduced biodiversity of microbial ecosystems (Aislabie et al., 2004). The organisms living in Maxwell Bay can be physiologically damaged via the food web. For example, mucous membrane inflammation and immune suppression are known in penguins (Samiullah, 1985; Eppley & Rubega, 1990; Culik et al., 1991; Briggs et al., 1996; Briggs et al., 1997). These complaints can entail diminished viability and a lower reproduction rate (Sec. 3.1.1). Waste washed ashore, such as hazardous materials, sharp-edged metal parts on which animals can injure themselves, or small plastic pellets that can be swallowed, contain an additional risk. In the 2008/09 season, large quantities of packaging material drifted from the Chinese station to the southern shore of Ardley Island (Sec. 3.2.2).

In past years, the main flight route running immediately north of Ardley Island in the direction of the Tte. Marsh runway led to considerable pressure on the breeding bird populations, especially in the sensitive phase of rearing chicks between December and January (Peter et al., 2008). The minimum flight heights and distances stipulated for this island (ATS, 2009e) were also followed in the seasons 2008/09 to 2011/12. This included sometimes major violations by airplanes and helicopters, often in connection with the logistical operations of supply vessels (Sec. 3.2.6 & 3.3.1). However, compared with the observations of 2003/04 to 2006/07, such low overflights clearly declined in the last four seasons (Sec. 3.3.1).

Unauthorised walking and driving on ASPA No. 125 is likewise in contradiction to the current management plan for this area (ATS, 2009d). With regard to the values to be protected, however, crossing the sites on foot is regarded as less problematic and, in our experience, is due mainly to ignorance of the protected area boundaries or to difficulties in recognising these boundaries on the ground. This concerned visitors to the Fildes Peninsula (participants in the Antarctic Leadership Venture of the Wharton University of Pennsylvania, inhabitants of the private EcoBase Nelson and participants in the APECS Summer School), plus members of the different stations on the Fildes Peninsula.

When vehicles leave the road network, there is always a possibility that breeding birds and vegetation will be disturbed. However, driving in protected areas and the intentional search for fossils and minerals as private souvenirs are far more serious (see Peter et al., 2008, Chapter 5.2.1.5.). Such infractions were repeatedly confirmed by our own observations and by numerous vehicle tracks found both in the peripheral area of the Collins Glacier (site 125c) and on Fossil Hill (site 125a, Sec. 3.3.3, Fig. 76). For instance, in January 2009, station members were observed deliberately searching for fossils in the peripheral area of the Collins glacier (pers. comm. M. Kopp & S. Lisovski). With the aid of Chinese four-wheel-drive vehicles (pers. comm. one station member), large quantities of stone were presumably also removed.

The Fildes Peninsula is one of the most important palaeobotanical sites of fossil finds of the Antarctic because its plant fossils represent the most complete terrestrial data set of the Antarctic (Poole et al., 2001; Poole, 2005). The breaking open of potential fossil and mineral-bearing rock strata and the removal of specimens from the area for non-scientific objectives thus represent a considerable scientific and aesthetic loss for the Fildes Peninsula.

4 Risk analysis

Based on the assessment made of the values to be protected of the Fildes Region as described in Peter et al. (2008, Chapter 5.1.), the current threats posed by human activities are outlined below and compared with the threats and risks previously described and anticipated by Peter et al., 2008).

Before activities are carried out, the Protocol on Environmental Protection to the Antarctic Treaty requires the prior evaluation of risks of environmental impacts through human activities, with the degree of impact forecast determining the meticulousness of the analysis. An analysis of current and potential threats indicates a need for protection of the area, as well as for possible management measures. In addition, these measures are dependent on the predictability, frequency and intensity of the threat posed by actual human activity (Peter et al., 2008).

4.1 Station operations

Construction activities carried out are in some cases based on what are, to a degree, only inadequate IEEs, e.g. adding to the increased risk of local contamination with hazardous materials and waste through the use of unsuitable materials and a lack of safeguards. Examples include the use of insulating materials which skuas are able to destroy, and the lack of basins under oil storage tanks (Sec. 3.2.1.2, 3.2.2 & 3.2.5). Furthermore, it repeatedly became clear that activities associated with construction work led to the disturbance of animals and the destruction of vegetation, breeding areas, and scientifically significant areas. As the number of station members grows, the risk potential for the environment continues to increase through elevated requirements in terms of logistics, resources and traffic, as well as through scientific and leisure activities, particularly if station members have not undergone sufficient training regarding behavioural guidelines.

In the past, newly constructed station buildings led to breeding sites being abandoned or to whole seabird colonies being relocated (Sec. 3.1.1.2). In addition, the negative impact on skuas due to continued feeding at stations can also be mentioned. Taking severe oil contamination and its associated damage to the marine ecosystem as an example, the risk potential posed by stations in particular should be highlighted (Sec. 3.2.5). The risk potential decreases through the renovation of buildings, facilities and machinery, but rises again through increased intensity of use. This therefore confirms the prognosis (*cf.* Peter et al., 2008) that the threat to values to be protected will increase parallel to increased human activities associated with station operations.

4.2 Traffic

Leaving aside local contamination by harmful substances, the hazard potential posed by land traffic is small, but increases in leaps and bounds if areas outside the road network are driven across. When this happens, not only is vegetation damaged, sometimes to a substantial degree, but also animals in their resting and breeding phases are disturbed, with the negative consequences described (Sec. 3.1.1 & 3.4.2.3). As the size of the station vehicle fleets increases, while the common practice of leaving the road network is kept by, the risk of disturbance and damage to flora and fauna continues to rise. During the study period, air traffic was at a similarly high level when compared to Peter et al., 2008), with increased adherence to minimum distances and altitudes in relation to Ardley Island reducing the risk potential. The threat posed by shipping traffic is comparatively limited, but does increase in isolated cases due to the proximity of activities to breeding bird colonies and to the multitude of logistical activities associated with ship arrivals. In comparison with the previous study period, the number of ship's days increased from 66 % to 80 % on average, which reflects an increased potential for disturbance. To a large extent, the arrival of ships is concentrated on certain days, resulting in additional cumulative effects from shipping and air traffic associated partly with tourist visits to the peninsula (Sec. 3.3.2).

The risk of the introduction of non-native species will clearly rise due to the increased number, and elevated inner-seasonal fluctuation, of station members, due to increased visitor numbers (which are likely to rise further), and due to other non-guided visitors, such as ships' crews. As there are currently no measures in place for examining or disinfecting air passengers on arrival, the increased risk of introduction as described in Peter et al., 2008) is elevated by these increased visitor numbers. Various species of insect were found in stations also as a result of logistical activities and of the import of food, building materials and the like without any prior checking (Sec. 3.1.4). The occasional discovery of non-native grass species and insects illustrates the current threat, even if local effects on the Fildes Region have been slight until now. The actual extent of the establishment of introduced species is difficult to predict, also in terms of an environment which is altering due to climate change.

4.3 Research

The risk potential posed by scientific activities in the Fildes Region depends to a large extent on the type of research and the way it is carried out, with its effect on the environment varying from minimal to great. As described in Peter et al. (2008), seabirds in particular are under the greatest threat from scientific work and disturbance connected with such work, as emphasised by breeding pair numbers and breeding success for southern giant petrels, as well as by individual changes to behaviour in skuas (Sec. 3.1.1). For southern giant petrels in particular, the interaction of scientific work and other factors, such as disturbance by visitors to the breeding areas, certainly has negative effects. The number of scientific projects in the research area is generally on the rise, and along with this the potential for disturbance and conflict is also increasing. This is accompanied by more logistical movements (see above) which can also have a disruptive effect on flora and fauna. The disintegration of experimental equipment remaining in the field has a minor negative effect on the environment (Sec. 3.4.1).

With the number of research activities growing, it is increasingly urgent that they be coordinated effectively, as disturbance intensities will otherwise continue to rise (Sec. 3.4.1). For breeding birds in particular, this would mean increased expenditure of energy on escape and defence, as well as shortening of resting and feeding phases (Peter et al., 2008). The carrying out of scientific activities in ASPA No. 150 Ardley Island represents a considerable hazard potential in this sensitive area in particular, and this is likely to increase if the trend observed continues. Finally, the risk potential depends greatly on spatial and temporal coordination of the projects, on the behaviour of the individual scientists, as well as on the methods applied in the field. For this reason, SCAR produced a set of behavioural guidelines (SCAR, 2009c, 2011b), which are apparently only partly complied with in the Fildes Region

4.4 Visitors

As already emphasised in Peter et al. (2008), the risk potential posed by visitors depends on their behaviour and on the sensitivity of the areas visited. It increases all the more with the frequency with which remote and/or sensitive areas in the Fildes Region are visited. Although the increase in combined air and ship tourism conjectured in the previous project actually occurred, the risk of disturbance posed by the leisure behaviour of station members and other non-guided visitors is much higher than that posed by tourists as such, who only stay in the area for a short time and then mainly near to stations. Repeated violations of the regulations in the ASPA areas disturb animals, sometimes on a massive scale, as well as damaging vegetation to a limited extent. The repeated to regular collecting of fossils (and minerals), which is still taking place, increases the loss of scientific materials and robs the Fildes Region and in particular the ASPA No. 125 of the values it has to be protected.

4.5 Cumulative effects

As the hazard potential posed by individual activities is elevated in comparison to 2003-2006 (Peter et al., 2008), an increase in the risk based on cumulative effects can also be presumed. These include the different uses of space by the various types of ship as described and influences accumulating as a result, as well as the use of extended fleets of vehicles for the stations, in addition to logistical activities for the purposes of science and leisure. Furthermore, the link between scientific and tourist visits to breeding bird colonies in particular is cause for concern. The link between tourist and logistical activities is also a part of this, including flights carrying both tourists and scientists. On the other hand, there may be positive benefits as resources are then used efficiently.

4.6 Summary of current and future threats

In Tab. 5 the risk potential posed by human activities for the environment, modified according to Peter et al. (2008), is assessed in a summary and are brought up to date. There were sporadic substantial increases in waste entering the environment due to building activities and to clearly inadequate waste management (Sec. 3.2.2), leading to the risk potential being raised from “low to medium” to “medium”. The severe oil contamination of 2009 highlights the potential threat, although actual effects on marine habitats at the site were not investigated. Air traffic was assessed as being “low to high” (Sec. 3.3.1); the increase in traffic and improved conditions or compliance to flight guidelines offset each other here.

There is increasing international awareness of the possibility of non-native organisms being introduced as a result of human activities in the Antarctic. This aspect has therefore been added to Tab. 5, updating Peter et al. (2008). There are an exceptionally large number of people (including travellers in transit) and a multitude of different activities in the Fildes Region. In addition, as far as is known, there are hardly any measures in place to prevent the introduction of non-native organisms. As a result of these factors, the risk potential for non-native species being introduced is now assessed as “high”.

The ban on the use and transportation of heavy fuel oil by ships in the Antarctic (IMO, 2010), which came into force in August 2011, is unlikely to have any marked influence on shipping traffic in Maxwell Bay as it mainly affect large cruise ships with over 500 passengers (*e.g.* IAATO, 2010), which are not allowed to disembark any passengers in the Antarctic (ATS, 2009b) and generally do not enter Maxwell Bay. Specifically exempted from the heavy fuel oil ban are ships taking part in security and SAR operations (IMO, 2010), such as Argentinian and Chilean patrol ships, for example.

Tab. 5: Updated scale of the risk potential of current human activities in the Fildes Region, amended according to Peter et al. (2008) (in bold = amended assessment for 2008-2012).

Human activity	**Threat potential for flora and fauna**	**Time scale of the environmental damage**
Station construction	medium to high	immediate
Waste distribution	**medium**	**immediate/ mid-term**
Discharge of organic substances	medium	mid-term
Introduction of non-native organisms	**high**	**mid-/long-term**
Oil contamination	medium to high	**immediate/ mid-term**
Gaseous emissions	low	long-term
Use of field huts	low to medium	mid-term
Vehicle tracks & road use	medium to high	**immediate/ mid-term**
Air traffic	low to high	immediate
Ship & boat traffic	low to medium	mid-term
Wastewater discharge	low to medium	**immediate/ mid-term**
Visiting animal assemblages	medium to high	immediate
Treading/driving on vegetation	medium to high	**immediate/ mid-term**
Fishing	**low to medium**	**immediate/ mid-term**
Fossil and mineral collection	**medium to high**	**mid-/longterm**
Cumulative effects	medium to high	**immediate/ mid-term**

Because fishing as a leisure pursuit was seen to be more common when compared to the situation in 2006, and was usually linked to disturbance of breeding birds, the risk potential posed by this activity is now assessed as “low to medium”.

The risk potential posed by visits to fossil-rich areas or by collecting fossils, if done repeatedly or using motor vehicles, is considered to be higher than in 2006 (Peter et al., 2008) and is now assessed as “medium to high”. This is because such activities cause a loss of scientific value in the areas affected and can thus cause lasting damage.

The current and future environmental risks were compared to their amended assessments in comparison to the situation in 2006 (Tab. 6; Peter et al., 2008, Tab: 5. 2. -1). The influencing factors “Station operations/Building”, “Visits to natural environments”, “Air traffic” and “Shipping traffic” were assessed in relation to various environmental parameters. In relation to the area influenced, there is a noticeable increase in the environmental risk posed by the “Station operations/Building” factor and the activities associated with it (Sec. 3.2, 3.2.2 & 3.4.2.3). Modernisation work on the stations, which is still continuing to some extent (primarily at the Chinese Great Wall station), gives reason to expect a further increase in the number of station staff during the summer months. This may lead to increased impact on the environment, not only due to logistics but also due to research projects and leisure activities. No substantial change to this trend is foreseeable.

The accumulation of short-term scientific projects, such as those carried out with the support of INACH and associated with Escudero station, causes a considerable fluctuation in station members. Insufficient continuity in projects and of agents can lead to desensitisation with respect to the extremely sensitive ecosystem of the Antarctic and to a loss of quality in the data collected. For this reason we estimate the influence of human activities (of station operations and visits to natural environments) compared to natural variation to be even greater than in 2006 (*cf.* Tab. 6).

What are currently more difficult to estimate, but in the long-term will be crucial, are the speed and intensity of environmental changes due to climate change. The reduction in local sea and shelf ice in the Antarctic Peninsula (Turner et al., 2009), associated with an increase in air and water temperatures, is already leading to changes in primary production and thus a resulting reduction in krill stocks. This in turn, influences the distribution of Adélie penguins in various ways. While populations in the northern Antarctic Peninsula are shrinking, they seem to be remaining stable in the south, or even to be increasing in some areas (*e.g.* Forcada et al., 2006; Lynch et al., 2008; Carlini et al., 2009). It is to be expected that the cumulative effects will be exacerbated further by climate change. Progressive glacier melting on King George Island will, for example, create new, not-yet-colonised areas for both indigenous and non-native organisms.

In general, a significant increase is to be expected in the near future in the negative anthropogenic environmental impact in the Fildes Region, so long as no management geared towards this region is implemented and no appropriate and effective monitoring mechanisms are in place.

What amounts, in summary, to a high risk potential posed by current human activities in the Fildes Region, represents a moderate increase in comparison to previous assessments.

Tab. 6: Updated estimate of the current and future environmental risk (Jezek & Tipton-Everett, 1995), amended according to Peter et al. (2008). In bold = amended assessment for 2008-2012. Increases in environmental risks in the future are shown in red.

Influence factors / ***Parameter***	**Current Environmental Risk**				**Expected Future Environmental Risk**			
	Station operation & construction	*Visiting nature areas*	*Air traffic*	*Ship & boat traffic*	*Station operation & construction*	*Visiting nature areas*	*Air traffic*	*Ship traffic*
Extent of changes (% of resource)	**moderate-significant**	moderate	moderate-significant	low	**moderate-significant**	moderate-significant	moderate-significant	moderate
Affected area	**< 10 %**	20 % frequently, 80 % of the region seldom	25 %	< 10 %	**< 10 %**	more extensive, more frequent	25 %	< 10 %
Duration	operation continuous, construction transitory	transitory	transitory	transitory	operation continuous, construction transitory	longer	transitory	transitory
Activity frequency (Summer)	continuous	daily or weekly depending on area	daily, weekly only in bad weather	**nearly everyday**	continuous	more frequent	more frequent	more frequent
Biotic & abiotic characteristics & processes of the area	threatened	threatened	potentially threatened	potentially threatened	threatened	threatened	threatened	threatened
Influence of the activities	direct and cumulative	direct and cumulative	direct and cumulative	direct and cumulative	direct and cumulative	direct and cumulative	direct and cumulative	direct and cumulative

Continue Tab. 6: Updated estimate of the current and future environmental risk (Jezek & Tipton-Everett, 1995), amended according to Peter et al. (2008). In bold = amended assessment for 2008-2012. Increases in environmental risks in the future are shown in red.

Influence factors	**Current Environmental Risk**				**Expected Future Environmental Risk**			
Parameter	*Station operation & construction*	*Visiting nature areas*	*Air traffic*	*Ship & boat traffic*	*Station operation & construction*	*Visiting nature areas*	*Air traffic*	*Ship traffic*
Temporal and spatial character of human activity influences	predictable, in part intense	unpredictable, intense if near breeding places	predictable on main routes, unpredictable, intense if on new routes	predictable, less intense	predictable, in part intense	more intense	more intense	predictable, less intense
Speed of return to original condition or equilibrium after disruption	slow	quick-slow	quick/slow	slow	slow	quick-slow	quick-slow	slow
Potential of modifying natural processes (climate etc.)	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Population variation (yearly, seasonally)	long & short term change	long & short term change	long & short term change	unknown	long & short term change	long & short term change	long & short term change	?
Natural variation compared to the influence of human activities	**smaller**	**partly smaller**	greater	unknown	**smaller**	smaller	greater	?
System buffering capacity	low	**medium**	strong	unknown	low	less	less	?

5 Conclusions and need for action

The Fildes Region is distinguished by a high biodiversity. At the same time, the peninsula, which covers just 29 km^2, is the location of six stations, which are staffed all year round, various field huts and a landing strip serving as a superregional logistical hub (Sec. 3.3.1 & 3.3.2).

Two of the six stations located in the study area underwent considerable extension during the study period (December 2008 to February 2012; Sec.3.2.1.2). According to Annex I of the EP, appropriate Environmental Impact Assessments (EIA) must be carried out for projects of this kind in the Antarctic. Based on this, an Initial Environmental Evaluation of the effects on the environment (IEE) should then be carried out if only “minor or transitory impacts” on the environment are likely. If the consequences are expected to be more serious, then a Comprehensive Environmental Evaluation (CEE) is to be undertaken. Only IEEs were carried out before extensions to existing infrastructure on the Fildes Peninsula. These evaluations did not take cumulative effects sufficiently into account (ASOC, 2007), even though the building activities proved to be so extensive in some cases that drawing up a CEE would have been appropriate. Furthermore, the actual implementation of the building activities was at variance with some of the measures described in the EIAs, resulting in considerable environmental protection deficiencies (Sec. 3.2.1.2). Those Treaty Parties that implement the measures are first and foremost responsible for this. Similarly, construction projects should always be checked to see whether they are carried out in accordance with the particular EIA in question. Furthermore, in order to create standard, binding rules (ASOC, 2007; Bastmeijer & Roura, 2008), it is desirable to produce a clearer definition of which anticipated effects will require the implementation of an IEE and which will require a CEE.

According to information provided by cruise ship staff, the obvious effects of years of human activity in the area mean that the Fildes Peninsula is overwhelmingly judged as being unattractive for cruise tourism. This is consistent with the fact that the number of cruise ships visiting the Fildes Peninsula remained relatively constant, while the increasing exchange of tourists from cruise ships to air travel has led to a further increase in numbers (Sec. 3.3.2 & 3.4.2). For example, 1,702 cruise ship tourists disembarked in the Fildes Region during the 2009/10 season (source: IAATO, http://image.zenn.net/REPLACE/CLIENT/1000037/1000116/application/vnd.ms-excel/touristsitevisitct_byvessel_pen3.xls, accessed: 02.07.2012). Taking an average length of stay of two hours, this corresponds to 3,404 “tourist-hours” for the season. As up to 84 % only visited the stations (IAATO, 2012b), it can be assumed that traditional cruise tourism has only a comparatively limited influence on the environment in the study area. In contrast, the stations in the study area are inhabited by an average of 316 people during the summer (Sec. 3.2.1.1). Based on the representative survey held among station staff and scientists (Peter et al., 2008, Chapter 4.6.), this results in a value of 35,770 hours for the same period (November 2009 to February 2010). These hours were primarily spent on wildlife observation and on walks in natural environments and along beaches. In absolute terms, station inhabitants therefore not only spend ten times more time in what are sometimes sensitive natural environments (Riddle, 2010), but also move around freely, without being accompanied by experienced guides who, as they do with regular tourists, can ensure that minimum distances, etc., are observed. Particularly problematic here is that, based on empirical evidence, a large proportion of station staff regard the Antarctic environment as being insensitive and not really worth protecting (Peter et al. 2008). Moreover, not all station members, including scientists, receive sufficient training with respect to behavioural guidelines and environmental issues. In addition, station personnel are often able to use station vehicles and boats for excursions, whereby the risk of disturbance is increased if the established road network is not kept to or sensitive nesting sites, seal pupping localities and haul-outs are visited (Sec. 3.1.1, 3.3.3 & 3.4.2.3; Headland, 1994). In such cases, the southern giant petrel is particularly under threat. Displacement of this bird's nesting sites due to repeated anthropogenic disturbance has been recorded (Pfeiffer, 2005; Peter et al., 2008, Sec. 3.1.1). It is only through consistent avoidance of nesting sites and their surroundings that the long-term survival of this sensitive breeding bird can be guaranteed in the Fildes Region (Peter et al., 2008, Chapter 6.2.8.). The designation of the region as an ASMA could significantly contribute to this, as it would involve the introduction of mandatory regulations (management plan), as well as spatial zoning and protected zones, if applicable.

Numerous observations in the study area attest to the fact that legally binding regulations are not observed by station staff and or by some scientists, whether unwittingly or deliberately (Sec. 3.4.2.3 & 3.4.3). A lack of knowledge on the part of station members and visitors about the protected areas and management plans makes it clear that the problem lies in the actual implementation of these regulations. The lack of knowledge of existing guidelines makes them ineffective in practice. In order to guarantee effective protection, it is essential to have comprehensive information prior to and during stays in the Fildes Region, along with a certain degree of monitoring of compliance with rules. Furthermore, awareness of the negative effects of violating regulations for protected areas must be created or reinforced. Appropriate information in the form of a poster in English, Russian, Spanish and Chinese detailing local characteristics of the Fildes Region along with general requirements was prepared as part of the project (see Appendix 2) and made available to the stations. However, it should still be obligatory for instructions to be provided on site to both new arrivals and those returning to the region. Such instructions could then be supplemented and expanded by presentations by scientists. As demonstrated by the study "Aliens in Antarctica Project" (SCAR, 2009a, 2010), there is also a considerable need for action regarding participants in National Antarctic Programmes (Sec. 3.1.4) in order to minimise the introduction of non-native organisms into the Antarctic region.

