An Introductory guide

to the

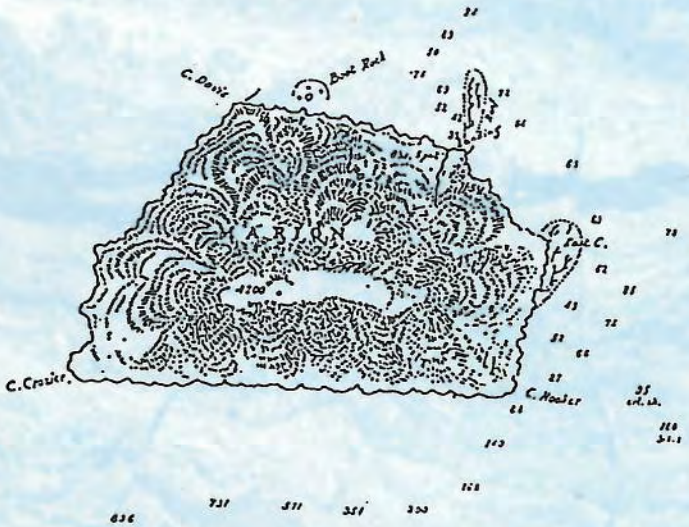
Marion

and

Prince Edward Island

Special Nature Reserves

50 years after annexation



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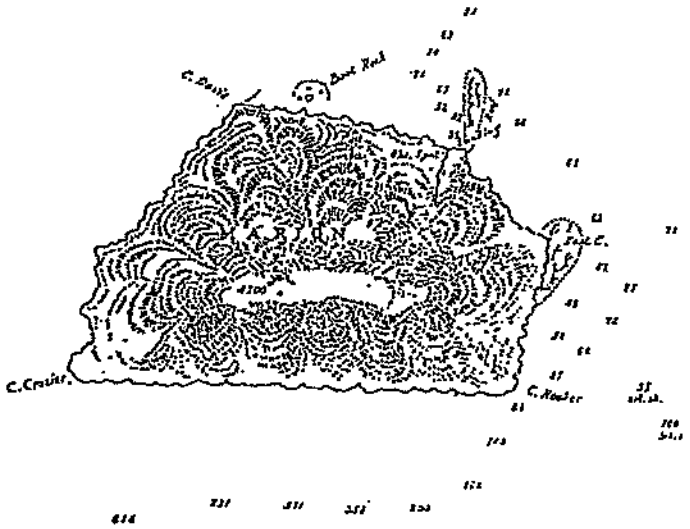

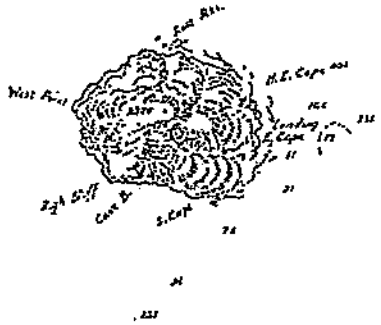

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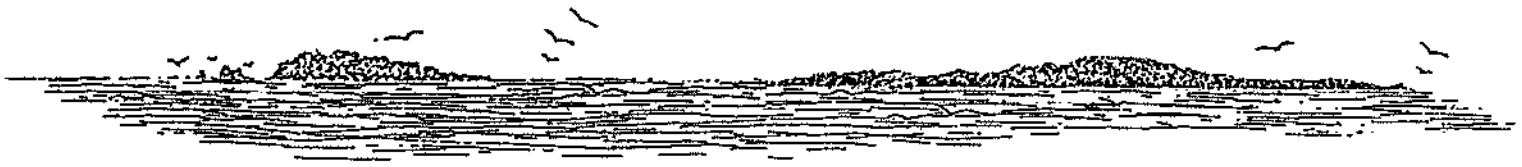

Cover
Historical Map drawn in 1873 by Captain G.S. Nares R.N. during the HMS Challenger expedition, and used for the annexation of the islands in 1948.

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An Introductory Guide

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Marion and Prince Edward Island

Special Nature Reserves

50 years after annexation

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Christine Hänel and Steven Chown
Department of Zoology and Entomology, University of Pretoria, South Africa
Directorate Antarctica and Islands, South African Department of Environmental Affairs and Tourism

Photo: S Chown

The Scientific Station at Transvaal Cove, Marion Island

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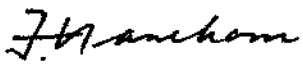
FOREWORD

This year we were celebrating the 50th anniversary of the annexation of the Prince Edward Islands. The appearance of this booklet is therefore timely. Since South Africa annexed the Prince Edward Islands, our knowledge of them has increased greatly. At first, meteorologists were the sole users of Marion Island, and their unbroken record of climate monitoring since 1947 has proved to be a benchmark for assessing climate change, both in the Southern Ocean and in a global context. Later, scientists in many other fields followed in their footsteps. The first biological and geological expedition was instrumental in drawing the attention of scientists in South Africa and elsewhere in the world to the unique opportunities for research and monitoring provided by the biota and ecosystems at the islands. Since then, many researchers have visited the islands. Indeed, our knowledge of Marion Island's ecosystem is virtually unparalleled in South Africa and in the sub-Antarctic. As a consequence much of the knowledge that is required to manage the islands as Special Nature Reserves is now available, although much work remains to be done.