The coordination of scientific activities in the Fildes Region is currently almost exclusively limited to on-site agreements for preventing the spatial and temporal overlapping of projects (Sec. 3.4.1). Scientists from different fields therefore learn about possible influences on and limitations to their studies more by coincidence than plan. Possible improvements are discussed in Sec. 6.2.1. There are only a few cases of known scientific cooperation in the research area, whereas the stations work together logistically to a certain degree. A positive example to be highlighted is the occasional exchange of vehicles (or assistance in the transport of people of materials), or the meetings held by doctors in the local stations in the 2009/10 season exchanging professional knowledge and coordinating expertise. However, there is further potential for the exchange and mutual use of equipment and vehicles, which could mean that station fleets could be significantly reduced in size. The upkeep and maintenance of vehicles, station buildings and installations should be improved in order to prevent any unnecessary environmental contamination. Although there are noticeable efforts to optimise station operations, the minimum requirements made by the EP are still not being met by all stations. There are substantial differences of waste management, and wastewater treatment in particular (Sec. 3.2.2 & 3.2.4). The cause of what are sometimes considerable shortcomings has less to do with the lack of logistical options for the proper disposal of station waste, including hazardous or toxic substances, and more to do with station members' insufficient awareness or lack of knowledge about the damage and environmental threats consequent on these shortcomings. Furthermore, old waste dumps form a large problem. The waste buried in these is currently reaching the surface on a massive scale through solifluction (Sec. 3.2.2). Initial measures for removing such waste are already being taken. However, in order to clean up the areas in a sustainable way, much more comprehensive measures are required, which then need to be adapted to local conditions. The processing of the mix of various types of waste, stones and soil is both costly and technologically complex, but will be absolutely necessary in the near future. Similar projects have already been implemented at various stations in the Antarctic (*e.g.* Australia, 2011b, 2012a; Sec. 6.2.3). The measures mentioned could serve to improve the current environmental situation in the Fildes Region considerably. Through designating the region an ASMA, efforts could be concerted and measures could be made more efficient so as to achieve improved results for protecting the environment and for making research more efficient.

6 Management

6.1 Developments since the founding of an IWG

On the basis of the expected increase in human activities in the Fildes Region and the corresponding negative influence on the ecosystem, the development and application of effective management for the area is becoming increasingly important in order to minimise further negative environmental impacts.

With the help of an international working group (IWG) founded in 2006 within the CEP, management proposals for the Fildes Region have been discussed by 15 of the Antarctic Treaty Parties who have been associated with the working group since its founding. The basis for the discussion is, in essence, the results of the research project carried out by Peter et al. (2008). In order to reduce the existing conflicts of interest between science, logistics, tourism and the protection of geological and historic values, as well as of nature and the environment, the designation of a "Fildes Peninsula Region" (or as an alternative, "Maxwell Bay") ASMA was proposed (Brazil et al., 2006). The great advantage of this instrument over other variants would be that it would involve a comprehensive approach and have a legally binding character. Following wide-ranging discussions, Chile, Argentina and Uruguay are still to be convinced by this option (Germany & Chile, 2010). Instead they give preference to the use of separate Codes of Conduct for various activities (such as tourism, logistics and scientific research, Germany, 2007; Germany & Chile, 2007), whereby a zoning system based on Harris (1994), as already described by Peter et al. (2008) and proposed to IWG members at the 30th ATCM (Chile & Germany, 2010) is additionally conceivable. Discussions relating to a spatial extension of a proposed Facility Zone for the whole of the Fildes Region ended with a jointly-prepared proposal (Chile & Germany, 2011, see Appendix 4). However, concrete discussions on the designation of an ASMA have not been held amongst IWG members since 2009. We, on the other hand, see an ASMA designation, whether as a "Fildes Peninsula Region" ASMA or as a variant covering a larger area such as a "Maxwell Bay" ASMA, as the only promising option for the arrangement of human activities and environmental protection in a sustainable way and for the compulsory regulation of these (Peter et al., 2008).

6.2 Special management proposals within the scope of a possible ASMA

A summary is given below of particularly important points to be taken into account for a management plan for the Fildes Region based on an ASMA. Further proposals can be found in Peter et al. (2008).

6.2.1 Stations and scientists

In order to ensure that the expected increase in the number of scientific projects in the Fildes Region does not lead to further environmental damage and loss of quality in research work, the linking and coordination of logistical and scientific activities will need to be improved . In order to minimise unnecessary duplications in field work and the disturbance associated with these as much as possible, information regarding planned field work should be exchanged, preferably before the beginning of the season. This was also a matter of concern for the SCAR KGI Action Group, which has since been disbanded (see http://www.scar.org/communications /presidentsnotes/KGI-AG_ToR.pdf, accessed: 02.07.2012), although implementation in practice was not adequately achieved. For this purpose COMNAP prompted the setting up of the "Antarctic Peninsula Advance Scientific Information" (APASI) information platform (Retamales & Rogan-Finnemore, 2009; https://www.comnap.aq/projects, accessed: 02.07.2012, Sec. 3.4.1). Limiting the number of field projects would be sensible and desirable for the Fildes Region. As also called for by the SCAR President, a further intensification of scientific cooperation between the various countries working in this region is certainly to be encouraged, in addition to the exchange of information (Visit of the SCAR President to the Fildes Peninsula: http://www.scar.org/communications/presidentsnotes/mar09.html, accessed: 02.07.2012). At the same time, a more intensive national or international appraisal of projects before approval would be desirable.

The establishment of a "Management Group" or "Coordination Group" is proposed in this respect in order to comprise the managers of the existing stations together with responsible representatives from the National Antarctic Programme of those Treaty Parties that have scientific facilities or staff in the area. Their duties might include the dovetailing, supervision and coordination of logistical and scientific activities, supporting communication between station members and visitors, and the provision of information and training to visitors and staff on the significance of the region and existing local regulations. Another possible task for this group might be to monitor all activities on site in order to determine the extent of cumulative influences. In addition, they might oversee the implementation of, and adherence to, a possible management plan for the region and, if applicable, the processing of proposals for its regular revision (Chile & Germany, 2009; INACH, 2010).

The requirement for effective coordination involves not only scientists, but also station staff working in the region as operators. The necessity for logistical cooperation presupposes regular communication between the stations. However, there are still big language problems as even some station managers or radio operators do not possess sufficient language skills.

The expansion of stations, the increase in the number of people present in the summer, and an increase in the area traversed by vehicles and pedestrians are all closely connected. A general ban on vehicles of any kind departing from the existing road network would, for example, be a first step towards improving the environmental situation. As a further step, measures to minimise the need for diversions from the established road network could bring long-term success and thereby protect sensitive vegetation against destruction. This could be achieved by permanently paving or draining of particularly difficult sections of road (for example, particularly muddy areas between Bellingshausen and Artigas stations).

If visitors, station staff and scientists strictly complied with the existing behavioural guidelines (SCAR, 2009c; ATS, 2011c; SCAR, 2011b), negative effects of human activities on flora and fauna could be considerably reduced.

6.2.2 Drinking water

The protection and monitoring of drinking water quality should take on a more important role than before. It is after all of fundamental importance to the health of the people living on the Fildes Peninsula. Kitezh Lake in the middle of the Fildes Peninsula is a major source of water supply to the Russian and Chilean stations. An acute risk to human health is posed by the oil-contaminated areas and sites with a high concentration of waste in the immediate vicinity of the lakes supplying drinking water supply. Numerous hazardous materials have also been documented in them (Peter et al., 2008, Chapter 4.4.3., Sec. 3.2.2.3 & 3.2.5). There is a risk of harmful substances filtering out into these lakes from contaminated ground at waste dumps and tank farms, as well as of contamination by station sewage (Goldsworthy et al., 2003). In addition, gaseous emissions, which are generated by the burning of waste, power generation, vehicular traffic and air and shipping operations (Gasparon & Burgess, 2000; Gasparon & Matschullat, 2006; Smykla et al., 2005; Osyczka et al., 2007; Lim et al., 2009; Yogui & Sericano, 2008, Sec. 3.2.6), also represent a t hreat to the waterbodies and watercourses in the area.

Due to these risks, the protection of drinking water should be taken into account in any future management plan. One possibility would be to set up a bu ffer zone of, for example, 50 m around the lakes from which drinking water is extracted, as well as around the watercourse between Kitezh Lake and water supply lake fed from it (Fig. 87 – Fig. 89). Within this zone, special guidelines on management and the handling of fuels should be in force. Visiting of these areas by vehicle (frequent oil leakages) or even refuelling, and the transportation or storage of diesel containers should be avoided, along with the dumping or storage of waste of any kind. Special regulations would be required at Lago Uruguay (Fig. 87), where a main road would cut across the buffer zone, and at the lake supplying drinking water within Bellingshausen station (Fig. 88).

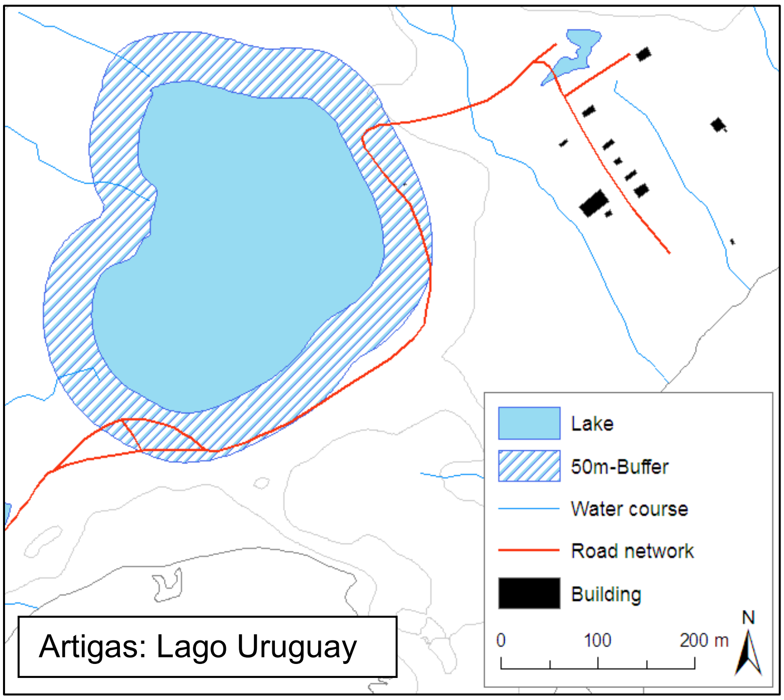


Fig. 71: Detailed representation of the source of drinking water for the Uruguayan station Artigas, incl. a potential 50 m protection zone proposed by us.

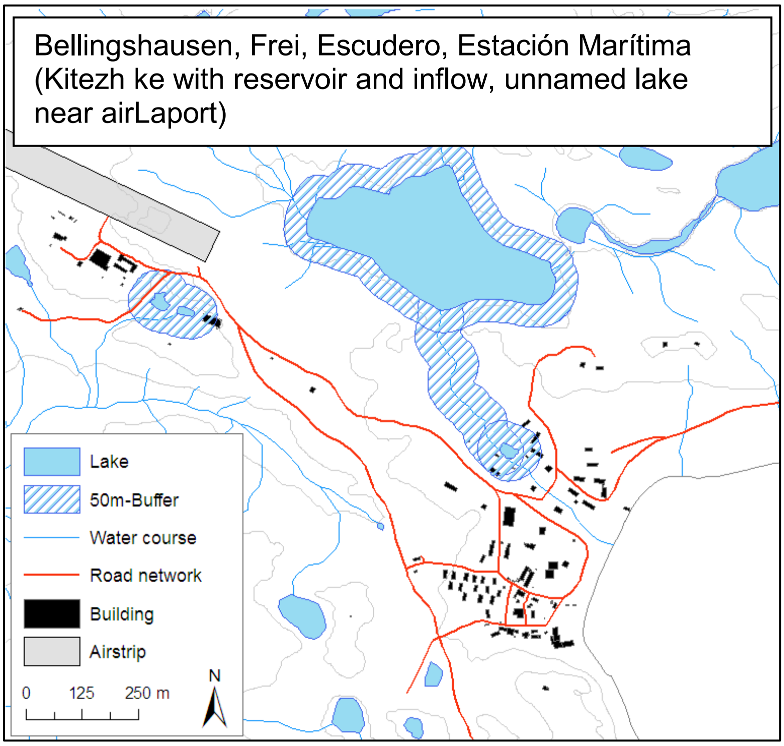


Fig. 88: Detailed representation of the sources of drinking water for the stations Bellingshausen, Frei, Escudero, the Chilean naval base and the airport, incl. a potential 50 m protection zone proposed by us.

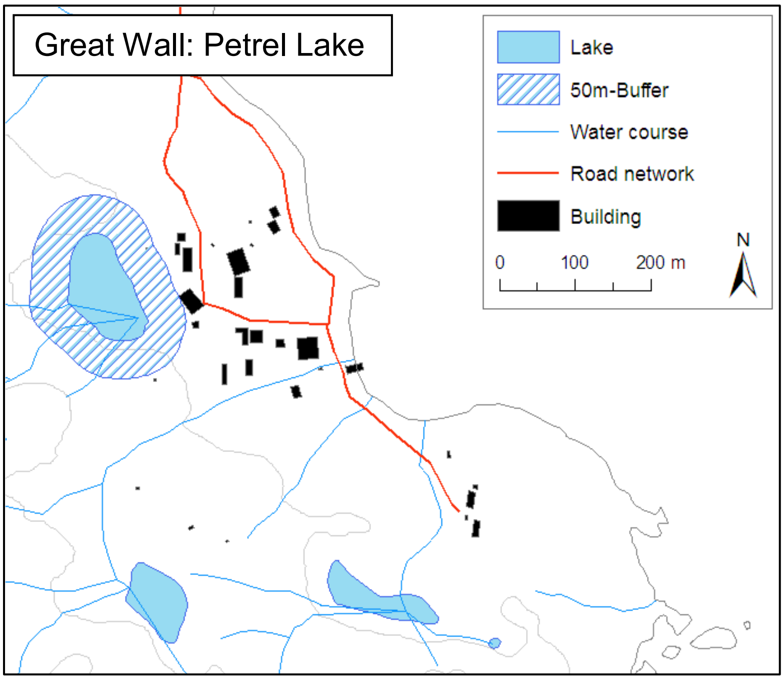


Fig. 89: Detailed representation of the source of drinking water for the Chinese station Great Wall, incl. a potential 50 m protection zone proposed by us

6.2.3 Waste, oil and wastewater management

It is essential to implement a compulsory waste management system which complies with the requirements of the EP more closely than hitherto, and not only in the context of the protection of drinking water. It should be compulsory for the recommendations made by various inspection reports compiled by Antarctic Treaty Parties (*e.g.* United States, 2007) to be incorporated into the waste management policies of the various stations. Deficiencies such as the storage of waste in the open and the release of organic materials (Australia, 2001b), particularly through actively feeding skuas, as well as by allowing installations to remain in place that are no longer used or that are falling into disrepair, should be remedied immediately in order to minimise any further release of waste into the environment (Sec. 3.2.2). The removal of waste coming to light at old waste dumps should be made compulsory. As some such sites are to be found in protected areas (ASPA No. 150, ASPA No. 125), environmentally friendly measures need to be developed for these sites in particular.

The oil spills already described (Sec. 3.2.5), along with other anticipated threats posed by increasing anthropogenic activities in the Fildes Region and the coming to light of old waste storage sites, make it clear that the development and application of measures for preventing or disposing of materials contaminated with oil or hazardous substances is essential (Australia, 2012b, c). As has already happened in other areas of the Antarctic (*cf.* Australia, 2004, 2006, 2012a), large quantities of soil material should be removed and leaking meltwater should be collected and purified as they are polluted with heavy metals (from batteries, for example) and oil residues. Moreover, such measures should be accompanied by an environmental risk assessment and a comprehensive long-term monitoring of the ecosystem (COMNAP, 2006b, 2007b; Australia, 2011a, 2012d; Australia & Kingdom, 2012) in order to document the effects of the measures and to minimise the threat to the environment, as for instance described by Stark et al. (2006) or Australia (2004, 2006, 2011b, 2012a). The introduction of comprehensive and universally applicable guidelines for cleaning up contaminated areas in the Antarctic is currently under discussion (Australia, 2012b).

More comprehensive implementation of the COMNAP Best-Practice Recommendations for energy management in the stations could lead to a reduction in fuel needs and thus to a reduced risk of oil spills (COMNAP, 2007a).

Even though there are improvements at all stations with respect to wastewater treatment, due to the high risk of additional nutrients and harmful substances being released and to the introduction of foreign microorganisms into the environment through station wastewater, comprehensive and continuous wastewater monitoring is essential in order to guarantee the effectiveness of the existing installations for wastewater purification (Chile, 2012c). A positive development to highlight in this context is the establishment of an Antarctic environmental monitoring centre in Chile (Chile, 2012a), which aims to make environmental data available (e.g. on contamination at wastewater discharge points) and to help improve the training of station staff.

6.2.4 Introduction of non-native species

Due to climate change and to the expected escalation of anthropogenic activities, the potential for non-native species becoming established in the Fildes Region will increase further. Future management must therefore provide regulations and control mechanisms for effectively impeding the introduction of non-native species. Regular on-site monitoring is required in order to regulate inventorying the species already present and preventingtheir proliferation, along with any necessary measures. Guidelines for conduct in the case of discovery of an introduced species have already been published (United Kingdom, 2010). The Antarctic Treaty Parties have recently prepared a comprehensive non-native species manual (ATS, 2011e). In addition, SCAR provided comprehensive instructions on how to prevent the introduction of non-native species through food imports (SCAR, 2011a). Both sets of guidelines should be applied in the Fildes Region as soon as possible. However, first of all greater significance needs to be placed on explaining the risk potential posed by non-native species when scientists and particularly station personnel are informed about regulations and codes of conduct in the Antarctic. Many station members seem not to be aware of the risk potential (Sec. 3.1.3 & 3.1.4).

6.2.5 Tourism

Tourist visits to the Fildes Region continue to be limited largely to station visits, excursions to stretches of beach along the Drake Coast where there are many seals, or outings to the visitor zone of Ardley Island (Sec. 3.4.2). Universally binding Visitor Site Guidelines for the visitor zone of Ardley Island outside the ASPA No. 150 are already in force (ATS, 2011d; Chile & Argentina, 2011). Further increases in air-cruise passenger exchanges mean that more frequent visits in and around the stations cannot be excluded. This is an aspect that will most certainly need to be taken into account in any future management plan. The visitor zones already proposed in 2009 (*cf.* Chile & Germany, 2009 and Peter et al., 2008) are located in the areas of interest to tourists. They are currently frequented by tourists and only minor disturbance effects are to be expected from visitors. These zones should be included in a draft plan for visitor management. Guidelines for maximum visitor numbers to individual areas in order to prevent cumulative effects are an option.

In order that areas of scientific interest, such as the two ASPAs (No. 150 and No. 125) and the breeding sites of birds and botanically valuable areas, are not damaged by visitors, the designation of zones with restricted access (“restricted zones” or “sensitive zones”, Peter et al., 2008, Chapter 6.2.8.) within any “Fildes Peninsula Region” ASMA is recommended.

Signs in stations would be desirable, clearly providing general information about the stations, the sensitive environment and all relevant guidelines. Appendix 2 contains a design for an informative poster which is already available in English, Russian, Spanish and Chinese. Furthermore, signposts and path markers, such as those already used for the upgrading of the road from Bellingshausen to the church, should support visitor management. In this context it is highly recommended that a sign be located at the Ardley Isthmus to inform people in the locally spoken languages about the island’s protected status and the regulations on entering it.

6.2.6 Monitoring

The EP demands regular logging of the impact of station operations and science on the environment through the respective National Antarctic Programmes (Art. 3, EP). This requirement is either not fulfilled or fulfilled only partially by the majority of National Antarctic Programmes. Regular, standardised logging of anthropogenic activities and the analysis of a range of easily measured biological and chemical, terrestrial and marine parameters, such as population numbers and breeding success figures for seabirds using the most non-invasive of measures, would be required for quantifying human impacts and estimating their short-term and long-term effects on the environment (Sec. 7). Annual waste monitoring carried out by station personnel from the Uruguayan Artigas station, for example, provides methodological approaches for this (Sec. 3.2.2.5).

Only through long-term surveys can changes in the environment be perceived and appropriate measures developed. International cooperation and coordination of logging is desirable so that monitoring is as efficient, comprehensive and comparable as possible, with results being published at regular intervals (Hughes, 2010). Monitoring should ultimately also provide sufficient base data for making decisions about successful area management (*cf.* ATS, 2005b; COMNAP, 2006a).

7 Unanswered questions and research needs

Most points made with respect to unanswered questions and existing research needs in the conclusion of the previous project (2003/04 to 2005/06) (*cf*. Peter et al., 2008) are also relevant at the conclusion of this project (2008/09 to 2011/12). Mention should be made, in particular, of the following issues.

Significant current environmental changes in the territory should be registered each summer as the international process for coordinating measures for protecting the Fildes Region will extend over several years. Data collection for the present project ended at the end of February 2012.

The long-term monitoring programme serving to assess changes in population numbers and reproduction rates for Antarctic birds caused by both anthropogenic and natural factors is one of the longest-running programmes in the Antarctic (Peter et al., 1988; Woehler et al., 2001). Its value is increasing with time, not only in connection with the impact of stations and tourists, but also in connection with extreme climate change in the region. Groups that should particularly be monitored are penguins and southern giant petrels, the former in cooperation with South Korean colleagues.

Monitoring the performance of ongoing or future measures every three to five years is necessary and s hould include comprehensive biological monitoring (numbers of bird breeding pairs, seal haul-outs and pupping sites, and range expansion in plants) as well as the logging of changes with respect to traffic, waste, tourism, etc.

There is a need for special research in other fields which could not be covered in recent, such as:

- Monitoring of shifts in seal haul-outs (also in areas outside the Fildes Region) compared with natural variations in their numbers
- Studies of colonisation by flora and fauna in areas made available by glacier melting
- Lichens as bioindicators for mechanical and chemical pollution (including heavy metal concentrations, *cf.* Poblet et al., 1997; Smykla et al., 2005; Lim et al., 2009)
- South polar skuas as indicators for the radioactive pollution of the north-west Pacific around Japan (these birds overwinter in this region and breed on King George Island (Kopp et al., 2011)
- Investigations into the causes of population decline in certain animal species, such as Adélie and chinstrap penguins

8 Summary

The Fildes Region, comprising the Fildes Peninsula, Ardley Island and smaller islands off the coast, is distinguished by a comparatively high biodiversity. On the peninsula, which covers just 29 km^2, there are six stations which are occupied all year round, several field huts and an airfield which serves as a superregional hub. The high density of stations and the varied human activities in the region often clash with the environmental standards in the Antarctic laid down in the EP by law. The present report documents the current terrestrial environmental situation as recorded over three field seasons (December to March) between 2008 and 2012 and outlines changes in relation to the studies in the period 2003 to 2006 (Peter et al., 2008). As such it offers up-to-date scientific base data for the ongoing discussion regarding the management measures required.

Recording numbers of breeding pairs and the breeding success for gentoo, Adélie and chinstrap penguins, and the southern giant petrel are focal points for the studies. The current figures for breeding pairs on Ardley Island with respect to nesting penguins confirm the trend in population development for this colony observed over many years: a decline in Adélie and chinstrap penguins, while the number of gentoo penguins is increasing. There are strong fluctuations in the numbers of breeding pairs in the local population of southern giant petrels in some sub-colonies, as well as an alarming decline in breeding success, which can presumably be ascribed to anthropogenic disturbance. Breeding pair figures and the distribution of other species of breeding birds were also documented. In the 2008/09 season, in a largely undisturbed part of the study area, the first record was made of a light-mantled sooty albatross as a breeding bird south of 60°. Of the 13 bird species breeding in the Fildes Region, nearly all are at slight to acute risk due to anthropogenic influences (destruction of breeding habitats, anthropogenic disturbance, and feeding by station members). In addition, five species of seal frequent the Fildes Peninsula for the purposes of reproduction. An increase in the area of Antarctic fur seal pupping places has been recorded over the last 25 years. Since the first population count 27 years ago, a clear increase in Antarctic hair grass has been recorded. Its distribution is declining only at a few sites close to stations and in habitats disturbed by building work.

Walking on and driving over lichen and moss caused light to medium damage. However, extensive destruction is primarily caused by building activities (including extraction of materials). Several introduced non-native species were found to have infiltrated the research area, including grasses and insects.

The management plans for both protected areas in the Fildes Region, ASPA No. 125 Fildes Peninsula and ASPA No. 150 Ardley Island, were undergoing revision during the study period. ASPA No. 125 was divided up into what are now eight separate sections, while the visitor zone on the north-eastern beach of Ardley Island was excluded from the ASPA No. 150 protected area. Numerous infringements of the management plan rules for each of the two ASPAs were recorded during the study period.

The ongoing building activities within the existing stations and surrounding them caused the greatest impact in the research area. Since the 2005/06 season, five of the six stations have been extended, in some cases substantially. This meant that the average number of people increased by 26 % to 316 in the summer, and by 33 % to 126 people in the winter. All stations are now equipped with installations for wastewater treatment. However, in at least two stations these are clearly not adequate for satisfying the minimum requirements of the

EP. There continue to be clear shortcomings in respect of waste management in some stations in the form of waste storage and incineration in the open. This violates existing regulations (EP) and causes continuous pollution of the environment by harmful substances. The active feeding of skuas and gulls is still common in all of the stations. Furthermore, it was proven that the Fildes Region is directly influenced to a minor degree by a lack of waste management or inadequate waste management on the part of ships, yachts and nearby stations. In addition to 42 waste dumps already known, a further four old dumps were recorded. Due to progressive cryoturbation, these are becoming increasingly visible and are exhibiting clear contamination with oil and other hazardous materials. Efforts to clean these up are not in evidence or are very limited in scope.

At least one large oil spill during the study period led to the polluting of soil on the Fildes Peninsula and adjacent marine habitats with several thousand litres of fuel. The measures taken to contain these were neither adequate nor in line with existing recommendations.

Improvements in terms of oil spill prevention are represented by the exchange of old, badly corroded tanks for new, double-walled fuel tanks in the Great Wall and Artigas stations, as well as the installation of a permanent fuel line at Great Wall Station.

Records of air and shipping traffic showed that, following a sharp rise from 2003 to 2006, both activities remained at the same high level. The installation of a landing support system now allows flight operations under poor visibility. Compared to 2003/04-2005/06, researchers recorded significantly fewer violations of the overflight regulations contained in the management plan for ASPA No. 150 Ardley Island. The observed increase in shipping traffic is primarily based on the more frequent arrival of supply, research and patrol ships. Conspicuously often, there was more than one ship in inner Maxwell Bay and these were additionally accompanied by intensive aeroplane, helicopter and zodiac traffic. On the other hand, the proportion of cruise ships arriving in the Fildes Region did not rise; only the exchange of passengers through the Air/Cruise programme, as well as one- and two-day tours provided by a private Chilean tourism company increased. To be regarded critically is the large number of delegations as well as passengers travelling on supply, research or patrol ships. These people are not guided while on shore or informed about codes of conduct and local conditions. With respect to shipping traffic in Maxwell Bay, a similarly high level or a further increase is to be expected as the role of the Fildes Peninsula as a logistical centre for the region will probably increase with various building projects planned.

With the exception of one station, the vehicle fleet of all of the stations had grown considerably in comparison to 2006. A strong increase was noted in the use of off-road, four-wheeled motorcycles (quad bikes) by station personnel on leisure excursions and scientists in particular, notably also beyond the existing road network, which often causes disturbance in breeding areas and damage to vegetation. Numerous new tracks were registered even in the ASPA No. 150 Ardley Island and ASPA No. 125 Fildes Peninsula protected areas. Construction vehicles also left clear damage to vegetation when sourcing building materials. In general, it can be observed that station personnel and, to some extent, scientists lack information and awareness of the sensitive Antarctic flora and fauna.

Based on the negative development of the environmental situation in the Fildes Region observed over the study period, immediate implementation appears to be urgently required of measures for reducing the current shortcomings and environmental problems, along with accompanying monitoring. The designation of the region as an Antarctic Specially Managed

Area would offer the most suitable framework for improving coordination of activities, the creation of generally compulsory regulations and the use of measures for guaranteeing scientific research and protection of the environment.

9 Literature

Ainley, D., Russell, J., et al. (2010): Antarctic penguin response to habitat change as Earth's troposphere reaches 2 degrees C above preindustrial levels. Ecological Monographs 80, 49-66.

Aislabie, J.M., Balks, M.R., et al. (2004): Hydrocarbon spills on Antarctic soils: Effects and management. Environmental Science & Technology 38, 1265-1274.

Algers, B., Ekesbo, J., et al. (1978): The impact of continous noise on animal health. Acta Veterinaria Scandinavica 67, 1-26.

ASOC (2007): Implementing the Madrid Protocol: A case study of Fildes Peninsula, King George Island. IP136. ATCM XXX. New Delhi.

ATS (1961): Exchange and availability of scientific data. Recommendation I-3. ATCM I. Canberra.

ATS (1989): Promotion of international scientific cooperation: A declaration. Recommendation XV-14. ATCM XV. Paris.

ATS (1991): Site of Special Scientific Interest (SSSI) No. 33 Ardley Island, Maxwell Bay, King George Island. Recommendation XVI-2. ATCM XVI. Bonn.

ATS (2001a): Extension of expiry dates for SSSI 4 (Cape Crozier), 5 (Fildes Peninsula), 6 (Byers Peninsula), 7 (Haswell Island), 18 (Northwest White Island), 33 (Ardley Island), 35 (Bransfield Strait) and 36 (Dallmann Bay). Measure 3. ATCM XXIV. St. Petersburg.

ATS (2001b): Guidelines for handling of pre-1958 historic remains whose existence or present location is not known. Resolution 5. ATCM XXIV. Saint Petersburg.

ATS (2004): Guidelines for the operation of aircraft near concentrations of birds. Resolution 2. ATCM XXVII. Cape Town.

ATS (2005a): Extension of Expiry Dates for the Management Plan for ASPA 125 (Fildes Peninsula), 127 (Haswell Island), 144 (Chile Bay), 146 (South Bay), 150 (Ardley Island). Measure 4. ATCM XXVIII. Stockholm.

ATS (2005b): Guidelines for Environmental Monitoring. Resolution 2. ATCM XXVIII. Stockholm.

ATS (2008): Annual list of Initial Environmental Evaluations (IEE) and Comprehensive Environmental Evaluations (CEE) prepared between April 1st 2007 and March 31st 2008. SP006. ATCM XXXI. Kiyv.

ATS (2009a): Guidelines for the designation and protection of Historic Sites and Monuments Resolution 3. ATCM XXXII. Baltimore.

ATS (2009b): Landing of Persons from Passenger vessels in the Antarctic Treaty area. Measure 15. ATCM XXXII. Baltimore.

ATS (2009c): Protection of the southern giant petrel. Measure 15. ATCM XXXII. Baltimore.

ATS (2009d): Revised Management Plan for Antarctic Specially Protected Area No. 125 Fildes Peninsula, King George Island (25 de Mayo). Measure 6. ATCM XXXII. Baltimore.

ATS (2009e): Revised Management Plan for Antarctic Specially Protected Area No. 150 Ardley Island, Maxwell Bay, King George Island (25 de Mayo). Measure 9. ATCM XXXII. Baltimore.

ATS (2011a): Antarctic Historic Sites and Monuments: Monument to the Antarctic Treaty and Plaque. Measure 11. ATCM XXXIV. Buenos Aires.

ATS (2011b): Antarctic Historic Sites and Monuments: No 1 Building at Great Wall Station. Measure 12. ATCM XXXIV. Buenos Aires.

ATS (2011c): Guidelines for visitors to the Antarctic. Resolution 3. ATCM XXXIV. Buenos Aires.

ATS (2011d): List of Sites subject to Site Guidelines. Resolution 4. ATCM XXXIV. Buenos Aires.

ATS (2011e): Non-native Species Manual. Resolution 6. ATCM XXXIV. Buenos Aires.

ATS (2012): Annual list of Initial Environmental Evaluations (IEE) and Comprehensive Environmental Evaluations (CEE) prepared between April 1st 2011 and March 31st 2012. SP006. ATCM XXXV. Hobart.

Australia (2001a): Report on the open-ended Intersessional Contact Group on Diseases of Antarctic Wildlife, Report 1 - Review and Risk Assessment. WP010. ATCM XXIV. Sankt Petersburg.

Australia (2001b): Report on the open-ended Intersessional Contact Group on Diseases of Antarctic Wildlife, Report 2 - Practical Measures to diminish risk (draft). WP011. ATCM XXIV. Sankt Petersburg.

Australia (2004): Thala Valley clean-up. IP054. ATCM XXVII. Cape Town.

Australia (2006): Monitoring the remediation of the Thala Valley waste disposal site at Casey station. IP077. ATCM XXIX. Edinburgh.

Australia (2011a): Environmental issues related to the practicality of repair or remediation of environmental damage. WP028. ATCM XXXIV. Buenos Aires.

Australia (2011b): Thala Valley Waste Removal. IP048. ATCM XXXIV. Buenos Aires.

Australia (2012a): Assessment, monitoring and remediation of old Antarctic waste disposal sites: the Thala Valley example at Casey station. BP014. ATCM XXXV. Hobart.

Australia (2012b): Clean-up techniques for Antarctica. BP011. ATCM XXXV. Hobart.

Australia (2012c): Development of environmental quality standards for the management of contaminated sites in Antarctica. BP013. ATCM XXXV. Hobart.

Australia (2012d): Environmental issues related to the practicality of repair or remediation of environmental damage. WP026. ATCM XXXV. Hobart.

Australia & Kingdom, U. (2012): An Antarctic Clean-Up Manual. WP021. ATCM XXXV. Hobart.

Australia, Peru, et al. (2005): Report of Joint Inspections under Article VII of the Antarctic Treaty and Article 14 of the Environmental Protocol. WP032. ATCM XXVIII. Stockholm.

Bannasch, R. & Odening, K. (1981): Zoologische Untersuchungen im Gebiet der sowjetischen Antarktisstation "Bellingshausen" [Zoological investigations in the area of the soviet Antarctic base "Bellingshausen"]. Geod. Geoph. Veröff. R. I 8, 3-20.

Barbosa, A., Benzal, J., et al. (2012): Population decline of chinstrap penguins (Pygoscelis antarctica) on Deception Island, South Shetlands, Antarctica. Polar Biology Online first,

Bargagli, R. (2005): Antarctic ecosystems: environmental contamination, climate change, and human impact. Berlin. Springer.

Bargagli, R. (2008): Environmental contamination in Antarctic ecosystems. Science of the Total Environment 400, 212-226.

Barnes, D.K.A. & Convey, P. (2005): Odyssey of stow-away noctuid moths to southern polar islands. Antarctic Science 17, 307-311.

Barsch, D., Blümel, W.-D., et al. (1985): Untersuchungen zum Periglazial auf der König-Georg-Insel Südshetlandinseln/Antarctica. Berichte zur Polarforschung 24, 75.

Bastmeijer, K. & Roura, R. (2008): Environmental Impact Assessment in Antarctica. In: K.K. Bastmeijer, T. (eds.). Theory and Practice of Transboundary Environmental Impact Assessment Brill/Martinus Nijhoff, Leiden, Boston, 175-219.

Berkman, P.A., Andrews, J.T., et al. (1998): Circum-Antarctic coastal environmental shifts during the Late Quaternary reflected by emerged marine deposits. Antarctic Science 10, 345-362.

Blackmer, A.L., Ackerman, J.T., et al. (2004): Effects of investigator disturbance on hatching success and nest-site fidelity in a long-lived seabird, Leach's storm-petrel. Biological Conservation 116, 141-148.

Bonnedahl, J., Broman, T., et al. (2005): In Search of Human-associated Bacterial Pathogens in Antarctic Wildlife: Report from Six Penguin Colonies Regularly Visited by Tourists. Ambio 34, 430-432.

Braun, C., Hertel, F., et al. (accepted): Environmental Situation and Management Challenges for the Fildes Peninsula Region. In: T. Tin, D. Liggett, P. Maher, M.E. Lamers. The Future of Antarctica: Human impacts, strategic planning, and values for conservation Springer

Braun, C. & Lüdecke, C. (2012): Fildes Peninsula – A Place of Threatened Historic Sites. Presented at: IPHC Hobart Conference. C. Braun,C. Lüdecke, International Antarctic Heritage Committee: http://www.polarheritage.com/content/library/Cornelia_Luedecke_Brau_IPHC_2012.pdf.

Braun, C., Mustafa, O., et al. (2012): Environmental Monitoring and Management Proposals for the Fildes Region (King George Island, Antarctica). Polar Research 31,

Brazil (2012): Brazilian Yacht Accident. IP064. ATCM XXXV. Hobart.

Brazil, China, et al. (2006): Possibilities for environmental management of Fildes Peninsula and Ardley Island. Proposal to establish an intersessional contact group.

Bricher, P.K., Lucieer, A., et al. (2008): Population trends of Adelie penguin (Pygoscelis adeliae) breeding colonies: a spatial analysis of the effects of snow accumulation and human activities. Polar Biology 31, 1397-1407.

Briggs, K.T., Gershwin, M.E., et al. (1997): Consequences of petrochemical ingestion and stress on the immune system of seabirds. ICES Journal of Marine Science 54, 718-725.

Briggs, K.T., Yoshida, S.H., et al. (1996): The influence of petrochemicals and stress on the immune system of seabirds. Regulatory Toxicology and Pharmacology 23,

Carlini, A.R., Coria, N.R., et al. (2009): Responses of *Pygoscelis adeliae* and *P. papua* populations to environmental changes at Isla 25 de Mayo (King George Island). Polar Biology 32, 1427-1433.

CEP (2010): List of Historic Sites and Monuments approved by the ATCM

Chile (2002a): Muelle soporte bomba aducción agua potable Base Antártica Prof. Julio Escudero. IP19. RAPAL XIII. Buenos Aires, Argentina.

Chile (2002b): Reemplazo planta tratamiento aguas servidas en Base Escudero. IP42. RAPAL XIII. Buenos Aires, Argentina.

Chile (2007a): Historic Sites of the Northern Coast of Fildes Peninsula, King George Island (South Shetland Group). IP127. ATCM XXX. New Delhi.

Chile (2007b): Management and further protection within ASPA 125: Current situation IP115. ATCM XXX. New Delhi.

Chile (2007c): Monument to the Antarctic Treaty. WP041. ATCM XXX. New Delhi.

Chile (2008): Seguridad y control aeronáutico, en las operaciones aéreas hacia Base Presidente Frei, en la Isla Rey Jorge. IP20. RAPAL XVII. Buenos Aires, Argentina.

Chile (2009a): The effect of marathons held on the Antarctic continent. WP054. ATCM XXXII. Baltimore.

Chile (2009b): Mitigación Medioambiental en Bases Aéreas Antárticas de la Fuerza Aérea de Chile y costos asociados. IP15. RAPAL XX. Montevideo, Uruguay.

Chile (2009c): Operaciones aéreas en el Aérodromo Teniente Marsh. Alcance y connotación para apoyo al resto de las bases antárticas. IP14. RAPAL XX. Montevideo, Uruguay.

Chile (2011): Proposal of Modification for the Historic Monument No. 82. Installation of Commemorative Plaques at the Monument to the Antarctic Treaty. W059. ATCM XXXIV. Buenos Aires.

Chile (2012a): Antarctic Environmental Monitoring Centre. IP076. ATCM XXXV. Hobart.

Chile (2012b): Maritime support tasks performed by Chile in the Antarctic area during season 2011/2012. IP077. ATCM XXXV. Hobart.

Chile (2012c): New records of the Presence of Human Associated Microorganisms in the Antarctic Marine Environment. WP055. ATCM XXXV. Hobart.

Chile (2012d): Retiro de chatarra desde la base Presidente Eduardo Frei Montalva, isla Rey Jorge. BP038. ATCM XXXV. Hobart.

Chile & Argentina (2011): Guidelines for the north-east beach of the Ardley Peninsula (Ardley Island), King George Island / Isla 25 de Mayo, South Shetland Islands. WP049. ATCM XXXIV. Buenos Aires.

Chile & Germany (2009): Second Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island. WP 04. ATCM XXXII. Baltimore.

Chile & Germany (2010): Third Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island. WP040. ATCM XXXIII. Punta del Este.

China (2008): Annual Report of China Pursuant to Article 17 of the Protocol on Environmental Protection to the Antarctic Treaty. IP068. ATCM XXXI. Kyiv.

China (2011): Proposed addition of No.1 Building Commemorating China’s Antarctic Expedition at Great Wall Station to the List of Historic Sites and Monument. WP005. ATCM XXXIV. Buenos Aires.

Chown, S.L., Huiskes, A.H.L., et al. (2012): Continent-wide risk assessment for the establishment of nonindigenous species in Antarctica. PNAS 109, 4938-4943.

Chwedorzewska, K.J. & Korczak, M. (2010): Human impact upon the environment in the vicinity of Arctowski Station, King George Island, Antarctica. Polish Polar Research 31, 45-60.

COMNAP (2006a): Practical Biological Indicators of Human Impacts in Antarctica. IP088. ATCM XXIX. Edinburgh.

COMNAP (2006b): Waste management in Antarctica. Proceedings of the 2006 workshop held by the COMNAP Environmental Officers Network (AEON). Hobart

COMNAP (2007a): Best Practice for Energy Management – Guidance and Recommendations. WP035. ATCM XXX. New Delhi.

COMNAP (2007b): COMNAP's 2006 Workshop on Waste Management in Antarctica. IP098. ATCM XXX. New Delhi.

COMNAP (2008a): COMNAP Fuel Manual: https://www.comnap.aq/Publications/Comnap%20Publications/fuel-manual-v1.pdf.

COMNAP (2008b): Search and Rescue in the Antarctic. IP099. ATCM XXXI. Kyiv.

Culik, B., Adelung, D., et al. (1990): The effect of disturbance on the heart rate and behaviour of Adélie Penguins *(Pygoscelis adeliae)* during the breeding season. In: K.R. Kerry, G. Hempel. Antarctic Ecosystems. Ecological Change and Conservation Springer Verlag, Berlin, 177-182.

Culik, B.M., Wilson, R.P., et al. (1991): Oil pollution of Antarctic penguins: Effects on energy metabolism and physiology. Marine Pollution Bulletin 22, 388-391.

de Leeuw, C. (1994): Tourism in Antarctica and its impact on vegetation. Arctic Centre, University of Groningen.

Ducklow, H.W., Baker, K., et al. (2007): Marine pelagic ecosystems: The West Antarctic Peninsula. Philosophical Transactions of the Royal Society B-Biological Sciences 362, 67-94.

Eppley, Z.A. & Rubega, M.A. (1990): Indirect Effects of an Oil-Spill - Reproductive Failure in a Population of South Polar Skuas Following the Bahia Paraiso Oil-Spill in Antarctica. Marine Ecology-Progress Series 67, 1-6.

Favero, M., Silva, M.P., et al. (2001): Preliminar data on seabird by-catch along the Patagonian shelf by argentine longline fishing vessels: period 1999–2001. Proceedings of the First South American Workshop for Conservation of Albatrosses and Petrels.

Fiala, M. & Delille, D. (1999): Annual changes of microalgae biomass in Antarctic sea ice contaminated by crude oil and diesel fuel. Polar Biology 21, 391-396.

Flügel, W.-A. (1985): Hydrological and hydrochemical investigations of arctic and antarctic drainage basins underlaying by continuous permafrost. Beiträge zur Hydrologie. Sonderheft 5.1, 111-126.

Flügel, W.-A. (1990): Water Balance and Discharge Simulation of an Oceanic Antarctic Catchment on King George Island, Antarctic Peninsula. Beiträge zur Hydrologie 11, 29-52.

Forcada, J., Trathan, P.N., et al. (2006): Contrasting population changes in sympatric penguin species in association with climate warming. Global Change Biology 12, 411-423.

Fowbert, J.A. & Smith, R.I.L. (1994): Rapid increase in native vascular plants in the Argentine Islands, Antarctic Peninsula. Arctic and Alpine Research 26, 290-296.

Fowler, G.S. (1999): Behavioural and hormonal responses of Magellanic penguins *(Spheniscus magellanicus)* to tourism and nest site visitation. Biological Conservation 90, 143-149.

Fraser, W.R. & Trivelpiece, W.Z. (1996): Factors controlling the distribution of seabirds: winter-summer heterogeneity in the distribution of Adélie Penguin populations. In: R.M. Ross, E.E. Hofmann,L.B. Quetin. Antarctic Research Series. Foundations for Ecological Research West of the Antarctic Peninsula, 257-272.

Frenot, Y., Chown, S.L., et al. (2005): Biological invasions in the Antarctic: extent, impacts and implications. Biological Reviews 80, 45-72.

Gardner, H., Kerry, K., et al. (1997): Poultry virus infection in Antarctic penguins. Nature 387, 245.

Gasparon, M. & Burgess, J.S. (2000): Human impacts in Antarctica trace-element geochemistry of freshwater lakes in the Larsemann Hills, East Antarctica. Environmental Geology 39, 963-976.

Gasparon, M. & Matschullat, J. (2006): Trace metals in Antarctic ecosystems: Results from the Larsemann Hills, East Antarctica. Applied Geochemistry 21, 1593-1612.

Gebauer, A., Peter, H.-U., et al. (1987): Floristisch-ökologische Untersuchungen in der Antarktis - dargestellt am Beispiel der Verbreitung von *Deschampsia antarctica* DESV. im Bereich von Fildes Peninsula / King George Island (South Shetland Islands). Wissenschaftliche Zeitschrift Universität Jena Naturwissenschaftliche Reihe 36, 505-515.

Gerighausen, U., Bräutigam, K., et al. (2003): Expansion of Antarctic vascular plants on an Antarctic island - a consequence of climate change? In: A.H.L. Huiskes, W.W.C. Gieskes, J. Rozemaet al. Antarctic Biology in a Global Context Backhuys Publishers, Leiden, 79-83.

Germany (2007): Possible Modules of a 'Fildes Peninsula Region' ASMA Management Plan.

Germany (2010a): Research Project “The role of human activities in the introduction of non-native species into Antarctica and in the distribution of organisms within the Antarctic”. IP014. ATCM XXXIII. Punta del Este.

Germany (2010b): Revised Possible Modules of a Management Plan for Antarctic Specially Managed Area No. ***, Fildes Peninsula Region, South Shetland Islands. WP040 Annex II. ATCM XXXIII. Punta del Este.

Germany (2011): Progress Report on the Research Project “The role of human activities in the introduction of non-native species into Antarctica and in the distribution of organisms within the Antarctic”. IP026. ATCM XXXIV. Buenos Aires.

Germany & Chile (2007): Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island.

Germany & Chile (2010): Third Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island.

Giese, M. (1996): Effects of human activity on Adelie penguin *Pygoscelis adeliae* breeding success. Biological Conservation 75, 157-164.

Goldsworthy, P.M., Canning, E.A., et al. (2003): Soil and water contamination in the Larsemann Hills, East Antarctica. Polar Record 39, 319-337.

González-Solís, J., Croxall, J.P., et al. (2000): Foraging partitioning between giant petrels *Macronectes* spp. and its relationship with breeding population changes at Bird Island, South Georgia. Marine Ecology Progress Series 204, 279-288.