The declaration of the islands as Special Nature Reserves has meant changed circumstances for all visitors to the islands. Although the Prince Edward Islands Management Plan sets many of the regulations out in detail, a guide to the islands' environment and wildlife has not been available for some time. This booklet seeks to redress this problem. In addition, for the first time, it also gives new visitors an indication of the layout of the base and its facilities, and provides a synthetic overview of the guidelines for conduct on the islands.

To Prof Steven Chown and Ms Christine Hänel, a special word of thanks for taking on this project and to all those people involved in making this booklet a reality.



Dr F Hanekom
Deputy Director-General
Environmental Affairs and Tourism

Chairperson
South African Committee for Antarctic Research

PREFACE

This booklet is about the Prince Edward Islands. More specifically, because most readers will visit Marion rather than Prince Edward Island, the booklet is mostly about Marion. Although it attempts to cover as many of the frequently asked questions as we could remember ourselves asking as newcomers to the islands almost 15 years ago, it is by no means comprehensive. Instead its aim is to dwell briefly on a broad array of the natural and human features on the islands, and then to provide pointers to the wealth of information that exists on each of these. With the array of expertise available in the various specific fields, there is little point (or space) in providing numerous colour plates for the identification of the flora and fauna that occur there. Our goals are rather to provide some information on the identity, numbers and biologies of the more common species of animals and plants at the islands, and on how these species interact to form communities. That these communities function in delicate harmony and survive harsh conditions, yet at the same time are vulnerable to unnatural disturbance is a point we make regularly. Alien species pose a remarkable threat to the fauna, flora and ecosystems of these islands. We also provide some information on the islands' geological, glacial, and human histories, because they too are important if a visitor is to gain some understanding of the islands' ecosystems, and why they have attracted and continue to attract humans. In so doing, we hope to provide the reader and visitor to the islands with a phrasebook that will render the natural beauty of the islands more comprehensible and make a stay at the islands more comfortable, yet ensure that environmental compromises are reduced to the minimum.