Gröndahl, F., Sidenmark, J., et al. (2009): Survey of waste water disposal practices at Antarctic research stations. Polar Research 28, 298-306.

Hahn, S., Reinhardt, K., et al. (2007): Oceanographic and climatic factors differentially affect reproduction performance of Antarctic skuas. Marine Ecology-Progress Series 334, 287-297.

Harris, C.M. (1994): Standardisation of zones within specially protected and managed areas under the Antarctic Environmental Protocol. Polar Record 30, 283-86.

Harris, C.M. (1998): Science and environmental management in the Mcmurdo Dry Valleys, Southern Victoria Land, Antarctica. In: J.C. Priscu. Ecosystem dynamics in a polar desert Antarctic Research Series, Washington D.C., 337-350.

Headland, R.K. (1994): Historical development of Antarctic tourism. Annals of Tourism Research 21, 269-280.

Hemmings, A.D. (1990): Human Impacts and Ecological Constraints on Skuas. In: K.R. Kerry, G. Hempel. Antarctic Ecosystems - Ecological Change and Conservation Springer Verlag, Berlin, 224-230.

Hernández, J., Stedt, J., et al. (2012): Human-associated Extended Spectrum β-Lactamase (ESBL) in the Antarctic. Applied and environmental microbiology 78, 2056-2058.

Hughes, K.A. (2004): Reducing sewage pollution in the Antarctic marine environment using a sewage treatment plant. Marine Pollution Bulletin 49, 850-853.

Hughes, K.A. (2010): How committed are we to monitoring human impacts in Antarctica? Environmental Research Letters 5, 1-3.

Hughes, K.A. & Convey, P. (2010): The protection of Antarctic terrestrial ecosystems from inter- and intra-continental transfer of non-indigenous species by human activities: A review of current systems and practices. Global Environmental Change 20, 96-112.

Hughes, K.A. & Convey, P. (2012): Determining the native/non-native status of newly discovered terrestrial and freshwater species in Antarctica - Current knowledge, methodology and management action. Journal of Environmental Management 93, 52-66.

Hunter, S. (1984): Breeding Biology and Population-Dynamics of Giant Petrels Macronectes at South Georgia (Aves, Procellariiformes). Journal of Zoology 203, 441-460.

IAATO (2004): IAATO Overview of Antarctic Tourism 2003-2004 Antarctic Season. IP063. ATCM XXVII. Cape Town.

IAATO (2005): IAATO Overview of Antarctic Tourism 2004-2005 Antarctic Season, revised. IP082 rev. ATCM XXVIII. Stockholm.

IAATO (2006): IAATO Overview of Antarctic Tourism 2005-2006 Antarctic Season. IP086. ATCM XXIX. Edinburgh.

IAATO (2007): IAATO Overview of Antarctic Tourism 2006-2007 Antarctic Season. IP121. ATCM XXX. New Delhi.

IAATO (2008): IAATO Overview of Antarctic Tourism 2007-2008 Antarctic Season and Preliminary Estimates for 2008-2009 Antarctic Season. IP085. ATCM XXXI. Kyiv.

IAATO (2009): IAATO Summary of Antarctic Ship-Based Tourism: Final Statistics for the 2008-09 Season and Revised Estimates for the 2009-10 Season; Projected Trends through the 2012-13 Season. IP007. Antarctic Treaty Meeting of Experts (ATME). Wellington.

IAATO (2010): IAATO Overview of Antarctic Tourism: 2009-10 Season and Preliminary Estimates for 2010-11 and Beyond. IP113. ATCM XXXIII. Punta del Este.

IAATO (2011): IAATO Overview of Antarctic Tourism: 2010-11 Season and Preliminary Estimates for 2011-12 Antarctic Season. IP106 rev1. ATCM XXXIV. Punta del Este.

IAATO (2012a): IAATO Overview of Antarctic Tourism: 2011-12 Season and Preliminary Estimates for 2012-13 Season. IP039. ATCM XXXV. Hobart.

IAATO (2012b): Tourism statistics, http://www.iaato.org/tourism_stats.html.

IMO (2010): Amendments to MARPOL Annex I on Special requirements for the use or carriage of oils in the Antarctic Area. Information Paper 94 for XXXIII Antarctic Treaty Consultative Meeting, 3-14 May. Punta del Este, Uruguay. IP094. ATCM XXXIII. Punta del Este.

INACH (2006): Programa de Investigacion Cientifica y Tecnologica Antartica del INACH, XLII Expedicion Cientifica Antartica PROCIEN 2005-2006.

INACH (2007): Programa de investigacion Cientifica y Tecnologica. PROCIEN 2006-2007.

INACH (2008): Programa de Investigacion Cientifica y Tecnologica. PROCIEN 2007-2008.

INACH (2010): Results of the Meeting of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula RegionATCM. Punta Arenas.

Jarbour, J. (2009): National Antarctic Programs and Their Impact on the Environment. In: K.R. Kerry,K.R. Riddle. Health of Antarctic Wildlife. A challenge for Science and Policy Springer Verlag, Berlin, 211-229.

Jezek, K.C. & Tipton-Everett, L. (1995): Managing the Antarctic Environment: From Observations To Policy. Byrd Polar Research Center Report. No. 12.

Kerry, K., Riddle, M., et al. (1999): Disease of Antarctic Wildlife. Australian Antarctic Division, Channel Highway, Kingston, 7050, Australia.

Kingdom, U. (2010): Guidance for visitors and environmental managers following the discovery of a suspected non-native species in the terrestrial and freshwater Antarctic environment. WP015. ATCM XXXIII. Punta del Este.

Kingdom, U. (2012): Colonisation status of known non-native species in the Antarctic terrestrial environment (updated 2012). IP050. ATCM XXXV. Hobart.

Kopp, M., Peter, H.U., et al. (2011): South polar skuas from a single breeding population overwinter in different oceans though show similar migration patterns. Marine Ecology-Progress Series 435, 263-267.

Krzyszowska, A. (1990): The content of fuel oil in soil and effect of sewage on water nearby the H. Arctowski Polish Antarctic Station (King George Island). Polish Arch. Hydrobiol. 37, 313-326.

Lange, U. & Naumann, J. (1989): Expeditionsbericht der 1. DDR-Antarktisexpedition, Überwinterungsteilnehmer an der 33. Sowjetischen Antarktisexpedition Station Bellingshausen 1987-1989, Teil I & II. unveröffentl. Ber.

Leotta, G., Vigo, G., et al. (2006): Isolation of *Campylobacter lari* from seabirds in Hope Bay, Antarctica. Polish Polar Research 27, 303-308.

Lewis-Smith, R.I. (1994): Vascular plants as bioindicators of regional warming in Antarctica. Oecologia 99, 322-328.

Lewis-Smith, R.I. & Richardson, M. (2011): Fuegian plants in Antarctica: natural or anthropogenically assisted immigrants? Biological Invasions 13, 1-5.

Lim, H.S., Han, M.J., et al. (2009): Heavy Metal Concentrations in the Fruticose Lichen Usnea aurantiacoatra from King George Island, South Shetland Islands, West Antarctica. Journal of the Korean Society for Applied Biological Chemistry 52, 503-508.

Lisovski, S., Pavel, V., et al. (2009): First breeding record of the Light-mantled Sooty Albatross (*Phoebetria palpebrata*) for the maritime Antarctic. Polar Biology 32, 1811-1813.

Lynch, H.J., Fagan, W.F., et al. (2009): Timing of clutch initiation in Pygoscelis penguins on the Antarctic Peninsula: towards an improved understanding of off-peak census correction factors. CCAMLR Science 16, 149-165.

Lynch, H.J., Naveen, R., et al. (2008): Censuses of penguin, Blue eyed Shag *Phalacrocorax atriceps* and Southern Giant Petrel *Macronectes giganteus* populations on the Antarctic Peninsula 2001-2007. Marine Ornithology 36, 83-97.

Lynch, H.J., Naveen, R., et al. (2012): Spatially integrated assessment reveals widespread changes in penguin populations on the Antarctic Peninsula. Ecology 93, 1367-1377.

MacKenzie, D. (2012): Superbugs spied off the Antarctic coast. New Scientist Magazine

Mäusbacher, R. (1991): Die jungquartäre Relief- und Klimageschichte im Bereich der Fildeshalbinsel Süd-Shetland-Inseln, Antarktis. Heidelberg. Geographisches Institut der Universität Heidelberg.

Micol, T. & Jouventin, P. (2001): Long-term population trends in seven Antarctic seabirds at Pointe Geologie (Terre Adelie). Human impact compared with environmental change. Polar Biology 24, 175-185.

Mönke, R. & Bick, A. (1988): Fachlicher Bericht über die Teilnahme der DDR-Biologengruppe an der 31. Sowjetischen Antarktisexpedition (SAE), Station "Bellingshausen", King-George-Island (Südshetland Inseln/Antarktis).

Nadler, T. & Mix, H. (1989): Fachlicher Bericht über die Teilnahme der DDR-Biologengruppe an der 32. Sowjetischen Antarktisexpedition, Station Bellingshausen, King George Island, Südshetland-Inseln. unpubl. rep. 66pp.

New Zealand (2006): Non-native Species in the Antarctic. Report of a Workshop. WP013. ATCM XXIX. Edinburgh.

Osyczka, P., Dutkiewicz, E.M., et al. (2007): Trace elements concentrations in selected moss and lichen species collected within Antarctic research stations. Polish Journal of Ecology 55, 39-48.

Parmelee, D.F., Maxson, S.J., et al. (1979): Fowl cholera outbreak among Brown skuas (*Catharaca skua lonnbergi*) at Palmer Station. Antarctic Journal of the United States 14, 168-169.

Pearson, M. (2008): Artefact or rubbish - A dilemma for Antarctic managers. In: O. S. Barr and P. Chaplin (Eds). in: ICOMOS Monuments and Sites No.XVII. International Polar Heritage Committee, Norway. Cultural Heritage in the Arctic and Antarctic Regions, 5.

Pearson, M. & Stehberg, R. (2006): Nineteenth century sealing sites on Rugged Island, South Shetland Islands. Polar Record 42, 335-347.

Pearson, M. & Stehberg, R. (2011): Geographic and technical influences of the location, nature and conservation of nineteenth century sealing sites in the South Shetland Islands. In: O. S. Barr and P. Chaplin (Eds). in: ICOMOS Monuments and Sites No.XVII. International Polar Heritage Committee, Norway. Polar settlements - Location, techniques and conservation., 8.

Pearson, M., Stehberg, R., et al. (2010): Conserving the oldest historic sites in the Antarctic: the challenges in managing the sealing sites in the South Shetland Islands. Polar Record 46, 57-64.

Peter, H.-U., Braun, S., et al. (2002): Brown skuas and Antarctic station activities at Fildes Peninsula, King George Island, South Shetland Islands. Poster at the XXIII. International Ornithological Congress.

Peter, H.-U., Buesser, C., et al. (2008): Risk assessment for the Fildes Peninsula and Ardley Island, and the development of management plans for their designation as Antarctic Specially Protected or Specially Managed Areas. Dessau: German Federal Environment Agency, http://www.umweltdaten.de/publikationen/fpdf-l/3478.pdf.

Peter, H.-U. & Huch, M. (2008): Das Internationale Polarjahr 2007/08. Folge 21: Studenten-Expeditionen im Internationalen Polarjahr. Polarforschung 78, 125-127.

Peter, H.-U., Kaiser, M., et al. (1988): Untersuchungen an Vögeln und Robben auf King George Island (South Shetland Islands, Antarktis). Geodätische und geophysikalische Veröffentlichungen Reihe 1, 1-127.

Pfeiffer, S. (2005): Effects of Human Activities on Southern Giant Petrels and Skuas in the Antarctic, PhD thesis.

Pfeiffer, S. & Peter, H.-U. (2004): Ecological studies toward the management of an Antarctic tourist landing site (Penguin Island, South Shetland Islands). Polar Record 40, 345-353.

Poblet, A., Andrade, S., et al. (1997): The use of epilithic Antarctic lichens (*Usnea aurantiacoatra* and *U. antartica*) to determine deposition patterns of heavy metals in the Shetland Islands, Antarctica. Science of the Total Environment 207, 187-194.

Poole, I. (2005): Anatomical and Morphological Assessment of Plant Macrofossils from King George Island, Antarctica. Leaf & wood flora from King George Island: Final Report.

Poole, I., Hunt, R.J., et al. (2001): A fossil wood flora from King George Island: Ecological implications for an Antarctic Eocene vegetation. Annals of Botany 88, 33-54.

RAPAL (2011): Informe finalRAPAL XXII. Lima, Perú, 03.-06.October 2011.

Regel, J. & Pütz, K. (1995): Effect of human disturbance on body temperature and energy expenditure in penguins. Polar Biology 18, 246-253.

Retamales, J. & Rogan-Finnemore, M. (2009): The Role of the Council of Managers of National Antarctic Programs. In: P.A. Berkman, M.A. Lang, D.W.H. Walton,O.R. Young. Science Diplomacy. Antarctica, Science, and the Governance of International Spaces Smithonian Institution Scholarly Press, Washington D.C., 231-239.

Riddle, M.J. (2009): Human-Mediated Impacts on the Health of Antarctic Wildlife. In: K.R. Kerry,M.J. Riddle. Health of Antarctic Wildlife: A Challenge for Science and Policy Springer Verlag, London, 241-262.

Riddle, M.J. (2010): Environmental governance a world apart: the view from the south. Presented at: International Polar Year Oslo Science Conference. M.J. Riddle. Oslo

Riffenburgh, B. (1998): Impacts on the Antarctic environment: tourism vs government programmes. Polar Record 34, 193-196.

Riffenburgh, B. (2007): Encyclopedia of the Antarctic. CRC Press.

Roberts, B. (1940): The life cycle of Wilson's Petrel *Oceanites oceanicus* (Kuhl). British Graham Land Expedition Scientific Report 1, 141-194.

Rounsevell, D. & Binns, D. (1991): Mass deaths of King Penguins (*Aptenodytes patagonica)* at Lusitania Bay, Macquarie Island. Aurora 10, 8-10.

Roura, R. (2010): Monitoring the transformation of historic features in Antarctica and Svalbard: local processes and regional contexts. Polar Record 46, 289-311.

Samiullah, Y. (1985): Biological Effects of Marine Oil Pollution. Oil & Petrochemical Pollution 2, 235-264.

Sander, M., Balbao, T.C., et al. (2007a): Decline of the breeding population of Pygoscelis antarctica and Pygoscelis adeliae on Penguin Island, South Shetland, Antarctica. Polar Biology 30, 651-654.

Sander, M., Balbao, T.C., et al. (2007b): Recent decrease in chinstrap penguin (Pygoscelis antarctica) populations at two of Admiralty Bay's islets on King George Island, South Shetland Islands, Antarctica. Polar Biology 30, 659-661.

Sander, M., Carneiro, A.P.B., et al. (2006): Distribution and status of the kelp gull, Larus dominicanus Lichtenstein (1823), at Admiralty Bay, King George Island, South Shetland, Antarctica. Polar Biology 29, 902-904.

SCAR (2008): Human disturbance to wildlife in the broader Antarctic region: a review of findings. WP012. ATCM XXXI. Kyiv.

SCAR (2009a): The IPY Aliens in Antarctica Project. IP010 rev.1. ATCM XXXII. Baltimore.

SCAR (2009b): Report of SCAR's 3rd Cross-Linkages Workshop. SCAR Bulletin 171.

SCAR (2009c): SCAR’s environmental code of conduct for terrestrial scientific field research in Antarctica. IP004. ATCM XXXII. Baltimore.

SCAR (2010): Preliminary Results from the International Polar Year Programme: Aliens in Antarctica. WP004. ATCM XXXIII. Punta del Este.

SCAR (2011a): Measures to reduce the risk of non-native species introductions to the Antarctic region associated with fresh foods. WP053. ATCM XXXIV. Buenos Aires.

SCAR (2011b): SCAR’s Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica. IP053. ATCM XXXIV. Buenos Aires.

SCAR (2012): Outcomes of the International Polar Year Programme: Aliens in Antarctica. WP005. ATCM XXXV. Hobart.

Shirihai, H. (2002): A complete guide to Antarctic Wildlife. Helsinki. Alula Press.

Small, C. & Taylor, F. (2006): Analysis of albatross and petrel distribution within the CCAMLR convention area: Results from the global Procellariiform tracking database. CCAMLR Science 13, 143-174.

Smith, R.C., Fraser, W.R., et al. (2003): Climate variability and ecological response of the marine ecosystem in the Western Antarctic Peninsula (WAP) region. In: D. Greenland, D.G. Goodin,R.C. Smith. Climatic variability and ecosystem response at long-term ecological research sites Oxford University Press, Oxford, 158-173.

Smykla, J., Szarek-Gwiazda, E., et al. (2005): Trace elements in the lichens *Usnea aurantiago-atra* and *Usnea antarctica* from the vicinity of Uruguay's Artigas research station on King George Island, Maritime Antarctic. Polish Botanical Studies 19, 49-57.

Stark, J.S., Johnstone, G.J., et al. (2006): Monitoring the remediation of a near shore waste disposal site in Antarctica using the amphipod *Paramoera walkeri* and diffusive gradients in thin films (DGTs). Marine Pollution Bulletin 52, 1595-160.

Stehberg, R. (2008): Archaeologists document historical remains in the South Shetland Islands. In: O. S. Barr and P. Chaplin (Eds). in: ICOMOS Monuments and Sites No.XVII. International Polar Heritage Committee, Norway. Cultural Heritage in the Arctic and Antarctic Regions, 4.

Stehberg, R., Pearson, M., et al. (2008): Protection and preservation of the oldest sites of the Antarctic: the case of Fildes Peninsula and Byers Peninsula in the South Shetland Islands. In: O. S. Barr and P. Chaplin (Eds). in: ICOMOS Monuments and Sites No.VIII. International Polar Heritage Committee, Norway. Historical Polar Bases - Preservation and Management, 9.

Tarasenko, S. (2009): Wastewater Treatment in Antarctica.

Trivelpiece, S.G., Geupel, G.R., et al. (1987): Rare bird sightings from Admiralty Bay, South Shetland Islands, Antarctica 1976-1987. Cormorant 15, 59-66.

Trivelpiece, W.Z., Hinke, J.T., et al. (2011): Variability in krill biomass links harvesting and climate warming to penguin population changes in Antarctica. Proc. Natl. Acad. Sci. U. S. A. 108, 7625-7628.

Turner, J., Bindschadler, R.A., et al., Eds. (2009): Antarctic Climate Change and the Environment. Cambridge, SCAR.

United Kingdom & Germany (1999): Report of a Joint Inspection under Article VII of the Antarctic Treaty, Antarctic Treaty Inspection Programme: January 1999. WP023. ATCM XXIII. Lima.

United States (2007): United States Report of Inspections. IP010. ATCM XXX. New Delhi.

Uruguay (2004): Relevamiento de restos historicos del naufragio de Pta. Suffield, Bahia Maxwell, Isla Rey Jorge (Isla 25 de Mayo), en relacion a la resolucion 5 (2001). IP107. ATCM XXVII. Cape Town.

Uruguay (2010a): Actualización del estudio de los restos históricos del naufragio de Punta Suffield. IP067. ATCM XXXIII. Punta del Este.

Uruguay (2010b): Identificación y evaluación de la acción antrópica de grupos poblacionales de mamíferos marinos pinnípedos en áreas de la costa del Estrecho de Drake, Isla Rey Jorge (Antártida insular). IP032. ATCM XXXIII. Punta del Este.

Uruguay (2011a): Discovery of human activity remains, pre-1958 in the north coast of the King George Island / 25 de Mayo. IP043. ATCM XXXIV. Buenos Aires.

Uruguay (2011b): Renovación del Parque de Tanques de combustible de la Base Científica Antártica Artigas (BCAA). IP063. ATCM XXXIV. Buenos Aires.

Uruguay (2012a): Actividades de investigación y proyectos científicos coordinados por el Instituto Antártico Uruguayo en la campaña 2011 – 2012. BP027. ATCM XXXV. Hobart.

Uruguay (2012b): Energy Efficiency project in Antarctic Research Station Artigas. BP025. ATCM XXXV. Hobart.

Uruguay (2012c): Renovación del Parque de Tanques de combustible de la Base Científica Antártica Artigas (BCAA). BP028. ATCM XXXV. Hobart.

Viblanc, V.A., Smith, A.D., et al. (2012): Coping with continuous human disturbance in the wild: insights from penguin heart rate response to various stressors. BMC Ecology 12, 1-22.

Vogt, S., Braun, M., et al. (2004): The King George Island Geographic Information System project. Pesquisa Antártica Brasileira 4, 183-186.

Waluda, C.M., Gregory, S., et al. (2010): Long-term variability in the abundance of Antarctic fur seals Arctocephalus gazella at Signy Island, South Orkneys. Polar Biology 33, 305-312.

Weimerskirch, H., Capdeville, D., et al. (2000): Factors affecting the number and mortality of seabirds attending trawlers and long-liners in the Kerguelen area. Polar Biology 23, 236-249.

Wilson, K.-J., Taylor, R.H., et al. (1990): The impact of man on Adélie Penguins at Cape Hallett, Antarctica. In: K.R. Kerry, G. Hempel. Antarctic Ecosystems. Ecological Change and Conservation Springer Verlag, Berlin.

Woehler, E.J., Cooper, J., et al. (2001): A statistical assessment of the status and trends of Antarctic and Subantarctic seabirds. SCAR BBS.

Woehler, E.J., Penny, R.L., et al. (1994): Impacts of human visitors on breeding success and long-term population trends in Adélie Penguins at Casey, Antarctica. Polar Biology 14, 269-274.

Yogui, G.T. & Sericano, J. (2008): Polybrominated diphenyl ether flame retardants in lichens and mosses from King George Island, maritime Antarctica. Chemosphere 73, 1589-1593.

Appendix 1

Tab. 7: Results of the monthly seal count on the Fildes Peninsula and Ardley Island, shown by season (- = no count).

Species	Month	2003/ 2004	2004/ 2005	2005/ 2006	2006/ 2007	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012
Southern elephant seal	December	-	362	701	443	-	602	655	749	550
	January	650	622	842	909	863	980	986	1,383	901
	February	623	476	582	452	-	866	752	686	633
	March	-	123	-	-	-	175	-	-	-
Weddell seal	December	-	102	70	56	-	38	34	66	123
	January	101	92	45	64	76	39	37	44	60
	February	25	45	5	37	-	28	20	43	59
	March	-	14	-	-	-	14	-	-	-
Antarctic fur seal	December	-	6	12	11	-	13	12	15	8
	January	19	164	7	30	97	70	19	88	23
	February	1,226	144	637	229	-	870	1,061	540	268
	March	-	505	-	-	-	178	-	-	-
Crabeater seal	December	-	3	0	0	-	1	0	0	2
	January	5	0	2	0	1	0	2	0	0
	February	0	2	0	0	-	0	0	0	1
	March	-	0	-	-	-	0	-	-	-
Leopard seal	December	-	0	0	1	-	0	0	1	0
	January	1	1	1	0	1	1	0	1	0
	February	0	0	0	1	-	0	2	0	0
	March	-	0	-	-	-	0	-	-	-

Appendix 2

A Suggestion for a poster with information about suitable behaviour in the Antarctic in English

B Suggestion for a poster with information about suitable behaviour in the Antarctic in Spanish

C Suggestion for a poster with information about suitable behaviour in the Antarctic in Russian

D Suggestion for a poster with information about suitable behaviour in the Antarctic in Chinese

Appendix 3

XXXIII Antarctic Treaty Consultative Meeting
3rd to 14th May, 2010
Punta del Este - Uruguay

WP 40

Agenda Item: CEP 7f

Presented by: Chile, Germany

Original: English

Third Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island

Attachments:

atcm33_att039_e.doc: Annex I: Results of the Meeting of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula Region

atcm33_att040_e.doc: Annex II: Revised Possible Modules of a Management Plan for Antarctic Specially Managed Area No. ***, Fildes Peninsula Region, South Shetland Islands

Third Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island

1. Introduction

At CEP VII, Germany introduced IP 005, "Research Project Risk assessment for the Fildes Peninsula and Ardley Island and the development of management plans for designation as Antarctic Specially Protected or Managed Areas'". This paper described the below mentioned German three-year research project (2003 – 2006) and introduced it for the first time. Several CEP members expressed their support for the proposal, and indicated that they would willingly assist Germany in the project.