Christine Hänel
Steven Chown

July 1998

FIGURE 1: GEOGRAPHIC LOCATION OF THE PRINCE EDWARD ISLANDS

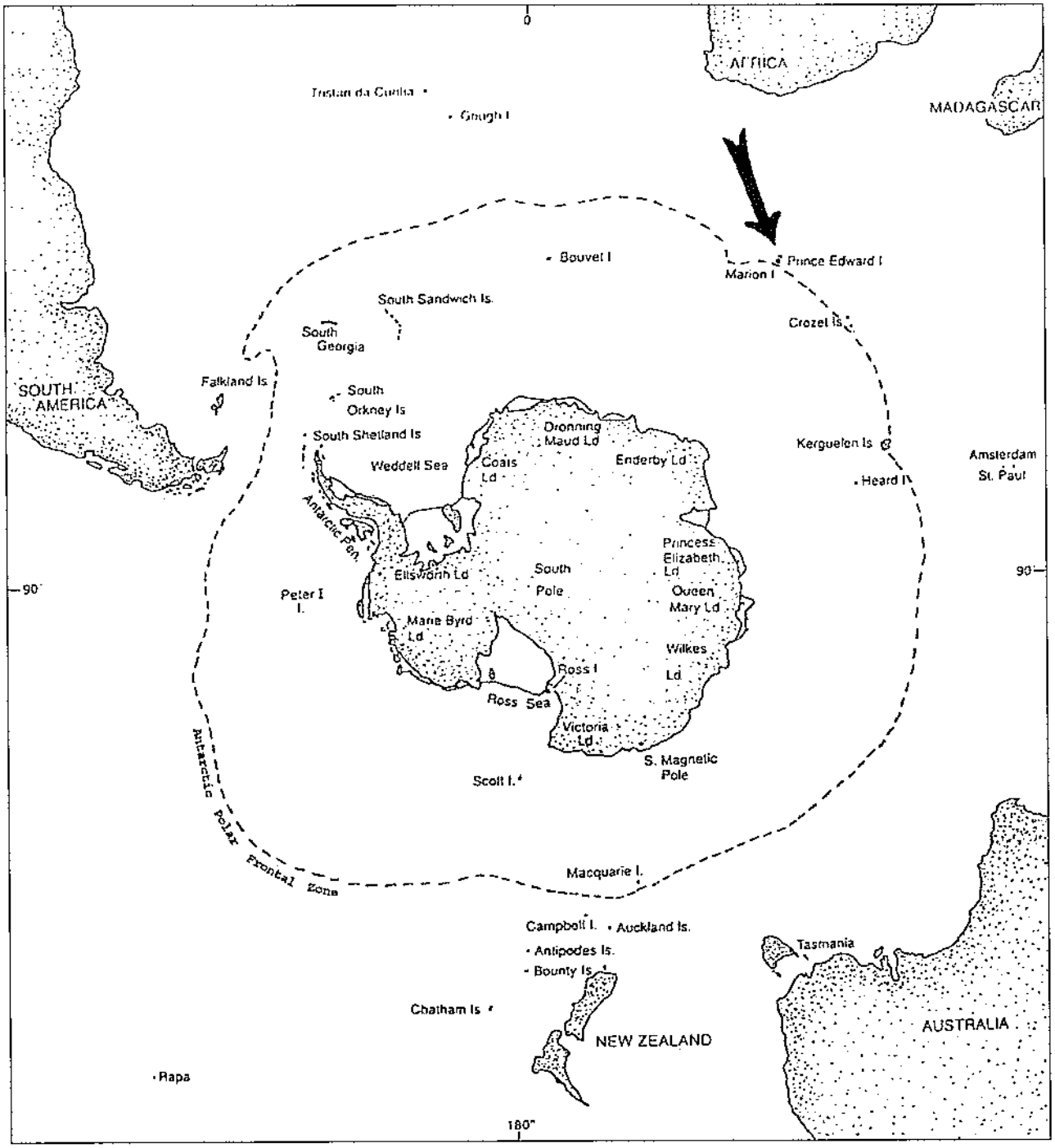
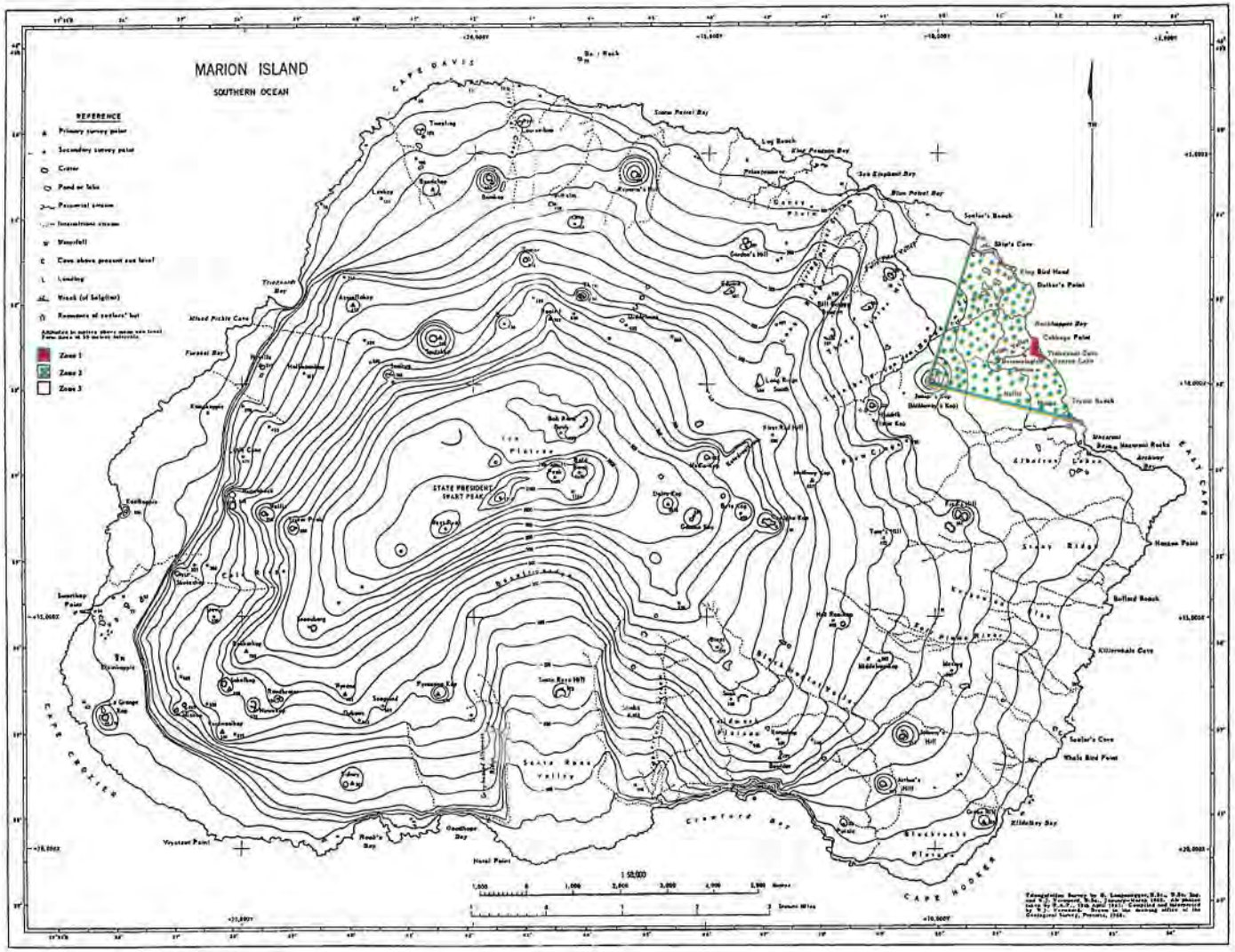