At CEP VIII, Germany introduced IP 016, "Progress Report on the Research Project Risk assessment for Fildes Peninsula and Ardley Island and the development of management plans for designation as Antarctic Specially Protected or Managed Areas". This paper provided an update of the project, noting the excellent cooperation with other Parties in the area through an informal co-ordination group.

At ATCM XXVIII, "Germany agreed that prior to tabling a draft Management Plan for Fildes Peninsula and Ardley Island (King George Island) and following a proposal by Chile an International Working Group should be established. This Working Group should be composed of those Parties with stations and/or huts in the area, Parties with an interest in the area as well as Observers to the Antarctic Treaty. It should discuss the issues related to the Draft Management Plan. For this purpose, Germany would organize two international workshops, one in September 2005 and another one in January/February 2006, in order to convene the participants on this issue" (Final Report of ATCM XXVIII, para. 90).

At CEP IX, Brazil, China, Germany, the Republic of Korea and the Russian Federation introduced WP 022, "Possibilities for Environmental Management of Fildes Peninsula and Ardley Island. Proposal to establish an Intersessional Contact Group". This paper reported on the main findings and recommendations of the King George Island Workshop "Possibilities for Environmental Management of Fildes Peninsula and Ardley Island" in January/February 2006 as well as on the outcome of the Workshop "Human impact on terrestrial habitats in the Antarctic" in September 2005". Discussion of this paper is reflected in paragraphs 70 to 75 of the CEP Report.

At ATCM XXIX, "Germany expressed satisfaction on reaching agreement with Chile in principle on developing an ASMA for Fildes Peninsula and Ardley Island. They will jointly convene – via note verbal – an international working group (paragraph 74 of the CEP Report). Germany expressed the hope that a substantive outcome of the group's work would be presented to the next ATCM. Chile confirmed that it will host a workshop to prepare the input on this issue for discussion at CEP X." (Final Report of ATCM XXIX, para. 77).

Pursuant to these understandings an international working group involving government representatives of interested Parties was convened by Germany and Chile in order to discuss management approaches, possibly aiming at drafting a management plan for an ASMA covering the Fildes Peninsula Region (see separate IP 22 rev. 1 by Germany and Chile).

At ATCM XXX, Germany introduced IP 112 "Possible Modules of a "Fildes Peninsula region" ASMA Management Plan". Further, Germany and Chile introduced IP 22 rev. 1 "Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island". Comments of 15 IWG parties to four questions concerning the future management of the Fildes Peninsula Region were reported.

At ATCM XXXI, Germany introduced IP 30 "Final Report on the Research Project "Risk assessment for Fildes Peninsula and Ardley Island and the development of management plans for designation as Antarctic Specially Protected or Managed Areas"". It contained a proposal for a "Fildes Peninsula region ASMA Management Plan" which was already presented to CEP X as IP 112 (2007) "Possible Modules of a 'Fildes

Peninsula region' ASMA Management Plan" and which was uploaded on the IWG web-based Discussion Forum.

At ATCM XXXII, Chile and Germany introduced WP 004 "Second Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island". Chile introduced IP 81 "Notes on a Multiple Protection System for some areas in King George Island: Zones under Annex V and their relevance to Fildes Peninsula and adjacent areas".

2. Intersessional Work

2.1 Meeting of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula Region

As agreed by ATCM XXXII 2009 in Baltimore, the extra meeting of the International Working Group on Fildes (IWG Fildes) took place in Punta Arenas, INACH, Chile, on 30 and 31 July 2009 to discuss items related to the management scheme of the area. 15 participants including representatives from Argentina, Chile, Germany, the Russian Federation and Uruguay as well an observer from IAATO and DAP took part.

The meeting addressed the need to establish and to further define a facility zone in the area. For this purpose, the boundaries of such a facility zone have to be fixed. This can only be done on the basis of comments from the National Antarctic Programs involved. Therefore, it was also agreed that the National Managers involved should formalize their cooperative efforts into a coordination group, for which Uruguay volunteered to take the lead. They were requested to report back to the convenors of the IWG Fildes.

The complete results of the IWG meeting in Punta Arenas including agreed issues and working plan/time schedule of the IWG Fildes for the intersessional period 2009/2010 are presented in Annex I.

2.2 Tasks of the IWG for the intersessional period until CEP XIII in 2010

At the IWG meeting in Punta Arenas, it was agreed that the convenors would work on a revised draft Management Plan for the Fildes Peninsula taking aboard comments made within the IWG Meeting as well as any written contributions for their submission as part of a Progress Report to the XXXIII ATCM (see the references contained in the chapter "Working Plan/Time Schedule" in Annex I).

Therefore, Germany revised the draft Management Plan on the basis of the comments received by Uruguay, China and the Russian Federation. This revised Management Plan is attached in Annex II in which all recent amendments are underlined. It also includes the code of conduct for scientific research, which is now in line with the code of conduct for scientific research by SCAR (IP 4 ATCM XXXII).

Further, detailed maps about the proposed location and size of a possible facility zone around their stations were presented by Uruguay, China, the Russian Federation and Chile. Uruguay made a proposal towards an integrated facility zone (see Map 3 of Annex II). However this map does not yet represent the agreed common boundaries of all parties with stations in the region and further work must be done towards that end.

3. Further Steps

While some progress has been made in the search of an agreed protection for the Fildes Peninsula Region, the following aspects should be taken into consideration for further discussion:

(a) The spatial synthesis of the different requirements concerning a possible Facility Zone, on the basis of the maps submitted by the countries with stations in the area;

(b) The proposed revised Management Plan and its relationship with the existing and any proposed ASPA included in the region;

(c) Any missing requirements, either in the information already provided by stations, or in other matters requiring coordination and enhancing or contributing to the justification for a Fildes Peninsula ASMA.

The participants of the IWG Meeting are pledged to continue their intersessional work at the web-based Fildes Discussion Forum of the Antarctic Treaty Secretariat.

In addition, the IWG conveners propose to have an IWG Meeting during CEP XIII in Punta del Este, Uruguay, in order to continue the discussion of all elements related to the nature, scope and characteristics of a management scheme for the Fildes Peninsula Region, including the suggestions by Uruguay and any other participant regarding the integration of the Fildes Facility Zones, and the revised Management Plan prepared by Germany.

Annex I:

Results of the Meeting of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula Region, Punta Arenas, INACH, Chile, July 30 to 31, 2009

As agreed by ATCM XXXII 2009 in Baltimore, the extra meeting of the International Working Group on Fildes took place in Punta Arenas on 30 and 31 July 2009 to discuss items related to the management scheme of the region. The meeting was chaired by the Convenors (Jorge Berguño, Chile, & Axel Szelinski, Germany) and discussed the items according to the Agenda (see Annex 1). The list of participants is attached as Annex 2.
After the four presentations:

- IWG Fildes - The current status by Heike Herata,

- News from the Fildes Region (research, logistic, tourism, monitoring, further activities) by Verónica Vallejos,

- Update of the German research project on Fildes by Christina Braun,

- Proposed Site guidelines for Ardley Island by Rodolfo Sánchez and Verónica Vallejos,

the future management of the region was discussed on the basis of the documents submitted to ATCM XXXII. These discussions were very constructive and fruitful whereby the following results could be reached:

Aspects of the future management system for Fildes Peninsula and Ardley Island (Zoning/protected areas/historic & archaeological sites)

- There was a common agreement on the necessity to establish and further define a facility zone. The boundaries can only be finalised on the basis of comments from the National Antarctic Programs involved.

- Therefore it was also agreed that the National Managers involved should formalize their cooperative efforts into a coordination group, for which Uruguay (Albert Lluberas) volunteered to take the lead, and are requested to report back to the Convenors of the IWG Fildes by 30 September 2009. This group *inter alia* should comment on the following issues:
    - The spatial definition of the facilities zones and its boundaries.
    - Missing information/elements in the current concept for the facility zone (see Appendix of WP 04).
    - The following elements were already identified at this meeting:
        - Location of stations,
        - Activities connecting the stations,
        - Roads used by vehicles,
        - Footpaths,
        - A buffer zone around human features and resources, e.g. drinking water, where appropriate,
        - Upgrading and future development of facilities,

- In order to improve management of tourist activities as well as the personnel of the National Programs in their free time, the meeting agreed to establish a zoning system for Fildes Peninsula and Ardley Island, based on a three step concept (traffic light: free roaming zone, closed area, restricted area). Such a zoning system should be further developed, taking into account values present and likely users.

- Specifically for archaeological sites/values not covered by existing ASPAs, it was recognized that the Guidelines for handling pre-1958 historic remains (Resolution 5 (2001), ATCM XXIV, St. Petersburg) should be further applied.

- The meeting agreed that site guidelines constitute a very useful tool to manage visits to Ardley Island. It was also recognized that, once approved, full compliance with these guidelines among the National Programs operating in the area should be ensured though education, outreach and training activities. The meeting took note of the Site Guidelines already prepared by Argentina and Chile for Ardley Island and that they are still open for comments before the XIII CEP meeting.

Coordination in the field

The meeting agreed to encourage the station managers in Fildes to form a Coordination Group in order to regularly exchange information on:

- coordination of existing and additional logistic activities,
- to find a communication mechanism to improve coordination of research (use of SCAR and COMNAP input),
- training and briefing of staff in the stations, disseminate information and educational material on the significance of the Region to those visiting, or working there,
- facilitate communication between those working in or visiting the area.

Working Plan / Time schedule

- The Convenors invite the participants and IWG members to provide written comments by 30 August 2009.
- The Convenors will informally contact CCAMLR concerning marine protection by 30 August 2009.
- Germany will compare the SCAR code of conduct for scientific research with the Code already included in WP 04 by 30 August 2009.
- Comments on the current draft Management Plan (see WP 04) should be submitted to the web-based discussion forum by 31 October 2009.
- The Convenors will prepare a revised draft Management Plan taking aboard comments within the IWG meeting as well as written contributions and upload it to the web-based discussion forum by 31 January 2010, for submission as a Progress Report to the XXXIII ATCM.

Annex II: Revised Possible Modules of a Management Plan for Antarctic Specially Managed Area No. *, Fildes Peninsula Region, South Shetland Islands** (all new amendments are underlined)

Prepared and proposed by Germany

Preamble

The Fildes Peninsula and Ardley Island (King George Island, South Shetlands, Maritime Antarctic) are intensively used for scientific, logistic and tourism-related activities by several nations. This multitude of activities obviously affects the environment in that area and often leads to conflicts of interest between nature conservation, science, logistics and tourism.

In response to these conflicts, a research project commissioned by the German Federal Environment Agency has been conducted since 2003 on the Fildes Peninsula, Ardley Island and associated small islands (<u>hereafter</u> the Fildes Peninsula Region). This project is designed to provide data for a full evaluation of the role and structure of a possible broad-scale management system which could supplement the existing protection provided by ASPAs to parts of the <u>area</u>.

Germany is carrying out this project for a number of reasons. One is that German scientists have been regularly present in the <u>area</u> since 1979. Their activities have been focused particularly on the collection of environmental and biological information. Furthermore, the project can be seen as a result of the joint United Kingdom and Germany inspection programme conducted in the Antarctic Peninsula area in January, 1999. This inspection produced the recommendation that "... consideration could be given towards further enhancing cooperation for example in logistic support, consistency in waste management procedures and a critical examination of scientific programmes to optimise productivity and minimise duplication". A second inspection was conducted in February 2005 by the United Kingdom, Australia and Peru (XXVIII ATCM, WP 32, Stockholm 2005). This inspection covered the Bellingshausen and Great Wall research stations which lie close to each other near Maxwell Bay in the <u>area</u>. The team found relatively little co-operation on science between the stations and no consistent or focused approach to monitoring. The team welcomed the initial consultations that had been made, and the baseline surveys then underway, carried out with the aim of proposing the <u>Fildes Peninsula</u> Region as an Antarctic Specially Managed Area <u>(XXVIII ATCM, WP 32)</u> <u>or to continue to develop appropriate environmental management mechanisms for this important area as stated by the CEP XII, Final Report (151).</u>

<u>Uruguay wishes to express that the future management of the region can be effectively done by other alternative procedures such as site guidelines, code of conduct for areas , rather than an full ASMA as initially proposed and has to be agreed and managed by the National Antarctic Program Managers Operating permanent stations in the Area.</u>

The following text includes "Possible Modules of a 'Fildes Peninsula <u>Region</u>' ASMA" in order to stimulate discussion of a management system. These modules are not the only ones possible and that the proposal is incomplete. There are, of course, several different possible management approaches and, as well as the proposed modules, all practicable options should be discussed. It should also be emphasised that the development of a management plan can be achieved only in close co-operation with all the Antarctic Treaty signatories represented in the area.

Please note that the <u>initial</u> proposal <u>was</u> elaborated according to the "Guide for the preparation of Management Plans for Antarctic Specially Protected Areas" and follows the structure of the Deception Island Management Package.

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Introduction

The Fildes Peninsula, Ardley Island and adjacent small islands (hereafter "Fildes Peninsula Region") forms the south-western part of King George Island, one of the South Shetland Islands in the Maritime Antarctic. The Region is a large ice-free area with important natural, scientific, educational, aesthetic, wilderness and historical values.

The Fildes Peninsula Region is intensively used for scientific, logistic and tourism-related activities and, during the years since 1968, seven nations (Argentina, Brazil, Chile, China, German Democratic Republic, Russia, and Uruguay) established research stations and field huts there. In addition, in 1980 Chile built a hard runway capable of handling intercontinental and intracontinental flights for transporting cargo, station personnel, and visitors, between stations in the South Shetland Islands, to the Antarctic Peninsula and South America. Supply, research, patrol and tourist vessels frequently anchor in Maxwell Bay.

Scientific programs underway in the Fildes Peninsula Region include several oceanographic, physical geography atmospheric, glacial, geological and biological investigations. Due to its high species diversity, Ardley Island has been designated as an Antarctic Specially Protected Area (ASPA, formerly SSSI) with an excluded visitor zone for station personnel and tourists. Two fossil-rich geological sites are also designated as an ASPA although this designation ceases on 31 December 2010.

Ship-based tourism occurs on a regular basis and combined air and ship tourism has currently established. There are frequent over flights. Sporting competitions (*e.g.* marathon), glacier walk and camping have taken place in recent years, illustrating the diverse spectrum of non-governmental activities in the area.

Human activities occurring during the breeding and moulting seasons of birds or seals produce conflicts of interest between nature conservation, science, logistics and tourism.

The designation of the area as an Antarctic Specially Managed Area (ASMA) offers an integrated strategy to manage these conflicts and to minimise the impact of diverse human activities.

1. Description of Values

The Fildes Peninsula Region has important natural, scientific, educational, aesthetic, wilderness and historical values.

i. Natural Value

This large ice-free area contains diverse fauna and flora as well as special geological features, such as fossils and Tertiary rock strata. This peninsula and neighbouring islands (Ardley, Geologists, Two Summit, Dart and Diomedea) are breeding sites for thirteen species of seabirds and four species of seals. Of special interest are the large breeding colonies of Southern giant petrels, Gentoo penguins, skuas and storm petrels. Ardley Island has a varied vegetation particular to the Region of lichen and moss.

ii. Scientific Value

The Fildes Peninsula Region is of great interest for science and several nations exploit the easy access to ice-free areas. The local fauna and flora offers unrivalled opportunities of gaining an understanding of adaptation to extreme environments. In addition, the more than 30 years of research in the area has produced several long-term sets of environmental data including meteorological and biological observations. Unique international scientific co-operation has developed, particularly in relation to seabird censuses and behavioural and physiological studies on penguins, skuas and petrels. Likewise, international field research is run in parallel by botanists, marine biologists, microbiologists, geologists, glaciologists, oceanographers, physicists and meteorologists. The concentration of stations offers a platform for communication and interdisciplinary approaches.

iii. Educational Value

The Fildes Peninsula Region is a peep hole into the Antarctic ecosystem. The airport offers the opportunity to fly in visitors for a few hours or days to receive a first impression of the Antarctic. Visitors have the opportunity to watch wildlife, to visit research stations and to experience international co-operation in science and logistics.

INSPIRE (formerly Mission Antarctica) initiated an environmental programme in 2001. Large amounts of scrap from the Russian Station Bellingshausen were removed in a three-year project. In parallel, an education programme is running with international pupils, teachers and sponsors to enhance interest and increase funding for further activities in the locality. A new building, located at Bellingshausen Station, is serving an education base and a model for educational, environmental and energy issues.

In 2004 Chile initiated the Antarctic School Fair where students present research projects und may win the opportunity to travel to Antarctica.

From the year of 2005, China begun to organize students coming to Antarctica to do some research activities. In the future, China will rebuild and expand the existing constructions in Great Wall Station and develop them to an education platform for environmental protection and new energy technology.

iv. Aesthetic Value

The Fildes Peninsula Region offers a wide spectrum of habitats and landscapes ranging from small wildlife hotspots to large glaciers, quiet inlets, and volcanic rock formations. The west coast of the Fildes Peninsula faces the winds and strong surges of the Drake Passage, while on the east there are the calm waters of Maxwell Bay. The narrow Fildes Strait, with its strong currents around small islands, allows stupendous views towards the Drake Passage, Maxwell Bay and the glacier on Nelson Island.

v. Historic Value

The sheltered waters of Maxwell Bay offered a relatively easy landing place for early explorers, whalers and sealers, and some traces remain. Near Suffield Point, Fildes Peninsula (62°11´12 □S, 58° 54´02 □W), a dry-stone wall enclosing three sides of an area roughly 2.40 by 2.40m was described close to the cliff (Lewis-Smith & Simpson, 1987). Stehberg (1983) excavated this site and found a small iron pot 'of European origin'. Also at Suffield Point, the remnants of a wreaked ship still lie in the water near the Uruguayan station in Maxwell Bay. The remains are probably from a sailing ship built in the second half of the 19th century. A detailed description was given by Uruguay to CEP VII (XXVII ATCM/IP 107).

Furthermore, three historical sites have been designated and marked in the Area (Nos. 50, 52 and 82 in the list of Historic Sites and Monuments, http://www.ats.aq/documents/cep/HSM_2007_e.pdf). There is a plaque on a sea cliff south-west of the Chilean and Russian stations. This commemorates the landing in February 1976 of the first Polish Antarctic maritime research expedition which involved the research vessel Professor Siedlecki, the trawler Tazar and their crews. There is also a monolith erected to commemorate the establishment on 20 February 1985 of the Chinese Great Wall Station by the First Chinese Antarctic Research Expedition. Finally, there is a Monument to the Antarctic Treaty and Plaque. The monument is located close to the Frei, Bellingshausen and Escudero Bases. The plaque at the foot of the monument commemorates the Signatories to the Antarctic Treaty and successive International Polar Years (1882-1883, 1932-1933 and 2007-2008).

2. Aims and Objectives

This plan aims to apply current information and best practice approaches to facilitate the orderly management of conflicting interests in the Fildes Peninsula Region. The management plan could minimise the negative effects of human activities on natural values and scientific work. The diverse and intensive use of the area is expected to continue and increase in the near future.

For these reasons, the objectives of the management plan are:

- to improve cooperation and coordination of activities between Antarctic Treaty Parties operating in the area;
- to solve existing and avert potential differences of interest between logistic, scientific, and tourist activities.

This could also include:

- reduce unnecessary degradation of natural values by human disturbances;
- state how the protected values of the Fildes Peninsula Region or of each zone of the area are to be conserved;
- support the use of aircraft, watercraft and land vehicles in a way that minimises environmental impacts (e.g. Resolution 4 (2004), IMO shipping guidelines);
- increase the efficiency of scientific and logistic operations caused by more intensive cooperation and coordination;
- promote the environmentally compatible dismantling and removal of unused infrastructure (buildings etc.);
- avoid further construction of all kinds except for scientific, logistics support, educational purposes;
- protect sensitive sites within the area *(e.g.* breeding and resting sites of birds and seals);
- manage tourism
- help to improve environmental education within the area (including station members);

- minimise the risk of introducing none-native plants, animals and microbes.

3. Management Activities

To achieve the aims and objectives of this Management Plan, the following management activities could be undertaken in the Fildes Peninsula Region:

- A Fildes Peninsula Region Coordination Group formed by National Antarctic Program Managers operating permanent stations in the area could be established to
  - promote the coordination of activities;
  - facilitate communication between those working in, or visiting;
  - maintain a record of all own activities when possible;
  - disseminate information and educational material on the significance of the area to those visiting, or working there;
  - monitor the site for cumulative impacts;
  - coordinate and asses the implementation of the Management Plan and revise it when necessary.
- A general *Fildes Peninsula Region Code of Conduct for each area*, supplemented by *Codes of Conduct for Facilities Zones* (Appendix 3), *Codes of Conduct for Scientific Research* (Appendix 4) and *Codes of Conduct for Visitors* (Appendix 5) could be used to guide and control activities within the area.
- National Antarctic Programmes operating within the area could ensure that their personnel are briefed on, and are aware of, the requirements of the Management Plan and supplemental documents (according to COMNAP training Checklist for operators).
- Tour operators visiting the area could ensure that their staff, crew and passengers are briefed on, and are aware of, the requirements of the Management Plan and supplemental documents.
- Signs and markers could be erected and maintained where necessary and appropriate to show the boundaries of ASPAs, and other zones. They would need to be informative and unobtrusive. They would also have to be secured and maintained in good condition and removed when no longer necessary.
- Contingency plans for stations emergencies, oil spills and other accidents with possible significant negative impacts on the environment could be harmonised if needed. They could be made available at the stations in at least one of the Antarctic Treaty languages (English, French, Russian and Spanish).
- Copies of the Management Plan and supplementing documents and maps could be made available for station personnel and visitors in any of the Antarctic Treaty languages (English, French, Russian and Spanish).
- The management options required for adjacent marine areas could be identified and evaluated.

4. Period of Designation

The area could be designated for a period of time to be reviewed by parties managing permanent stations in the Area.

5. Description of the Area

i. Geographical Co-ordinates, Boundary Markers and Natural Features

General description

The ASMA proposed comprises the land of the Fildes Peninsula and adjacent islands plus the sea along the coast of this land area extending 0.25 nautical mile (~ 460 m) seaward. This area lies approximately within the range 62°08´16´´S – 62°14´26´´S, 58°50´36´´W – 58°02´45´´W. The marine areas are included following the guidance of the "Working Paper on Guidelines for the Operation of Aircraft near Concentrations of Birds in Antarctica" (XXVII ATCM, WP 010, Cape Town 2004).