FIGURE 2: TOPOPGRAPHIC MAP OF MARION ISLAND

Taken from the map prepared by O. Langenenggger and W.J. Verwoerd 1961, with Management Zones 1 (solid), 2 (strippled) and 3 (rest of Island) indicated. Zone 4 areas are mostly bird colonies and are not shown (see Management Plan).



1. LOCATION AND TOPOGRAPHY

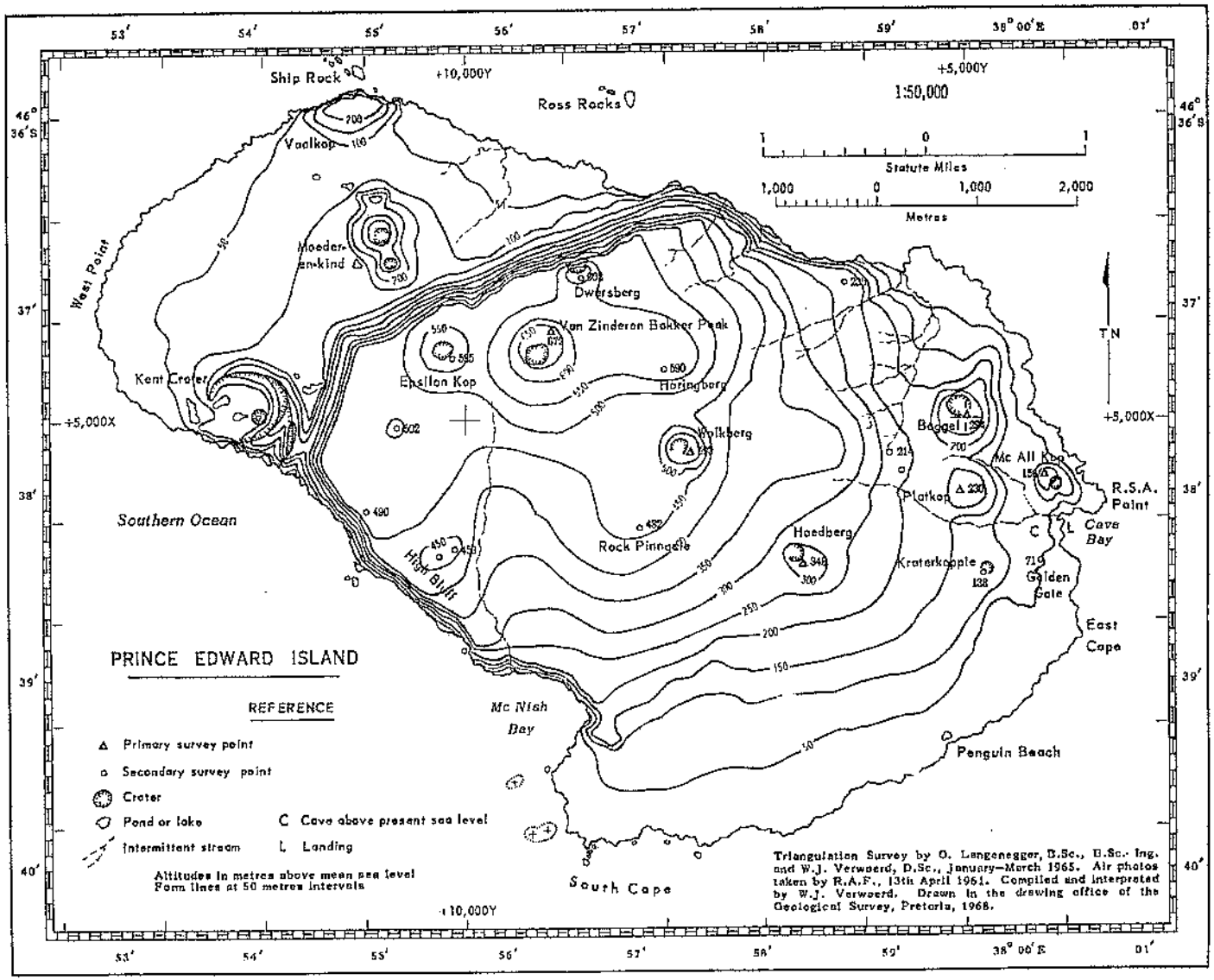
Marion Island and Prince Edward Island form the Prince Edward Islands (PEI) group or PEI archipelago. Together with Crozet, Kerguelen, Heard and MacDonald Islands, these islands form the South Indian Ocean Province, (also referred to as the Kerguelen Biogeographical Province), which is one of three provinces that constitute the sub-Antarctic region. Situated in the "roaring forties" of the southern Indian Ocean, the Prince Edward Islands lie approximately 1 770 km south east of Port Elizabeth, South Africa (the closest point on any continent), and 2 300 km north of Antarctica's closest point (Lützow-Holm Bay). The nearest landfall to both of the islands is Île aux Cochons of the French Crozet Island Group, which lies some 950 km to the east. The PEI lie close to each other, with the more southerly and larger island, Marion (grid reference: 46° 54' S; 37° 45' E), separated from the smaller Prince Edward Island (grid reference: 46° 38' S 37° 57 E) by a mere 19 km.

Marion Island is about 290 km^2 in area with some 72 km of mostly cliff-face coastline. The profile of the island is typically that of a shield volcano, with some modification to the western side. On the eastern half of the island there is a regular rise from the coastal plain to the peaks. On the western half of the island the coastal plain is narrow, and is bounded by a sharp rise in the form of inland (or sometimes coastal) cliffs, and subsequently a more gentle rise to the peaks (see contours and other details shown on the topographic map, Fig. 2). The island is dotted with reddish, conical hills, known as scoria cones, which mark the sites of old pyroclastic volcanic eruptions. The highest peak (known as State President Swart), rises to 1 230 m (4035 ft) above sea level. There are a number of reasonably flat coves on Marion Island, of which only two can be considered sandy (Ship's Cove and a small beach at Goodhope Bay). The remainder are either boulder, rocky or pebble beaches. The lowland terrain at Marion Island is generally marshy and wet, and there are many small ponds and lakes dotted across the landscape. Further inland the terrain includes numerous fern-covered slopes, eventually giving way to volcanic lava-covered hillsides and mountains, devoid of vegetation. This terrain can be extremely uneven and some of the larger lava flows are difficult to negotiate. At 1 000 m there is a flat, stationary glacier, known as the ice-plateau. In recent years, the solid blue ice that lies beneath the scoria on the plateau has shown signs of rapid melting, and the extent of this plateau is probably much smaller than indicated on the 1965-66 map of the islands.

Prince Edward Island (Fig. 3) has an even more rugged coastline and fewer beaches than Marion. It is more rectangular in shape, smaller (with a surface area of about 45 km^2), and reaches only half the altitude of the latter island. The highest point (672 m above sea level), Van Zinderen Bakker Peak, was named in honour of the man who initiated the first full-scale biological and geological expedition to the islands in 1965. The profile of the island is similar to that of Marion, although the west coast plain is much smaller and the western cliffs (especially High Bluff) more striking. The large cave on the east coast has given Cave Bay, the best landing site at Prince Edward Island, its name.

FIGURE 3: TOPOGRAPHIC MAP OF PRINCE EDWARD ISLAND

Taken from the map prepared by O. Langenegger and W.J. Verwoerd 1961. The entire Island is a Zone 4 area.



2. GEOLOGY AND GLACIAL HISTORY

Marion and Prince Edward Island represent the twin peaks of a coalescing shield volcano which, although rather sleepy, is still active (the last minor eruption occurred on the west-coast of Marion Island in 1980). The oldest dates for surface rocks at Marion Island are in the region of 270 000 years, while those for Prince Edward Island are 215 000 years. Nonetheless, it has variously been suggested that Marion Island is about 0.5 to 1 million years old. Essentially there are two main lava types on the islands. Grey basalt lava, which has been dated to roughly 270 000 - 48 000 years, is the oldest rock type on the islands. On Marion Island, ridges such as Skua Ridge, Stony Ridge, and Kerguelen Rise are all grey lava ridges and Tafelberg, just to the west of Juniors Kop, is an excellent example of a grey lava formation. Because of their age, the grey lava areas bear the marks of the extensive glaciations that took place on the island. Unsorted rocky material (i.e. stones of different sizes), large solitary boulders, and deep striations in the rocks on grey lava ridges all bear testimony to the ice sheets that scoured Marion Island as recently as 12 000 - 16 000 years ago. These kinds of formations can readily be seen on Tafelberg.

Prince Edward Island shows no sign of glaciation, and this may well be due to the fact that this low island was never covered to any great extent by ice sheets, or because the western side of the island has been eroded. However, the glaciations on Marion Island were fairly extensive during at least three different glacial episodes where temperatures were probably 4 - 7°C lower than they are at present, and large glaciers are thought to have covered the east coast. During these glacial periods the vegetation as it is currently on Marion Island would not have been present, and it is likely that only mosses, lichens and perhaps a few *Azorella selago* cushion plants would have been present.