The Fildes Peninsula Region is bounded on the northwest by the Drake site in Potrebski Cove and on the north east by a point 0.25 nautical mile east of Nebles Point in Maxwell Bay. The southern border would be the Fildes Strait including all islands north of Nelson Island. The most westerly point would lie ¼ nautical mile westwards of Flat Top Peninsula. This could, furthermore, include ASPA No. 125 and ASPA No. 150.

The total area of the proposed ASMA would be 63 km^2. Of the terrestrial part of this area about 20% is currently covered by the Collins Glacier.

The suggested name of this area is the "Fildes Peninsula Region ASMA".

Geology and geomorphology

The western part of King George Island is volcanic rock of early Tertiary origin (45-60 Ma, Smellie et al., 1984). Two stratigraphic sequences are distinguished – the Fildes and the Hennequin formation. The Fildes Formation is characterised by weathered olivine-basalts and basaltic andesites, rare pyroxene-andesites and dacites. Flat Top, Horatio Stump and Gemel Peaks are volcanic plugs and represent former volcanic centres on the Fildes Peninsula. The northern part of the Peninsula is formed by the Davies Heights (80-160 m a.s.l.) above sea level. The southern part is characterised by various elevations and hills. Horatio Stump in the south is the highest point of the Fildes Peninsula (166.60 m a.s.l.).

Climate

The area belongs to the cold climate zone of the maritime Antarctic. Meteorological data of the Russian Station Bellingshausen (http://south.aari.nw.ru/default_en.html) show comparatively high precipitation (~700mm per year) and strong westerly winds. Cyclones with speeds exceeding 100km/hour are typical. Mean temperatures vary between 1.5°C in summer (January/February) and -6.5°C in winter (July/August). Snowmelt starts by the end of October. During winter the surrounding waters are covered with fast sea ice but the duration of ice cover varies greatly between years.

Fauna

Thirteen species of seabirds breed in the area. In 2008/09 counts indicated over 5,000 pairs of penguins breeding on Ardley Island: Adelie (*Pygoscelis adeliae*, 545 breeding pairs), Chinstrap (*P. antarctica*, 8) and Gentoo (*P. papua*, 5665). The largest breeding sites of Southern giant petrels (*Macronectes giganteus*) can be found on Dart and Two Summit Island and, with several small colonies, the total population in the area amounts to ~420 breeding pairs. Brown and South Polar skuas (*Catharacta antarctica lonnbergi* ~80 breeding pairs and *C. maccormicki* ~230 breeding pairs, data from 2005/2006) live sympatrically in loose colonies and sometimes hybridise (about 30 mixed pairs). Kelp gulls (*Larus dominicanus*), Antarctic terns (*Sterna vittata*), and Cape petrels (*Daption carpense*) breed along the rocky coast line in groups ranging from single nests to medium-sized colonies. Wilson's storm petrels and Black-bellied storm petrel (*Oceanites oceanicus* and *Fregetta tropica*) breed on scree further inland in colonies up to several hundred to a thousand pairs. Sheathbills (*Chionis alba*) breed in the southwest part of the Fildes Peninsula. Blue-eyed shags (*Phalacrocorax atriceps*) have been breeding in the area in recent years and could have nests on inaccessible islands or rocks.

Several species visit the area more or less frequently (South Georgia pintail (*Anas georgica)*, Emperor penguin *(Aptenodytes forsteri)* and King penguin *(A. patagonicus)*, Cattle egret *(Bubulcus ibis)*, White-rumped sandpiper *(Calidris fuscicollis)*, Black-necked swan *(Cygnus melanocoryphus)*,Wandering albatross *(Diomedea exulans)*, Black-browed albatross *(Diomedea melanophris)*, Macaroni penguin *(Eudyptes chrysolophus)*, Southern fulmar *(Fulmarus glacialoides)*, Blue petrel *(Halobaena caerulea)*, prions *(Pachyptila* spp.*)*, Snow petrel *(Pagodroma nivea)*, Light-mantled sooty albatross *(Phoebetria palpabrata)*, Soft-plumaged Petrel *(Pterodroma mollis)*, Pomarine skua *(Stercorarius pomarinus)*, Arctic tern *(Sterna paradisaea)* and Antarctic petrel *(Thalassoica antarctica)*).

In the summer months more than 600 Elephant seals (*Mirounga leonina*) and up to 1200 Antarctic fur seals (*Arctocephalus gazella*) rest and moult in the area. Furthermore, about 100 Weddell seals (*Leptonychotes weddelli*) and a few Crabeaters (*Lobodon carcinophagus*) and Leopard seals (*Hydrurga leptonyx*) visit the coast at regular intervals. In recent years, Crabeater, Elephant, Fur, Leopard and Weddell seals have also been breeding on the Fildes Peninsula.

Flora

The amount and type of terrestrial vegetation depends on relief, soil moisture content, and the degree of soil enrichment from birds and seals. The area is home to two flowering plants - Antarctic hair grass *(Deschampsia antarctica)* and Antarctic pearlwort *(Colobanthus quitensis*). Some areas, especially Ardley Island, are densely covered by moss carpets. A total of about 175 lichen and 40 moss species have been identified in the area. Two alien angiosperm species, a grass in the genus *Deschampsia* and one in *Poa* have become established.

ii. Infrastructure in the area

Existing permanent structures

Buildings and other infrastructure elements have been constructed in the area by Argentina, Brazil, Chile, China, the former GDR, Russia and Uruguay although a few have since been dismantled and removed.

List of existing research stations and field huts on the Fildes Peninsula and their current population (data from Council of Managers of National Antarctic Programmes COMNAP and the King George Island GIS Project).

operating nation	name of station or *field hut*	location	opened in	population summer	winter
Argentina	*Ballve*	62°12´36´´S 58°56´03´´W	1954	-	-
Chile	Professor Julio Escudero	62°12´05 ´´S 58°57´45´´W	1994	20	1
	Presidente Eduardo Frei	62°12´03 ´´S 58°57´45´´W	1969	150	60
	Teniente Rodolfo Marsh airport	62°11´37´´S 58°58´49´´W	1982		
	Refugio Ripamonti (former GDR hut)	62°12´42´´S 58°55´01´´W	1981	-	-
	Julio Ripamonti	62°12´36´´S 58°56´06´´W	1994	-	-
China	Great Wall	62°13´01´´S 58°57´43´´W	1985	20	11
	Refuge container	62°13.826´S 58°59.100´W	2009		
Russia	Bellingshausen	62°11´54´´S 58°57´34´´W	1968	35	11

	Priroda	62°08´59´´S 58°56´39´´W	1987	-	-
Uruguay	Artigas	62°11'05´´S 58°54'13´´W	1984	20	9

A further permanent structure is the Laboratory on Cosmic Radiation (Italian-Chilean Project) (62°12´08´´S, 58°57´43´´W).

Minor and semi-permanent structures (subtotal)

- Light house on Ardley Island erected by Argentina (at Punta Faro, 62°12´37´´S, 58°55´35´´W)
- Fuel tanks of the Russian Station Bellingshausen (62°11´34´´S, 58°56´06´´W)
- Russian huts near tanks (62°11´47´´S, 58°56´09´´W)
- Memorial cross south west of Frei Station (62°12´08´´S, 58°57´37´´W)
- Wooden beacon near highest point on Ardley Island (62°12´52´´S, 58°55´53´´W)
- Wooden beacon south west of Frei Station (62°12´19´´S, 58°57´17´´W)
- Wooden beacon at Point Christian (62°11´55´´S, 58°56´57´´W)
- Memorial plaque on the former position of the Brazilian field hut “Rambo” (62°09´55´´S, 58°57´56´´W)
- Uruguay Beacon at Suffield Point, solar powered, navigational aid inserted into the charts and notices to mariners.

6. Protected Areas and Managed Zones within the ASMA

i. Protected Areas, Historic Sites and Monuments

Within the proposed ASMA, two areas are designated as ASPAs and two as HSMs. In addition, there is a ship wreck that should probably be listed eventually as a HSM.

- ASPA No. 125 comprising two geologically interesting sites on the Fildes Peninsula (62°10´50´´ - 62°11´28´´S, 58°55´27´´ -58°56´38´´W, and 62°12´30´´ - 62°13´30´´S, 58°57´11´´ - 58°59´32´´W)
- ASPA No. 150 comprising Ardley Island (62°12´30´´ - 62°13´06´´S, 58°54´53´´ - 58°57´09´´W)
- HSM No. 50 plaque on a cliff south-west of the Chilean station Frei to commemorate the Polish research vessel ‘Professor Siedlecki’ and trawler ‘Tazar’ (62°12'S, 59°01'W)
- HSM No. 52 monolith in the Chinese Station Great Wall to commemorate the foundation of the station(62°13'S, 58°58'W)
- HSM No. 82 monument to the Antarctic Treaty and Plaque located close to the Frei, Bellingshausen and Escudero Bases commemorating the Signatories to the Antarctic Treaty and successive International Polar Years (62º 12' 01" S; 58º 57' 41" W)
- Ship wreck in Maxwell Bay (62°11´12´´S, 58°54´02´´W; IP107, XXVII ATCM/IP 107)

ii. Managed Zones within the Area

The aim of zoning is to protect the natural and cultural features of the area by defining suitable areas for the different kinds of activity. The proposed plan divides the ASMA into five types of zone (areas with threatened species, vegetation, sensitive geological features etc.) and defines the kind and amount of human activity appropriate to each. The five kinds of zone are Facility Zones, Restricted Zones, Sensitive Zones, Visitor Zones and Wilderness Zones (see Map 3). The following zoning system is suggested:

Facility Zones

These zones provide suitable locations in which access and support operations can be conducted and permanent facilities located. These zones should thus incorporate all research stations, the airport, official roads, and all other kinds of infrastructure. Some sea areas and air space should also be included to accommodate the air and sea traffic of the area. Special management guidelines should be applied in these zones to ensure environmental and human safety (see Map 3 and Appendix 3).

Visitor Zones

These zones provide appropriate management of low-impact, short-term, land-based visitor activities in the area. They help balance the need to protect nature while, at the same time, maximising visitor experience and enjoyment. These zones can be safely accessed and offer a range of attractions in close proximity. There is already one *Visitor Zone* in ASPA No. 150 near the penguin rookery in the northern part of Ardley Island. Further *Visitor Zones*, including recommended walking routes or foot paths, could be established near the Russian hut “Priroda”, the Chilean and Russian stations, the western coast between the airport and Flat Top Hill, along the beach south of the Chinese station, and east of the Uruguayan station towards Nebles Point (Map 3, see Appendix 6).

Sensitive Zones

These would include places of special biological interest such as patches of dense vegetation, sites occupied by medium-sized breeding groups of Southern giant petrels, or other seabird and seal sites. This classification would ensure that visitors were aware of the vulnerability of species at these sites. Human activities should be minimised in these zones and permanent facilities should not be installed.

Possible *Sensitive Zones* (see Map 3) are:

- Geologists Island (northern part): breeding site of Southern giant petrels
- South Fildes opposite Dart Island: breeding site of Southern giant petrels
- East and south of the Russian hut “Priroda”: breeding site of Southern giant petrels
- Nebles Point: breeding site of Southern giant petrels
- dense vegetation
- Northwest corner and central north beach of Ardley Island: breeding site of Southern giant petrels

Restricted Zones

These comprise areas of natural value that are highly sensitive to damage by human activities. In these areas it is desirable that human disturbance is kept to the absolute minimum. Two Summit Island and Dart Island could be defined as *Restricted Zones* (see Map 3), because large numbers of Southern giant petrels (IUCN red species list, category ‘Near threatened’) breed on these islands. Human visits to these colonies should be prevented because they would cause nesting birds to fly off the nest and this in turn could allow increased predation on eggs and chicks. Landing helicopters on these islands should also be prevented, a practice that might interest helicopter operators if tourism increases further. The prevention should extend to helicopter sightseeing as this could also threaten the birds. Zoning as restricted would aid in minimising such problems. To maintain the undisturbed state of areas so zoned, only very important scientific research and unavoidable management activity should be allowed.

Wilderness Zones

These would cover all areas within the ASMA not classified as Facility Zones, Restricted Zones, Sensitive Zones or Visitor Zones. Management of human activities should aim to maintain the quality of a relatively undisturbed wilderness. Establishing permanent facilities should therefore not be permitted in these zones but scientific research, environmental monitoring and management activities should be allowed.

7. Code of Conduct

The general management and operational requirements are stated in the following. Additional guidelines are given in the Appendices.

i. Access to and movement within the area

Access to the area is possible by sea and air. Vessels enter Maxwell Bay and anchor close to the research stations to the best of its ability based on its tonnage. Zodiacs and other boats transport people and cargo to the main landing sites in front of the stations. Air access is usually through the Chilean airport which is capable of taking large and small fixed-wing machines as well as helicopters. It is the operational centre for a large number of stations in the South Shetland area. Therefore, there are frequent transfers of station personnel, visitors and cargo not only to the research stations of the Fildes Peninsula but also to vessels in Maxwell Bay that supply stations in other areas. Regulation of this traffic requires the designated of specific landing sites for planes and helicopters. Landing at other sites in the area should be only permitted when supporting scientific investigations or in case of emergencies (according to WAM, AFIM and ATCM Resolution 4 (2004). All land traffic and pedestrian movement within the area should be undertaken in such a way as to minimize damage to vegetated ground and to soils. There should be no extension of the road network between the stations and field huts except for scientific purposes or in case of emergencies. Foot paths for people working in or visiting the area are already established in the Facility zones and Visitor zones but should be kept to a minimum in all other zones.

ii. Activities that may be conducted in the area

These activities could include scientific research, logistic operations in support of science, management, visitor activity and education. Science is not restricted at any site but in restricted zones it should be allowed only if absolutely necessary. ASPAs guarantee that science should interfere little with other activities. All other activities should be conducted within the designated zones with logistics being concentrated in Facility Zones, and visits and education mainly being carried out in Visitor Zones. This separation of activities reduces cumulative effects on the environment and protects the values of the area.

All human activities in the area should take place in such a way as to minimize detrimental effects on the environmental. Collection and removal of material endogenous to the area is only to be permitted for scientific, management or educational purposes.

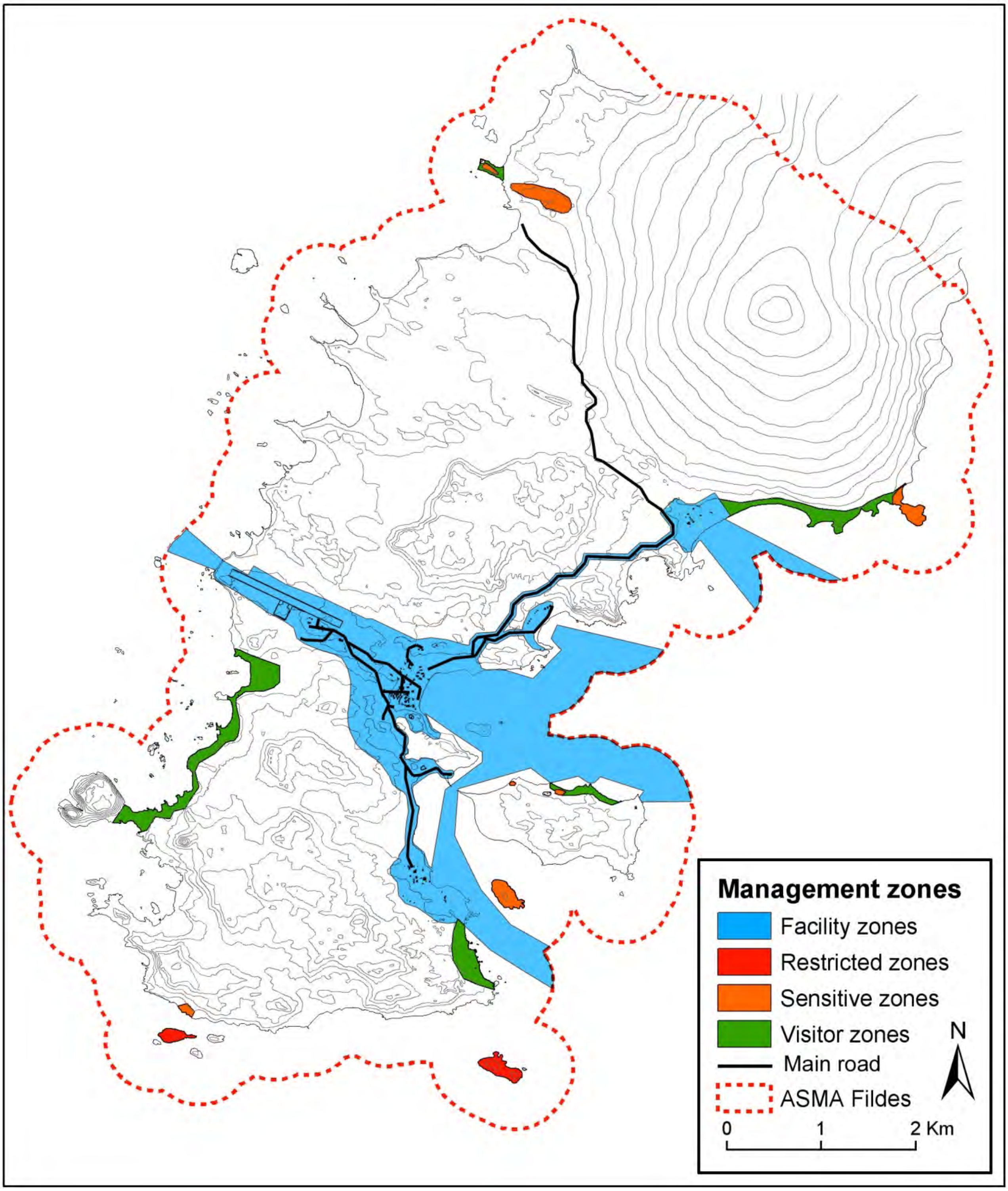
Iii Installation, modification or removal of structures

Special care has to be taken when installing, modifying or removing infrastructure from any site in the area. Disturbance of wildlife, movement of soil, noise and pollution should be kept to a minimum. No infrastructure should be permanently installed outside the Facility Zones. Environmental impact assessments are essential before any new installation and should be considered by the area's Coordination Group.

Field camps for scientific purposes can be set up temporarily in small areas but require the permission of national authorities or of the Managers of National Antarctic Programs. A few sites within Visitor Zones could be used as campsites for tourists but special attention needs to be given to minimising their impact on the environment. Campsites should be located as far away as practicable from wildlife, lakes, streambeds and long-term experiments, to avoid damaging or contaminating them. Individuals or groups should bring sufficient equipment to ensure safety.

iv. Reporting requirements

Reports of activities in the area should be coordinated and maintained by the Coordination Group in order to facilitate science and minimise cumulative effects. Inspection visits should occur frequently and reports on these visits should be considered in order further to reduce detrimental human effects on the environment. Any incidents in which protected values of the area are damaged need to be reported to the Coordination Group. Tour operators should report their visits to authorities in the stations that want to be visited and to IAATO.



8. Maps

Map 1: The 'Fildes Peninsula Region ASMA' No. *** located on King George Island, South Shetland Islands, Antarctica.

Map 2: The ‘Fildes Peninsula Region ASMA’ No.***

Map 3: Proposed zones within the possible ‘Fildes Peninsula Region ASMA’ (revised by Uruguay). All areas inside the proposed ASMA that are not classified as one four zone types listed could be classified as Wilderness Zone.

9. Supporting Documents

- Management Plan for ASPA No. 150 – Ardley Island (Appendix 1)
- Management Plan for ASPA No. 125 – Fildes Peninsula (Appendix 2)
- Code of Conduct for the Facilities Zones (Appendix 3)
- Code of Conduct of Scientific Research (Appendix 4)
- Code of Conduct for Visitors (Appendix 5)

Appendix 1: Management Plan for ASPA No. 150 – Ardley Island

Ardley Island (62°13' S; 58°56' W) was designated as Site of Special Interest (SSSI) No. 33 through Recommendation XVI-2 in 1991. Chile proposed the designation due to the island’s diverse community of birds and terrestrial plants. It is since been renamed as Antarctic Specially Protected Area No. 150. The area is used for intensive research, but also has an adjoining visitor zone. The area’s management plan was recently revised (Measure 6 (2009) ATCM XXXI).

Appendix 2: Management Plan for ASPA No. 125 – Fildes Peninsula

The ‘Antarctic Specially Protected Area’ No. 125 (former SPA No. 12 at ATCM IV, 1966, redesignated SSSI No. 5 at ATCM VIII, 1975) has been designated in order to protect two geologically important sites with unique fossil *ichnolites* and outcrops of Tertiary strata.

At ATCM XXXI it was completely revised because of new fossil finds and localities (Measure 6 (2009)). Now the ASPA No. 125 consists of eight different sites distributed over the Fildes Peninsula.

Appendix 3: Code of Conduct for the Facility Zones

1. Introduction

The Fildes Peninsula Region ASMA contains Facility Zones which include P. Frei and Escudero Stations (Chile), Great Wall Station (China), Bellingshausen Station (Russia) and Artigas Station (Uruguay) and the Chilean airport. It also includes infrastructure outside stations (all field huts, fuel tanks, lakes connected with pipelines for water supply), main roads, and beach areas used for logistic operations -influence area-. Activities within these zones are to be undertaken according to the following Code of Conduct the aims of which are to

- assure the health and safety of station personnel, researchers and visitors;
- facilitate scientific investigation in the area by establishing and maintaining supportive infrastructure;
- protect the natural, scientific and cultural values of the facilities zone.

A copy of the complete Fildes Peninsula Region ASMA Management Package will be kept at the Chilean, Chinese, Russian and Uruguayan Stations where relevant maps and information posters about the ASMA will also be available. The Station Leader or the Station Environmental Officer should brief station personnel on arrival about environmental management in the field, the location of protected areas, and the provisions of the ASMA Management Plan. Visitors should be made aware of the content of this Code of Conduct before arriving at the stations.

2. Station operation, construction and removal

2.1. Waste Management

Waste management should be included in the planning of all activities at the Chilean, Chinese, Russian and Uruguayan Stations. The detailed instructions are given in Annex III of the Environmental Protocol. Hazardous material should be removed from the Antarctic Treaty Area. Regular cleaning of rubbish from station grounds and surrounding areas reduces its dispersal into the environment by wind or birds. Cooperation between stations in clean-ups can increase their efficiency <u>if needed or requested</u>. Historical waste sites that cause adverse impacts should be cleaned up as soon as possible.

2.2. Use of water

Water sources need to be separated from any handling or disposal of wastes, fuel or other chemicals. Regular tests of water quality and routine cleaning of water holding tanks are necessary. Used station water should not be disposed of into the environment without treatment. Filter systems need to comply with current standards.

2.3. Generation of power

Regular inspections and modernisation of generators is required to reduce emissions and fuel leaks. Solar and wind power should be used as much as possible to minimize fuel demand.

2.4. Handling of fuel

The regular inspection of fuel storage facilities, supply pipe lines, pumps, reels and other fuel handling equipment is of high priority. Storage areas should be secured by siting them a safe distance from living quarters and from electrical supplies. In order to avoid incidences of fuel spills, *e.g.* during fuel transfer, all measures must be considered <u>(see COMNAP guidelines</u>). Any spills must be treated immediately with sufficient equipment according to Oil Spill Contingency Plans <u>of</u> each station with all available help by other stations on site. Oil spills shall be reported immediately to the Coordination Group <u>in time</u>. Station personnel should undergo regular emergency training.

2.5. Prevention of fire

Flammable substances need to be appropriately labelled. Fire fighting equipment should be available at dangerous sites like fuel stores and vehicle parks. Regular checks of electricity cables reduce the risk of short circuits.