A second volcanic phase followed the rapid melting of glaciers about 12 000 - 16 000 years ago, giving rise to the black basalt lava formations that dominate much of the islands' terrain. These rocks date from about 15 000 years ago (to 19 years in the vicinity of the new eruption at Kaalkoppie). The conical red and black scoria cones represent the main areas of explosive eruption on the islands and many of the large lava flows arose from them. Essentially three kinds of black lava can be found on the Prince Edward Islands. The best example of the first kind, Pahoehoe, can be seen in the vicinity of La Grange Kop, the Three Sisters, and at the base of Fred's Hill. Typical pahoehoe surfaces are flat or undulating, somewhat resembling a tarred road over short distances. Curved ropy structures are locally developed. Aa lava flows are the commonest kind on Marion Island. They are covered with loose black clinker fragments, usually piled up in heaps 5 to 20 metres high, and are tedious to cross even on the lower slopes of the island where they are covered by vegetation. On Gunner's Point and Cabbage Point near the landing stage of the scientific station at Transvaal Cove, the underlying surface is exposed by the removal of loose clinker and is jagged with red scoriaceous fragments welded against more or less agglutinated projections from the solid flow beneath. The Scientific Station (also variously known as the Base or Base station) is situated on a vegetation-covered aa flow. Block lava flows consist of angular blocks with sharp edges, usually heaped in chaotic fashion to form steep, parallel ridges, and they make for the most difficult terrain. The infamous Santa Rosa Valley, and 'Devil's Footprint' (above Cape Davis), represent the best examples of this kind of lava.

A number of other geological and geomorphological features can be seen on the islands. The best example of an ash (or tuff) cone on Marion Island is Kaalkoppie, and a fantastic example of a geological disconformity is present on the eastern boundary scarp of (i.e. the hillside above) Santa Rosa Valley. Various lava tubes and tunnels that make up the pahoehoe flows, and in some areas volcanic bombs and streamlined lapilli (or comet-like solidified rocks), can also be seen. Sadly, however, team members have collected these bombs and lapilli as artefacts over the years and very

few are now found on Marion Island. (Currently, the removal of any material, including any rocks or stones, from the Prince Edward Islands, for non-scientific purposes, is prohibited). Close to the Marion base, a fault line forms an obstacle to coastal walks, although its exact cause is disputed. Amongst the scoria, crystals of pyroxene and olivine can also be found, and Pyroxene Kop derives its name from the abundance of the former.

Clear evidence of frequent freeze/thaw events is visible in the shattered grey lava rocks on ridges such as Kerguelen Rise, and especially on Tafelberg. Windsorted rock stripes are also noticeable on exposed areas and there is some evidence of small-scale geomorphological structures associated with needle ice and other kinds of ground movement caused by freezing conditions. On the edges of the stationary glacier, or ice plateau, large moraines obscure the ice, but wind and water-carved blue ice are characteristic of the glacier itself. During winter, many of the large caverns that are caused by meltwater are covered by only a fine layer of snow, making the ice plateau dangerous.

3. CLIMATE

Given the position of the PEI, they must be regarded as remote fragments of land that are at the mercy of the surrounding ocean. Thus this southern ocean system and its atmospheric conditions are the primary agents affecting the climate of and weather conditions at the islands.

Located in the sub-Antarctic, the PEI lie in the middle of three water masses; with the Antarctic Polar Frontal Zone (the area where the cold Antarctic waters sink below the slightly warmer sub-Antarctic waters) lying just to the south of the islands, and the Subtropical Convergence (which separates colder sub-Antarctic waters from warmer northern waters) lying to the north. Oceanographers have also recently identified a weaker, but important sub-Antarctic front, which lies very close to the islands, and is important from the point of view of the distribution of marine organisms and their interactions with seabirds and seals. Because these fronts have no fixed boundaries, a shift in their position, and the occurrence of eddies, play important roles in the oceanic environment of the islands, be it the temperature of the water, its salinity, or the transport of biological (or foreign) material to the islands by means of the currents. The position of the islands in the 'Roaring Forties' also subjects them to the 'Westerlies' - the tempestuous winds that constantly blow from the west in these latitudes. With ever changing force, they buffet the islands for 150 days a year, often reaching gust strengths of 130 - 200 km per hour. These circumpolar winds are constantly interrupted by cyclones that can produce rain or snow, and anticyclones that are accompanied by dry spells (when their fronts pass over the islands). As a consequence of the continual passage of the cyclones (some 100 - 130 pass the islands each year), the weather is characterised largely by alternating warm, overcast, rainy periods and cold, clearer and drier ones. Nonetheless, the continual presence of cyclones near the islands makes for a high level of cloudiness; bright sunshine is a rare occurrence.