2.6. Construction and removal of infrastructure

An Environmental Impact Assessment should be undertaken before any construction or removal of buildings according to Annex I of the Environmental Protocol.

3. Traffic management

3.1. Land traffic

Vehicles should only be used around and between the stations when necessary. The existing road network should not be enlarged without a clear scientific or logistic purpose. Appropriate facilities must be provided for secure refuelling and servicing of vehicles. Any wildlife disturbance, vegetation damage, or interference with scientific work should be avoided.

3.2. Air traffic

Aircraft will generally take off from and land at the Chilean airport but the helicopter pads at the Chilean, Chinese, <u>Russian</u> and Uruguayan stations can also be used where there are <u>scientific, logistics support and rescue</u> reasons. All air traffic should be conducted <u>according to AFIM and WAM</u> within the facility zones avoiding all other zones within the ASMA boundary as far as possible. Special care should be taken when flying over land to reduce potential negative impacts on wildlife. Special guidelines should be followed as stated in the management plan of ASPA No. 150 and ATCM Resolution 4 (2004).

3.3. Sea traffic

Small boat and zodiac use should be concentrated in the marine areas within the facility zones as far as possible and only in support of scientific, logistic and tourist operations. All boats need to be operated by more than one person and be equipped with life jackets and VHF radios. Weather conditions need to be suitable to reduce the risk of accidents. For safety a second boat can be used or stay on stand-by for immediate support in an emergency.

4. Field excursions

The station leader or the station environmental officer will brief field parties on environmental management in the field, the location of protected areas, and the provisions of the ASMA Management Plan. All waste from field parties, except for human waste (faeces, urine and gray water) will be returned to the stations for safe disposal. All field parties will be equipped with VHF radios.

5. Protected Areas

ASPA Nos. 125 and 150 are located in the area. Station members will be made aware of the location of these areas and the restrictions on access to them. Information about the ASPAs including the management plans will be displayed in all stations.

6. Flora and fauna

Any activity involving the removal or harmful interference with native flora or fauna (Annex II to the Environmental Protocol) is prohibited unless authorised by a permit issued by the appropriate authority. Minimum approach distances to birds or seals should be followed to reduce disturbance. Scientists and visitors should take care near wildlife particularly in the breeding and moulting seasons. Birds are not to be fed on station food. Food wastes should be hidden to prevent scavenging by birds. The introduction of non-native species should be avoided by cleaning clothes, boots and equipment before entering the area. Each registered introduction of non-native species should be reported to the Coordination Group.

7. Visitors

Any visits to the Chilean, Chinese, Russian and Uruguayan stations should be arranged by informing the station leaders of the planned activity. Contacts are made via Marine VHF. Station leaders will coordinate visits to stations with expedition leaders. Visitors will be informed about the principles of this code of conduct and the ASMA management plan. They should follow visitor guidelines (Recommendation XVIII – 1, IAATO). The station leaders will appoint guides to present station-specific information.

Appendix 4: Code of Conduct for Scientific Research

Scientific investigations have priority among human activities in the Antarctic. Science activities in the area include research on the fauna and flora, on fossils, climate, glaciers, streams, lakes, soils, and local geology and geomorphology. The following guidelines for scientific conduct seek to reduce the environmentally detrimental impact of research in the area. They are following the SCAR's environmental code of conduct for terrestrial scientific field research in Antarctica (IP 4 XXXII ATCM) and should be applied by all scientists.

Introduction

1. Antarctica contains many unique geological, glaciological, and biological features. This landscape and its biological communities have limited natural ability to recover from disturbance. Many features could be easily and irreversibly damaged. This Code of Conduct provides recommendations on how scientists and/or associated personnel can undertake scientific field activities while protecting the Antarctic environment for future generations. These protocols ensure that human presence will have as little impact as possible. All personnel undertaking scientific research should be familiar with this Code of Conduct.

2. The Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol) provides a basis for environmental protection and management in the Antarctic. Climate change and increasing pressure from human activities suggest that comprehensive guidelines are needed to protect the unique features of Antarctica. This Code of Conduct complements the relevant sections of the Protocol and provides guidance for researchers conducting land-based field research (limnological, terrestrial, coastal/littoral, glaciological, biological and geological) in the area of land and permanent ice south of 60 degrees south. A 'field' activity is defined here as any scientific activity, and the logistics to support this activity, which is conducted in the natural environment, irrespective of its duration.

3. All countries with permanent and summer scientific stations are encouraged to include this Code of Conduct within the operational procedures of the Station and to ensure that personnel undertaking or supporting field scientific research follow this Code of Conduct.

4. It is recommended that this Code of Conduct be followed by all personnel undertaking scientific research to the maximum extent possible and as long as it does not affect the safety of the expedition.

General Guidelines

1. Antarctic scientists potentially have a higher chance of carrying alien propagules (e.g. seeds, spores, eggs, live insects) to Antarctic ecosystems than other Antarctic travellers because their field of study often takes them to alpine or northern polar habitats. In the process of conducting research within these habitats Antarctic scientists can inadvertently entrain propagules on clothing, equipment and equipment cases. If these items are then taken to the Antarctic and they have not been cleaned/ sterilised to remove or kill the propagules, an opportunity to transfer such material to Antarctica is created. The ecological potential for establishment of northern polar or alpine taxa is great as such species are adapted to cold environments. Equipment should be properly cleaned before it enters the Antarctic.

2. The implications of human transfer of taxa between locations can range from the modification of the genetic structure of populations to changes in local biodiversity and subsequent flow-on effects on community dynamics. Human transfer may involve species (or their propagules) from sites outside Antarctica, and such species would in most cases be considered alien. However, species indigenous to Antarctica, or that live both in Antarctica and in non-Antarctica areas can also be moved around. Many such species show strong genetic variation between different sites within Antarctica. Therefore, care should be taken not to move indigenous species around either. Such accidental movement of indigenous biota would compromise scientific studies of molecular adaptation, regional evolution and biogeography and reduce the inherent value that Antarctica offers as a system with limited anthropogenic influence.

3. Your field activities in Antarctica should be designed to have as little environmental impact as possible.

Before going into the field

4. Report your planned activity to your National Operator as thoroughly as possible and well in advance, in order to allow an assessment of the environmental impact you may cause on the field site(s) you visit, as required by Annex I of the Protocol for Environmental Protection.

5. Everything taken into the field must be returned to your station for proper cleaning where that is feasible and safe to do so.

6. To avoid introduction of alien species, chemical contamination, and transfer of materials between sites,

(i). Ensure that all your equipment and clothing, including footwear, is thoroughly cleaned.

(ii). Avoid taking unnecessary packaging and materials into the field. Several products used for packaging are prohibited in Antarctica, such as polystyrene beads or chips

(iii). Wherever possible, all precautionary measures should be taken to ensure collection and removal of human waste and grey water.

Once in the field

7. You should take particular care in areas with sensitive biological or geological features such as bird and seal colonies, roosting areas, vegetated areas, freshwater lakes and ponds, sand dunes, screes, fluvial terraces, ice core pyramids and ventifacts.

8. Avoid areas where wildlife is easily disturbed, especially during the breeding season. Remember than you are only allowed to cause disturbances to wildlife if scientifically justified and if you have been issued with a permit by an appropriate national authority

9. Even if you have a permit, avoid unnecessary disturbance to Antarctic flora and fauna.

10. Take only those samples (geological material, biological material, ice) for which you have permits and protect resources by taking as small a sample as possible.

11. You should map, record (preferably using GPS coordinates), and report to your national operator the location of any spill, camp site, soil pit, drilling site, sampling site, or any other disturbance for the benefit of future researchers.

12. You should try to minimise your impacts when moving around in the environment:

(i). Stay on established trails when available.

(ii). Avoid walking on vegetated areas, streambeds, lake margins, and delicate rock and soil formations.

(iii). Restrict ground vehicle usage to snow and ice surfaces, or designated tracks, wherever possible.

(iv). Where feasible, use recognized helicopter landing sites and ensure that markers for helicopter pads are clearly visible from the air.

(v). Minimise the disturbance to wildlife by following the ATCM guidelines for operations of aircraft near concentrations of birds.

(vi). You should restore any disturbances caused by your activity.

(vii). Algae and invertebrates live beneath stones. Moving rocks and stones should therefore be minimized.

(viii). Do not build cairns.

Management of scientific field sites

13. Prior to conducting any scientific activity, it is essential that you carefully consider and clearly define the scope of your activity, including its area, duration, and intensity.

14. Be aware of the cumulative impacts of the activity, both by itself and in combination with other activities within the region. Consider lower impact alternatives to the activity and re-use of existing facilities wherever possible.

15. In order to minimise environmental impacts of your field activity you should:

(i). Choose sites as close as possible to your research station, use existing pathways

(ii). Limit the number of visitors to your field site to the number of people required to carry out the fieldwork.

(iii). Where possible avoid areas that are especially vulnerable to disturbance such as vegetated areas, breeding sites, patterned ground, and water bodies.

(iv). Re-use existing sites wherever possible.

(v). Make sites no larger than needed for the proposed scientific activities.

(vi). Keep your site tidy during use.

(vii). Avoid activities which could result in the dispersal of foreign materials into the environment. In particular, avoid the use of spray paint, and conduct activities such as sawing or unpacking inside a tent or hut.

(viii). Secure equipment from being blown away or stolen by inquisitive birds (e.g. skuas, penguins).

(ix). Ensure there is the capacity to prevent and respond promptly and effectively to any environmental accident or incident.

16. Restore sites as far as feasible when your work is complete and take GPS coordinates for future reference. Remember that sites may require subsequent monitoring to comply with the Protocol for Environmental Protection

17. As it is important to prevent the introduction of foreign materials and contaminants into the environment:

(i). Avoid materials liable to shatter at low temperatures, e.g., polyethylene-based plastics.

(ii). Take care when handling fuel, chemicals and isotopes (stable or radioactive).

(iii). Store and handle fuel and chemicals using appropriate containers.

(iv). Use drip trays where possible when handling fuels or other liquids and take special care when handling fuel in high winds.

18. You should report any environmental accident or incident to your national operator.

19. If you plan to install equipment in the field:

(i). Ensure an environmental impact assessment is undertaken prior to any installation, as required by Annex I to the Protocol for Environmental Protection.

(ii). Clearly identify any equipment by country, name of the principal investigator and year of installation, and state the duration of the deployment.

(iii). Make sure installations can be retrieved and removed when no longer required, unless it is impractical or result in a higher environmental impact.

20. Do not displace materials or collect samples of any kind, except for scientific and educational purposes.

21. When taking samples from live animals ensure that the requirements set out in the "SCAR Scientific Code of Conduct for Experiments on Animals" (in preparation) are followed.

Field camps

22. Camping and scientific equipment should be cleaned before being brought into the Antarctic or before being transferred between sites.

23. Minimise the environmental footprint of your field camp by:

(i). Locating it as far as feasible from lake margins, stream beds and associated fans, and vegetated areas, to avoid damage or contamination.

(ii). Taking special care to ensure that no food or wastes are accessible to animals.

(iii). Re-using campsites whenever possible.

(iv). Keeping it tidy during use and restoring it, as far as is feasible, after use.

(v). Using solar and wind power as much as possible to minimize fuel usage.

24. Ensure that equipment and supplies are properly secured at all times to avoid dispersion by high winds or helicopter downdrafts. Remember that in some locations high velocity katabatic winds can arrive suddenly and with little warning.

25. Remember that if you are working in an ASPA or ASMA the management plan may have additional requirements for field camps and you will need to follow any conditions contained in your entry permit.

Habitat specific guidelines

Lakes and streams

26. Choose sampling equipment which is the least destructive, when the aquatic or coastal environment is to be sampled. Sample carefully and avoid cumulative impact. Dredges, trawls and box corers should be used as little as possible, avoiding excessive and unnecessary sampling.

27. Aquatic ecosystems in Antarctica are extremely poor in nutrients (except those with animal influence) and thus very sensitive to anthropogenic pollution. All visitors must take care to eliminate or minimize releases of human waste wherever possible.

28. You should avoid walking in the stream and lake beds, or too close to their margins as this may

disturb biota, affect bank stability and flow patterns. When a crossing must be made, use designated crossing points if available, otherwise walk on rocks.

29. Minimize the use of vehicles on lake ice if possible. If access to the water body is required for scientific research, use non-motorised boats whenever possible.

30. Ensure that all sampling equipment is tethered or otherwise secured and does not contaminate the water body.

31. Clean all sampling equipment before using it in another water body in order to avoid cross-contamination. Alternatively, use separate equipment in different sites.

32. Wherever possible you should use flumes, not weirs, when monitoring streams, or ensure that the stream will remain as it was before the study.

33. You should try to avoid the use of stable isotope tracers at the complete ecosystem level, use them as much as possible only in closed vessels. You should consider naturally occurring tracers. Radioactive isotope tracers should never be used, except in closed vessels. No stable or radioactive isotope tracers waste should be disposed into ecosystems. You should document all tracer use (location, type of tracer, amount).

34. To avoid introduction of contaminants or disturbance of the stratification of the water body and its sediments:

(i). Do not swim or dive in lakes, unless it is required for scientific purposes.

(ii). Remove all unwanted water and sediment materials from the site, even on permanently icecovered lakes, rather than discharging them back into the lake.

(iii). Ensure that you leave nothing frozen into the lake ice that may ablate out.

(iv). Consider using ROV’s as a tool for underwater and under-ice research in lakes and coastal/littoral habitats.

Terrestrial environments

35. Terrestrial vegetation includes very slow growing species. Damage by trampling will remain for years or even decades. Many terrestrial invertebrate species live in soils and feed on soil algae.

36. You should use existing paths in order to avoid disturbing large areas of vegetation and soil.

37. Clean all equipment and footwear, as far as is feasible, between sites to avoid transfer of propagules among sites.

38. When sampling in vegetated areas ensure that the vegetation is replaced and the site restored as far as is feasible.

39. Limit the use of mechanical equipment for sample collection, whenever possible.

40. When sampling soil in desert areas, use groundsheets to contain excavated material to minimise the extent of damage to the desert pavement. Backfill soil pits and as far as feasible replace the desert pavement materials at the soil surface to restore the site appearance.

41. Do not disturb or remove rocks, fossils, or ventifacts unless it is necessary for your research.
Glaciers and ice fields

42. Remember that the use of water in hot water drills could contaminate the isotopic and chemical record within the glacier ice.

43. Given that the hydrological systems under glaciers and ice sheets are connected to the wider environment and downstream contamination could occur, exercise caution when using chemical based fluids to drill to the base of an ice sheet.

Appendix 5: Code of Conduct for Visitors

This code of conduct has been produced for all visitors to the area (except for scientific purposes) including commercial tour operators (IAATO and non-IAATO members), private expeditions, and delegations of National Antarctic Programs when undertaking recreational visits.

There are a few sites in the Fildes Peninsula Region which may generally be visited: all Facility Zones, the Russian hut "Priroda", coastal sites south of the airport towards Flat Top Hill, east of the Uruguayan Station towards Nebles Point, the specified area on Ardley Island, and the beach south of the Chinese station (see Map 3). Visits to the stations are only permitted by prior agreement with the station leaders. Visits to other sites in the area are discouraged.

The following general guidelines apply to all the above sites visited in the Fildes Peninsula Region:

- Visits are to be undertaken in line with the Management Plan for the Fildes Peninsula Region ASMA ***, with Recommendation XVIII –1, and with IAATO visitor guidelines.
- All visits should be conducted in a way to reduce any risk to human safety.
- Vessels approaching Maxwell Bay must announce their planned activities via Marine VHF to the appropriate stations.
- Captains of all vessels in Maxwell Bay should wherever practicable contact local authorities to arrange positioning in the anchorage and landing procedures (according to IMO regulations).
- For commercial tourist operators, no more than 100 passengers may be ashore at a site at any time, accompanied by a minimum of one member of the expedition staff for every 20 passengers. For Ardley Island special requirements need to be considered unless differently stated by specific management plans or guidelines for specific areas (within the ASMA).
- In order to prevent biological introductions, carefully wash boots and clean clothes and equipment before landing.
- In the vicinity of wildlife, walk slowly and carefully. Maintain a precautionary distance of 5 metres from wildlife and give animals the right of way. Increase this distance if any change in behaviour is observed.
- Where possible visitors should stay in compact groups
- Do not walk on vegetation like mosses, lichens and vascular plants. Walking on the alga *Prasiola crispa* (associated with penguin colonies) is permissible as it will not cause it any adverse disturbance.
- Do not take biological or geological souvenirs or disturb artefacts.
- If there is marked path or zone, do not leave it.
- Do not leave any litter.
- Do not write or draw graffiti on any man-made structure or natural surface.
- Do not touch or disturb any types of scientific instruments or markers.
- Do not enter any field hut if not permitted.
- Station leaders should be asked about site-specific guidelines.

Appendix 4

WP 41

Agenda Item:	CEP 7a
Presented by:	Chile, Germany
Original:	English

Fourth Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island

Fourth Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island

1. Introduction

At CEP VII, Germany introduced IP 005 *Research Project Risk assessment for the Fildes Peninsula and Ardley Island and the development of management plans for designation as Antarctic Specially Protected or Managed Areas*. This paper described the below mentioned German three-year research project (2003 – 2006) and introduced it for the first time. Several CEP members expressed their support for the proposal, and indicated that they would willingly assist Germany in the project.

At CEP VIII, Germany introduced IP 016 *Progress Report on the Research Project Risk assessment for Fildes Peninsula and Ardley Island and the development of management plans for designation as Antarctic Specially Protected or Managed Areas*. This paper provided an update of the project, noting the excellent cooperation with other Parties in the area through an informal co-ordination group.

At ATCM XXVIII, Germany agreed that prior to tabling a draft Management Plan for Fildes Peninsula and Ardley Island (King George Island) and following a proposal by Chile an International Working Group should be established. This Working Group should be composed of those Parties with stations and/or huts in the area, Parties with an interest in the area as well as Observers to the Antarctic Treaty. It should discuss the issues related to the Draft Management Plan. For this purpose, Germany would organize two international workshops, one in September 2005 and another one in January/February 2006, in order to convene the participants on this issue" (Final Report of ATCM XXVIII, para. 90).

At CEP IX, Brazil, China, Germany, the Republic of Korea and the Russian Federation introduced WP 022 *Possibilities for Environmental Management of Fildes Peninsula and Ardley Island. Proposal to establish an Intersessional Contact Group*. This paper reported on the main findings and recommendations of the King George Island Workshop "Possibilities for Environmental Management of Fildes Peninsula and Ardley Island" in January/February 2006 as well as on the outcome of the Workshop "Human impact on terrestrial habitats in the Antarctic" in September 2005". Discussion of this paper is reflected in paragraphs 70 to 75 of the CEP Report.

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At CEP X, Germany introduced IP 112 *Possible Modules of a "Fildes Peninsula region" ASMA Management Plan*. Further, Germany and Chile introduced IP 22 rev. 1 *Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island*. Comments of 15 IWG parties to four questions concerning the future management of the Fildes Peninsula Region were reported. Further, Chile introduced IP *117 Workshop on Coordination of Activities in the Fildes Peninsula Region*.

At CEP XI, Germany introduced IP 30 *Final Report on the Research Project "Risk assessment for Fildes Peninsula and Ardley Island and the development of management plans for designation as Antarctic Specially Protected or Managed Areas"*. It contained a proposal for a "Fildes Peninsula region ASMA Management Plan" which was already presented to CEP X as IP 112 (2007) *Possible Modules of a 'Fildes Peninsula region' ASMA Management Plan* and which was uploaded on the IWG web-based Discussion Forum.

At CEP XII, Chile and Germany introduced WP 004 *Second Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island*. Chile introduced IP 81 *Notes on a Multiple Protection System for some areas in King George Island: Zones under Annex V and their relevance to Fildes Peninsula and adjacent areas*.

At CEP XII, Germany introduced IP 50 *Research Project "Current Environmental Situation and Management Proposals for the Fildes Region (Antarctic)"*

At CEP XIII, Chile and Germany introduced WP 040 *Third Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island.*

2. Work of the IWG for the intersessional period until CEP XIV in 2011

At an informal meeting of the IWG in Punta del Este, it was agreed that the convenors of the IWG, Chile and Germany, would work on a revised draft Management Plan for the Fildes Peninsula taking aboard comments made within the IWG Meeting as well as any written contributions for their submission as part of a Progress Report to the XXXIII ATCM (see Annex 1 "Tasks of the IWG Fildes for the intersessional period until CEP XIV in 2010/2011").

In the previous intersessional periods the draft Management Plan for the Fildes Peninsula has been revised several times on the basis of the comments received by Parties with stations in the area (WP 040 ATCM XXXIII). In 2010, it was revised again on the basis of comments by Uruguay and could be down-loaded from the web-based Fildes Discussion Forum of the Antarctic Treaty Secretariat.

In 2010, the spatial synthesis of the different requirements concerning a possible Facility Zone, which has already begun in 2009, could be finalized on the basis of the maps submitted by all parties with stations in the area (CHL, CHN, RUS, URY, see Annex 2).

The code of conduct for the facility zone as a part of the proposed management plan was revised on the basis of the comments by ASOC and Uruguay (see Annex 3). There are two remaining comments by ASOC, which have not been implemented so far. Before that, these comments need to be discussed further within the next intersessional period by IWG members.

Thus, it appears that not all of the tasks in Annex 1 have been fulfilled. Therefore, we propose to pick up the left tasks again in order to tackle them within the next intersessional period (see chapter 3).

3. Further Steps

The IWG's working plan for the intersessional period 2010-2011 (see Annex 1) could not be finalized. The majority of IWG members running a station in the area did not comment on the last version of the draft Management Plan for the Fildes Peninsula Region as well as on the code of conduct for the Facility Zone.

Some progress has been made with respect to the search for an agreed protection of the Fildes Peninsula Region. However, the following aspects should be taken into consideration and discussed further (unless otherwise agreed at CEP XIV):

- Code of conduct of the Facility Zone (see Annex 3)
- Additional spatial zones like a visitor zone and its corresponding code of conduct and other possible components on the basis of the manifold revised proposal of a management plan for the Fildes Peninsula Region
- The revised proposal of the Management Plan and its relation to the existing and any other potential ASPA included in the region

The participants of the IWG Meeting are kindly invited to continue their intersessional work at the web-based Fildes Discussion Forum of the Antarctic Treaty Secretariat.

In addition, the IWG conveners propose to have an IWG Meeting during CEP XIV in Buenos Aires in order to continue the discussion of all aspects related to the nature, scope and characteristics of a management scheme for the Fildes Peninsula Region.

Annex 1: Tasks of the IWG Fildes for the intersessional period until CEP XIV in 2010/2011

At CEP XIII held in Punta del Este (3 to 7 May 2010) the Convenors Chile & Germany presented the third Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula & Ardley Island (WP 040). In this Progress Report the IWG Conveners propose to have an IWG Meeting during CEP XIII in Punta del Este, Uruguay, in order to continue the discussion of all elements related to the nature, scope and characteristics of a management scheme for the Fildes Peninsula Region, including the suggestions by Uruguay and any other participant regarding the integration of the Fildes Facility Zones, and the revised Management Plan prepared by Germany.

This meeting took place in parallel to CEP XIII on 5 May 2010. The Convenors and the IWG members present agreed to continue their intersessional work at the web-based Discussion Forum of the ATS. They also underlined the importance of the Coordination in the field and encouraged the station managers in Fildes to continue their regular exchange of information. In the end the IWG members discussed the work to be carried out during the next intersessional period and agreed about the following Work Plan:

First Step: Facility Zone until 31 July 2010:

In order to finalise the work regarding the Facility Zone as already agreed on the Punta Arenas Workshop on 30 & 31 July 2009:

(a) If not done so far, all IWG members with stations in the region are invited to submit the spatial definition and its boundaries (proposed location and size) of a possible facility zone around their stations by 15 June 2010,

(b) On the basis of (a), the Convenors will prepare a revised proposal towards an integrated facility zone representing the agreed common boundaries of all parties with stations in the region by 31 July 2010.