The high latitudinal position of the islands also affects day length, such that in midsummer days are almost twice as long as those in midwinter. In December, for instance, daylength is approximately 16 hours, with the sun rising at about 04h00 (although it begins to get light as early as 02h30) and setting at about 20h00 (but again, it only becomes dark somewhat later). In June on the other hand, days are about 8 hours long, with the sun rising at 07h45 and setting at 16h30.

WEATHER ON MARION ISLAND

The most typical features of the Prince Edward Islands' weather and climate are:

- Predominantly strong westerly winds
- High precipitation (average: 2500 mm/year)
  (mainly rain, but also snow, and graupel or shotgun pellet-like ice-rain)
- Relatively low average air temperatures (annual average: 5.7°C)
- High humidity (annual average: 83 %)
- High degree of cloudiness
- Low incidence of sunshine (radiation) (25 - 30 % of that possible)
  (an average of 3.6 hours per day)

Generally the weather conditions are relatively constant. Average temperatures hardly fluctuate more than about 4.5°C throughout the year, and 2.3°C over 24 hours. The climate on the western side of Marion Island can be substantially different from that on the east (where the meteorological station is situated at Transvaal Cove). For example, the west coast is enshrouded with cloud more often than the east, and more regularly exposed to strong winds, rain and wild seas. Despite these seemingly constant conditions, the weather can fluctuate considerably over the course of a day, covering the gamut of seasonal repertoires. One may venture out on a sunny, clear morning and within a few hours, experience everything in the range of weather including rain, sleet, wind and dense fog, all of which can lead to extremely dangerous situations if one is unprepared for them. Likewise, gale force winds, which make walking difficult, can blow one minute and stop the next, leaving one thrown off balance in the ensuing calm.

Temperature

The mean annual temperature at the islands is approximately 5°C. The warmest months are January to March, with an average of 7.3°C typical for February, although maximum temperatures of up to 22.3°C have been recorded. The coldest months are between June and September, during which mean temperatures are in the vicinity of 3.2°C, and minima can be as low as -6.8°C. Thus the average temperature varies by about 4°C in the course of a year, while the difference between the absolute extremes (all be they rare) is close to 30°C. However, the temperatures felt are often substantially lower due to the wind-chill factor, or freezing potential (being the combined effect of strong wind and low temperature), which may reduce a 'measured' temperature of above freezing to an 'effective' temperature of well below zero. For instance, although the outside temperature may be given as 1°C by a thermometer, a human might experience the temperature as -10°C or -20°C depending on the wind speed. If this wind-chill factor is compounded by rain (i.e. a person is wet) then effective temperatures can be dangerously low. Furthermore, while the temperatures discussed above were obtained at the meteorological station situated on the sheltered east coast at Marion Island, about 10 m above sea level, it is important to bear in mind that temperatures at higher altitudes decline by 4°C to 4.5°C for every 1 000 m gain in altitude. Sea temperatures are warmest around March with a maximum of 8.0°C, and coldest in late September, dropping to 2.1°C.

Precipitation

Rain occurs throughout the year (on average rain is recorded at least for some portion of the day on 308 days per year, but is most frequent during the winter months of May - August, averaging 28 days a month!). It tends to be somewhat drier towards the end of winter and spring, from August to October. While a yearly average of approximately 2 500 mm is representative for the rainfall that has been recorded at Marion base, one should bear in mind that this figure can vary dramatically according to position on the island. Almost twice this amount (4 650 mm) was recorded over a one year period at First Red Hill (which is about 550 m above sea level, and about 5 km inland of Marion base), while slightly higher up towards the peaks (at about 750 m above sea level, and some 6 km inland), less than half the amount (935 mm) of rainfall experienced at Marion base was measured, which is probably due to a higher snowfall at this high altitude.

Snow and frost can occur in any month of the year, although it only snows at Marion base on about 82 days of the year. However, at sea level snow rarely lasts for more than a few days before it melts because of rain or higher temperatures. Nonetheless, the higher altitudes retain a snow cover for much of the year, although there can be periods in summer when even the highest peaks are snow-free. Permanent ice is found only on the ice plateau, yet during winter the soil surface may freeze and stay frozen for up to a week. This usually disrupts the water supply to Marion base for short periods.

Hail occurs mostly during winter in the form of snow and soft hail (and is therefore referred to a "graupel"

or "ice pellets"). Fog most frequently occurs in late summer, although about 2 - 3 days a month are expected to be foggy. Thunder and lightning also occur, although rarely (about 4 times a year).