(c) All IWG members are invited to submit the missing information/elements in the current concept for the Facility Zone (see Appendix of WP 040 (2010)).

(d) On the basis of (c), the Convenors will prepare the revised concept for the Facility Zone by 31 July 2010.

Second Step: Remaining Zones / current Management Plan until 31 October 2010:

In order to finalise the work regarding the draft Management Plan contained in Annex II of WP 040 (2010):

(a) All IWG members are invited to submit their comments, corrections and amendments of the Codes of Conducts for the remaining proposed zones by 30 September 2010,

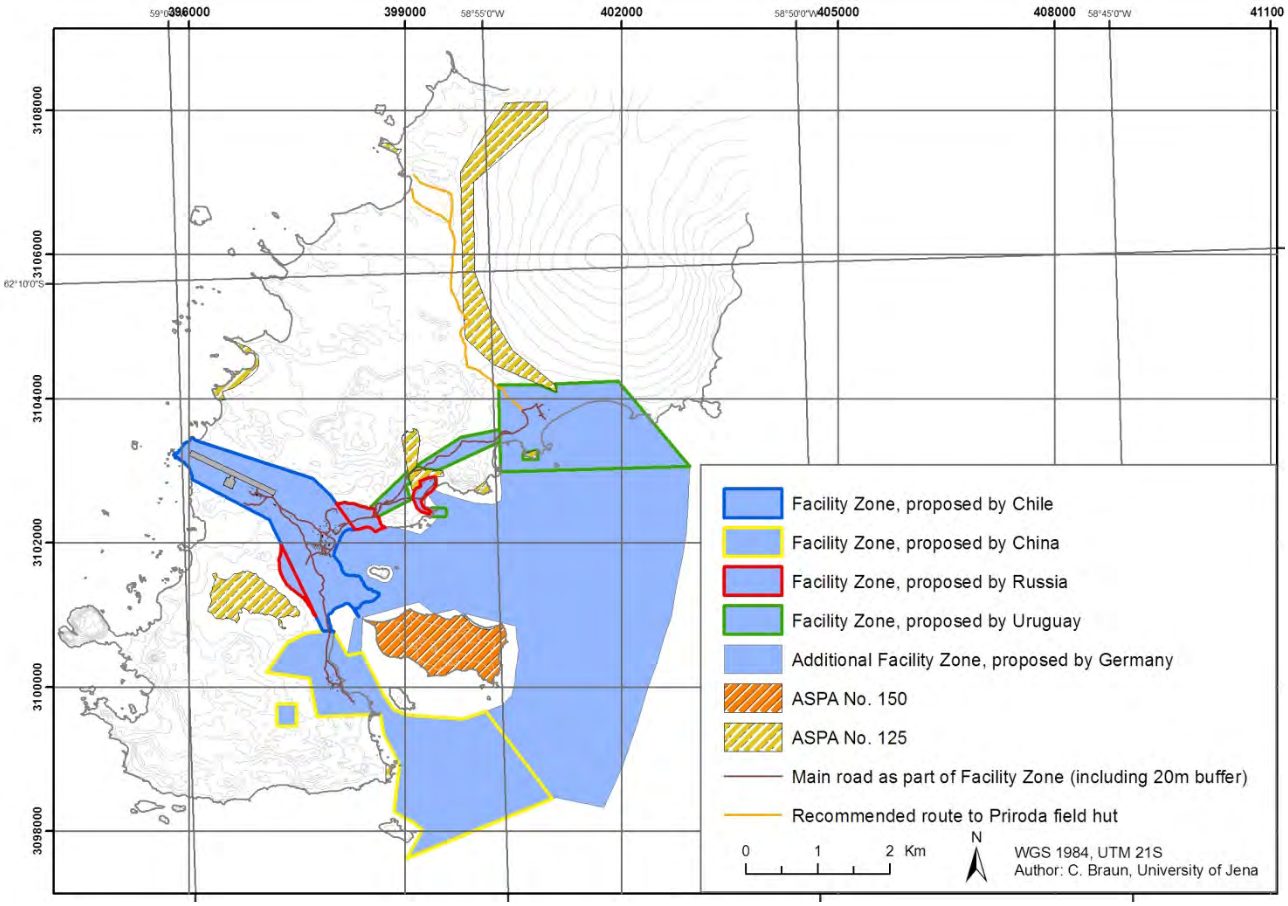
(b) All IWG members are invited to submit their comments, corrections and amendments of possible proposals for other Codes of Conduct and other possible components in the conceptual framework of the current draft Management Plan by 30 September 2010.

(c) The Convenors will prepare a revised draft Management Plan taking aboard comments under (a) and (b) by 31 October 2010.

Third Step: Preparation of the Progress Report to CEP XIV until 31 January 2011:

On the basis of step 1 and step II the Convenors will prepare a Progress Report to be submitted to CEP XIV /ATVM XXXIV by 31 January 2011.

Annex 2: Agreed proposal of a possible Facility Zone within the Fildes Peninsula Region



Annex 3: Code of conduct for a possible Facility Zone within the Fildes Peninsula Region with two remaining comments by ASOC, which could not be implemented so far and they need to be discussed further.

1. Introduction

The Fildes Peninsula Region ASMA contains Facility Zones which include P. Frei and Escudero Stations (Chile), Great Wall Station (China), Bellingshausen Station (Russia) and Artigas Station (Uruguay) and the Chilean airport. It also includes infrastructure outside stations (all field huts, fuel tanks, lakes connected with pipelines for water supply), main roads, and beach areas used for logistic operations -influence area-. Activities within these zones are to be undertaken according to the following Code of Conduct the aims of which are to

- assure the health and safety of station personnel, researchers and visitors;
- facilitate scientific investigation in the area by establishing and maintaining supportive infrastructure;
- protect the natural, scientific and cultural values of the facilities zone.

A copy of the complete Fildes Peninsula Region ASMA Management Package will be kept at the Chilean, Chinese, Russian and Uruguayan Stations where relevant maps and information posters about the ASMA will also be available. The Station Leader or the Station Environmental Officer should brief station personnel on arrival about environmental management in the field, the location of protected areas, and the provisions of the ASMA Management Plan. Visitors should be made aware of the content of this Code of Conduct before arriving at the stations.

2. Station operation, construction and removal

2.1. Waste Management

Waste management should be included in the planning of all activities at the Chilean, Chinese, Russian and Uruguayan Stations. The detailed instructions are given in Annex III of the Environmental Protocol. Hazardous material should be removed from the Antarctic Treaty Area. Regular cleaning of rubbish from station grounds and surrounding areas reduces its dispersal into the environment by wind or birds. Cooperation between stations in clean-ups can increase their efficiency if needed or requested. Historic waste sites that are not designated as a historic site or monuments should be cleaned up as soon as possible.

2.2. Use of water

Water sources need to be separated from any handling or disposal of wastes, fuel or other chemicals. Regular tests of water quality and routine cleaning of water holding tanks are necessary. Used station water should not be disposed of into the environment without treatment. Filter systems need to comply with best practice standards.

2.3. Generation of power

Regular inspections and modernisation of generators is required to reduce emissions and fuel leaks. Solar and wind power should be used as much as possible to minimize fuel demand. In addition, the adoption of measures to increase energy efficiency should be considered in every station.

2.4. Handling of fuel

The regular inspection of fuel storage facilities, supply pipe lines, pumps, reels and other fuel handling equipment is of high priority. Storage areas should be secured by siting them a safe distance from living quarters and from electrical supplies. In order to avoid incidences of fuel spills, *e.g.* during fuel transfer, all appropriate measures should be followed (see COMNAP guidelines). Any spills must be treated immediately with sufficient equipment according to Oil Spill Contingency Plans of each station with all available help by other stations on site or nearby. Oil spills shall be reported immediately to the Coordination Group in time. Station personnel should undergo regular emergency training.

2.5. Prevention of fire

Flammable substances need to be appropriately labelled. Fire fighting equipment should be available at dangerous sites like fuel stores and vehicle parks. Regular checks of electricity cables reduce the risk of short circuits.

2.6. Construction and removal of infrastructure

An Environmental Impact Assessment at the appropriate level should be undertaken before any construction or removal of buildings or other permanent infrastructure according to Annex I of the Environmental Protocol.

3. Traffic management

3.1. Land traffic

Vehicles should only be used around and between the stations when necessary. The existing road network should not be enlarged without a clear scientific or logistic purpose. Such expansion should be subject of an EIA at the appropriate level according to Annex I of the Environmental Protocol. Appropriate facilities must be provided for secure refueling and servicing of vehicles. Any wildlife disturbance, vegetation damage, or interference with scientific work should be avoided.

3.2. Air traffic

Aircraft will generally take off from and land at the Chilean airport but the helicopter pads at the Chilean, Chinese, Russian and Uruguayan stations can also be used where there are scientific, logistics support and rescue reasons. All air traffic should be conducted according to AFIM and WAM within the facility zones avoiding all other zones within the ASMA boundary as far as possible. Special care should be taken when flying over land to reduce potential negative impacts on wildlife. Special guidelines should be followed as stated in the management plan of ASPA No. 150 and ATCM Resolution 2 (2004).

3.3. Sea traffic

Small boat and zodiac use should be concentrated in the marine areas within the facility zones as far as possible and only in support of scientific, logistic and non-governmental operations. All boats need to be operated by more than one person and be equipped with life jackets and VHF radios. Weather conditions need to be suitable to reduce the risk of accidents. For safety a second boat can be used or stay on stand-by for immediate support in an emergency.

Crossing the isthmus between Ardley Island and Fildes Peninsula is only possible at high tide and with small boat and can be dangerous. The preferable route of getting from Bellingshausen or Frey station to the Hydrographers Cove or to the Great Wall station therefore is circumnavigating Ardley Island along its Northern and Eastern shore through the Maxwell Bay.

4. Field excursions

The station leader or the station environmental officer will brief field parties on environmental management in the field, the location of protected areas, and the provisions of the ASMA Management Plan. All waste from field parties, except for human waste (faeces, urine and gray water) will be returned to the stations for safe disposal. All field parties will be equipped with VHF radios.

5. Protected Areas

ASPA Nos. 125 and 150 are located in the area. Station members and visitors will be made aware of the location of these areas and the restrictions on access to them. Information about the ASPAs including the management plans will be displayed in all stations.

6. Flora and fauna

Any activity involving the removal or harmful interference with native flora or fauna (Annex II to the Environmental Protocol) is prohibited unless authorised by a permit issued by the appropriate authority. Minimum approach distances to birds or seals should be followed to reduce disturbance. Scientists and visitors should take care near wildlife particularly in the breeding and moulting seasons. Birds are not to be fed on station food. Food wastes should be hidden to prevent scavenging by birds. The introduction of non-native species should be avoided by cleaning clothes, boots and equipment before entering the area. Each registered introduction of non-native species should be reported to the Coordination Group, and remedial action should be considered.

7. Visitors

Any visits to the Chilean, Chinese, Russian and Uruguayan stations should be arranged by informing the station leaders of the planned activity. Contacts are made via Marine VHF. Station leaders will coordinate visits to stations with expedition leaders. Visitors will be informed about the principles of this code of conduct and the ASMA management plan. They should follow visitor guidelines (Recommendation XVIII – 1, IAATO). The station leaders will appoint guides to present station-specific information.

Appendix 5

IP 24

Agenda Item:	CEP 7f
Presented by:	Germany
Original:	English

Progress Report on the Research Project "Current Environmental Situation and Management Proposals for the Fildes Region (Antarctic)"

Attachments:

Progress Report on the Research Project "Current Environmental Situation and Management Proposals for the Fildes Region (Antarctic)"

1. Introduction

At CEP VII, Germany introduced IP 005 *Research Project Risk assessment for the Fildes Peninsula and Ardley Island and the development of management plans for designation as Antarctic Specially Protected or Managed Areas*. This paper described the below mentioned German three-year research project (2003 – 2006) and introduced it for the first time. Several CEP members expressed their support for the proposal, and indicated that they would be willing to assist Germany in the project.

At CEP VIII, Germany introduced IP 016 *Progress Report on the Research Project Risk assessment for Fildes Peninsula and Ardley Island and the development of management plans for designation as Antarctic Specially Protected or Managed Areas*. This paper provided an update of the project, noting the excellent cooperation with other Parties in the area through an informal co-ordination group.

At ATCM XXVIII, Germany agreed that prior to tabling a draft Management Plan for Fildes Peninsula and Ardley Island (King George Island) and following a proposal by Chile an International Working Group should be established. This Working Group should be composed of those Parties with stations and/or huts in the area, Parties with an interest in the area as well as Observers to the Antarctic Treaty. It should discuss the issues related to the Draft Management Plan. For this purpose, Germany would organize two international workshops, one in September 2005 and another one in January/February 2006, in order to convene the participants on this issue (Final Report of ATCM XXVIII, para. 90).

At CEP IX, Brazil, China, Germany, the Republic of Korea and the Russian Federation introduced WP 022 *Possibilities for Environmental Management of Fildes Peninsula and Ardley Island. Proposal to establish an Intersessional Contact Group*. This paper reported on the main findings and recommendations of the King George Island Workshop "Possibilities for Environmental Management of Fildes Peninsula and Ardley Island" in January/February 2006 as well as on the outcome of the Workshop "Human impact on terrestrial habitats in the Antarctic" in September 2005. Discussion of this paper is reflected in paragraphs 70 to 75 of the CEP Report.

At CEP IX, "Germany expressed satisfaction on reaching agreement with Chile in principle on developing an ASMA for Fildes Peninsula and Ardley Island. They will jointly convene – via note verbal – an international working group (paragraph 74 of the CEP Report). Germany expressed the hope that a substantive outcome of the group's work would be presented to the next ATCM. Chile confirmed that it will host a workshop to prepare the input on this issue for discussion at CEP X." (Final Report of ATCM XXIX, para. 77). Pursuant to these understandings an international working group involving government representatives of interested Parties was convened by Germany and Chile in order to discuss management approaches, possibly aiming at drafting a management plan for an ASMA covering the Fildes Peninsula Region (see IP 22 rev. 1 by Germany and Chile).

At CEP X, Germany introduced IP 112 *Possible Modules of a "Fildes Peninsula region" ASMA Management Plan*. Further, Germany and Chile introduced IP 22 rev. 1 *Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island*. Comments of 15 IWG parties to four questions concerning the future management of the Fildes Peninsula Region were reported. Further, Chile introduced IP *117 Workshop on Coordination of Activities in the Fildes Peninsula Region*.

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At CEP XII, Chile and Germany introduced WP 004 *Second Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island*. Chile introduced IP 81 *Notes on a Multiple Protection System for some areas in King George Island: Zones under Annex V and their relevance to Fildes Peninsula and adjacent areas*.

At CEP XII, Germany introduced IP 50 *Research Project "Current Environmental Situation and Management Proposals for the Fildes Region (Antarctic)".* Aim of this paper was to introduce the starting of the German research project and to inform the Treaty Parties about its purpose and methods and to request cooperation, especially from those Antarctic Treaty Parties running stations in the area.

At CEP XIII, Chile and Germany introduced WP 040 *Third Progress Report on the Discussion of the International Working Group about Possibilities for Environmental Management of Fildes Peninsula and Ardley Island.*

2. Progress Report and Preliminary Results of the Research Project

The preliminary results of the research project "Current Environmental Situation and Management Proposals for the Fildes Region (Antarctic)" are shown in the Annex.

3. Further steps

The project will be continued till August 2011. Final results of the study are expected by the end of 2011. Germany will introduce the final results to the International Working Group on Fildes Peninsula and will inform the Antarctic Treaty Parties accordingly at CEP XV.

Annex: Progress Report and Preliminary Results of the Research Project "Current Environmental Situation and Management Proposals for the Fildes Region (Antarctic)"

The Fildes Region, consisting of the Fildes Peninsula, Ardley Island and adjacent islands, is characterized by a high biodiversity and the presence of six permanent stations leading to a conflict of interests between the multiple uses of the region and the regulations of the Environmental Protocol to the Antarctic Treaty. In a first research project from 2003 to 2006, commissioned by the German Federal Environment Agency (Umweltbundesamt), the impacts of human activities in the region were assessed. It was shown that station operations, transport logistics, tourism, scientific research, nature conservation and the protection of historical and geological values regularly overlap in space and time (Peter et al., 2008). A risk analysis was carried out and resulted in a proposal of various possible management measures in order to prevent the region from further habitat degradation. Aim of the recent study was to assess changes in the terrestrial environmental situation by the repetition of the earlier monitoring during three field seasons. Therefore, the data of standardized and GPS/GIS-based assessment of fauna and flora and human activities were compared with the previous findings. First results were presented at the IPY conference in Oslo in 2010 and in a peer-reviewed publication (Polar Research, in press).

The breeding pair numbers of the thirteen seabird species were surveyed. Among that, a new breeding site of light-mantled sooty albatross was detected (Lisovski et al., 2009). The data of penguins breeding on Ardley Island confirmed the significant divergent trends for the three penguin species. While the total number of breeding pairs of gentoo penguins continued to increase, the numbers of Adélie penguins showed a strong decline. After a strong decrease in the past, the population of chinstrap penguins on Ardley Island remained constant on a very low level. The breeding pair numbers and breeding success of southern giant petrels in various colonies in the Fildes Region were subject to strong fluctuations. It is assumed that the decline in some colonies is connected with human disturbance, in particular visits of station personnel in their leisure time. The slight increases of breeding pair numbers in other, non-visited colonies indicates nest site shifts. By means of monthly seal counts several breeding sites of Antarctic fur seals have been confirmed so that meanwhile four seal species reproduce in the Fildes Region. Beside an introduced grass species, detected by the German scientists within a station area, various introduced insects (midges, moths) were reported by station members.

The survey of flight activities revealed no general increase, but a constant high level of days with aircraft use in the Fildes Region. Aircraft activity was observed on average on ~ 68 % of days of the study period. Landings of smaller aircrafts, mainly operating for tourism purposes exceeded logistics flights of Hercules C-130 by far. Furthermore, an increasing concentration of flight activity to certain days (during logistic operations) was noticed. The installation of a Transponder Landing System in the 2009/10 season, allowing flight operations even under conditions of low visibility, will certainly affect the flight activity in the Fildes Region, but did not yet resulted in a significant increase. The flights over the ASPA No. 150 Ardley Island below the defined vertical (610 m; 2000 ft) and horizontal (460 m; 1.500 ft) minimum distance due to Resolution 2 (2004) were conducted almost exclusively by National Antarctic Programs, but their observed number decreased considerably over time.

The observed growth of ship traffic in the Maxwell Bay over the six studied seasons was mainly caused by the increase of arriving supply, research and patrol vessels. At the same time, the number of days with ship traffic did not increase, indicating a growing accumulation of ships. Such peaks of marine activity were often connected with intense air traffic, mainly helicopter movements, cargo transport with heavy land vehicles or inflatable boats and station visits of tourists or ship crews. Despite growing levels of passenger exchange via air-cruise programs, the proportion of cruise vessels approaching Fildes Peninsula was relatively low during the study period, confirming the low attractiveness of the Fildes Region for cruise tourism.

Vehicle use beyond the existing road network was regularly observed, also affecting both, ASPAs No. 125 and No. 150, and often resulted in disturbance of breeding birds or damage of vegetation. Although meanwhile all stations on Fildes Peninsula operate sewage treatment plants of different levels of sophistication, the observed high turbidity and a pungent smell at some sewage outfalls indicate a poor quality or ineffective sewage treatment. The waste management in some stations still shows severe shortcomings, e.g. the continuation of open burning or open storage of waste. The latter led to a considerable entry of waste materials into the environment, also affecting the ASPA No. 150 Ardley Island. The banned practice of active feeding of skuas and gulls, including even with poultry products, has been reported at all stations on Fildes Peninsula. For the first time it was shown that the Fildes Region is affected to a certain extent by the waste management of neighbouring stations and ships and yachts present in the Maxwell Bay. The known areas with historical waste deposits were updated and thus increased by ~ 23 %.

Minor oil contaminations were constantly observed within the station areas and along the existing road network caused during fuel transfer, leaking station pipelines and tanks or spills from vehicles or the remobilisation of formerly contaminated soil. A major oil spill where several thousand litres of fuel were spilled was documented. As the applied mitigation measures were largely inadequate and failed to prevent chronic and widespread pollution of the local marine environment, negative impacts on the adjacent penguin colony on Ardley Island (ASPA No. 150) are assumed.

Recently, five out of six stations on Fildes Peninsula have been extended. Thus, the evident trend of extending station facilities has led to substantial improvements regarding scientific facilities and/or station's operations (e.g. the replacement of corroded single-walled fuel tanks), but was often connected with negative environmental impacts, mainly caused by the local extraction and removal of sand and gravel for building purposes. The impacts ranged from an increasing level of oil pollution by leaking vehicles, the disturbance of resting seals and breeding birds to the complete physical destruction of vegetation, seabird breeding sites and, despite their high scientific value for regional and global palaeoclimate, of beach ridges. As a consequence of the station extensions the land consumption by station buildings increased by ~ 65 % and the number of people living and working in the Fildes Region increased up to ~ 310 during summer and ~ 130 during winter. This is of high importance because, despite the fact that the number of tourists arriving in the Fildes Region far exceeds the number of station personnel, the latter is expected to have a comparatively higher environmental impact as they roam almost freely in the area. This implies a high risk of disturbance of fauna and flora, as a proportion of station members, including scientists, arriving in the Antarctic without an appropriate environmental briefing. Not all station personnel were aware of the existence of the region's two ASPAs and copies of their management plans were unavailable at some stations. In recent years, all National Antarctic Programmes have increased their scientific activities in the Fildes Region without appropriate coordination. This includes the risk of duplicity of research projects which may lead to detrimental effects on the quality and usefulness of the result and increased cumulative environmental effects. Leisure activities of station personnel probably represent the main contribution to human disturbance of fauna and flora in the region. In particular, excursions into sensitive and/or protected areas, which were not in compliance with the regulations of the ASPA management plans, were often recorded, e.g. for taking pictures or for fishing activities. It is also reported by some station members that local station personnel occasionally touch or catch animals for taking pictures or collect fossils and minerals. Heavy disturbance of resting birds and seals were observed as well as during landings of tourists travelling with ships of National Antarctic Programmes. When queried, some passengers stated that they have not been guided and had no knowledge of the existing visitor guidelines, e.g. those recommended by IAATO and generated by the Antarctic Treaty System. Tourism activities in the Fildes Region take place on a regular basis. Sea-borne tourism (landings of passengers of cruise vessels) did not grow, while, the number of tourist flights has increased, which are connected with one- or two-day programmes involving guided walks (air-borne tourism). The number of passengers transferred between cruise vessels via the Chilean airport on Fildes Peninsula (air-cruise tourism) rose almost tenfold between 2003 and 2010.The environmental impact of the yearly Marathon event was assessed. It is considered to be relatively low, as well as the various types of tourism. In contrast to the station personnel, most tourists are strictly guided, limited to certain routes and are briefed in advance about existing guidelines.

Summarizing the findings of the present study, it is shown that the terrestrial environment in the Fildes Region is under increasing pressure from human activities. The habitat degradation will increase further if no additional management measures are generated and implemented in the near future.