Wind

North west winds predominate (60 % of the winds are north westerlies) and these are also the strongest winds, with 'gales' (normally defined as winds exceeding 55 km/h) occurring on about 107 days a year, often raging at speeds of over 70 km/h for more than 24 hrs. Gusts of 160 km/h frequently occur, and gusts of over 200 km/h have been recorded. Calm conditions are rare. Wind direction can also predictably effect the climate. The frequent westerly winds are associated with cloudy conditions on the island, whereas the southerly winds bring cold, clear conditions. Winds from the north and east (although infrequent) are responsible for warm and sunny conditions on the island.

Tides and waves

Although little is known about the wave climate, tidal sea level changes are small, with an amplitude of 71 cm. Swells can, however, vary enormously in accordance with the prevailing storm systems. The most visible wave effects are generally westerly, when storms rage in the winter months, although storms from an easterly direction have also been recorded and can occur as late as May. During such storms, swells have been estimated at 10 - 12 m, with waves breaking over the eastern cliffs with tremendous force. These storms are most noticeable because of their pronounced effect on the infrastructure at Marion base. However, westerly storms may be more violent than these easterly ones.

Photo: C Hänel

Huge Southern Ocean swells engulph Gunners Point, a 10 m high cliff at Transvaal Cove, Marion Island, during an easterly storm

4. HISTORY OF HUMAN OCCUPATION

The existence of the Prince Edward Islands has been known to humans for over three centuries, although the first landing only took place more than 130 years after their discovery.

FIRST DISCOVERY

The first mention of the Prince Edward Islands dates back to the 4th of March 1663, when a Dutch East Indiaman, the 1 210-ton Maerseveen, under commander Barent Barentszoon Ham passed them *en route* to Java. The names then given to the islands were Dina (often called Dena or Denia) for the more northerly island, and Maerseveen for the more southerly one. No landing was made.

After that discovery it seemed as though the Islands had been forgotten. More than a century passed before the next human was to set eyes on the islands again, only to re-discover them in ignorance of the first discovery. It was the French naval officer M M Marion du Fresne of the frigate Le Mascarin, who in the company of another vessel, the Marquis de Castries was on his way south in search of the great southern continent - Antarctica - when he sighted the islands on the 13th of January 1772. Because no charts of the day had any land mapped near the position of the islands he sighted (other than a Dutch chart, that 50 years earlier showed Dina and Maerseveen incorrectly placed at 41° S), du Fresne thought he had reached the long sought Southern continent, and so gave the names Terre d'Espérance (Isle of Hope) to the southern island, and Île de la Caverne (after a large cave on the NE side) to the northern island. He tried to land, but after five days abandoned the attempt due to the bad weather. It had in the meantime also become evident that the land he thought to be promontories of the Southern continent, was in fact only islands. In his disgust, he changed the name of the group to Île des Froides (The Frigid Islands) and sailed on eastwards, later to discover the Crozet islands (named after Julien Marie Crozet, du Fresne's second in command).

Almost five years later the islands were renamed again. This time by Captain James Cook, who reached the islands on the 12th of December 1776 during his third voyage of exploration with the Resolution and Discovery. Since his chart did not give the names bestowed by du Fresne, Cook called them both the Prince Edward Islands, after the fourth son of King George III, the future father of Queen Victoria. Like the mariners before him, he too made no landing and sailed on east. There are various accounts which state that Cook was unaware of du Fresne's expedition, but subsequently named the larger island of the group Marion (the island that its namesake had sighted before him) in his honour. However, it was not until the middle of the 19th Century that this larger island was first referred to as Marion Island by sealers.

FIRST LANDING

The accounts brought back by Cook and other southern ocean explorers reported a wealth of animal life on and around the islands, which soon sparked an economic interest in them. Whalers and sealers began visiting the islands in rapidly increasing numbers, the whalers using the islands mainly to obtain temporary shelter for their ships, while the sealers usually went ashore to obtain skins and oil from the seals. Although they were pioneers of their day, they left little to posterity, with only few records of their activities. When and by whom the first landing was made on either of the two islands is not known. The earliest documented evidence of humans going ashore is of a party of sealers that

were dropped off on the Prince Edward Islands from the Catherine under the command of Henry Fanning in either December 1803, or January 1804. However, Fanning, in the narrative of his voyages, mentioned that in 1802 there were already sealer establishments on both Marion and Prince Edward islands. On the islands themselves, the oldest record of human occupancy is provided by the date "1805" inscribed in the rock-face at Cave Bay on Prince Edward Island.

SEALING ACTIVITIES

Sealers came from all over the world to exploit the animal resources on the islands: from the Cape, England, Scandinavia and America, with ships from the Cape making almost annual voyages. From the date of the first recorded landing in 1803, it took barely seven years of animal slaughtering for the fur seals to have declined so drastically that the trade in skins was no longer viable as a single economic activity. Thus, after 1810, the sealing industry shifted its attention to the elephant seals. Blubber from these animals represented a wealth in retrievable oil. This elephant sealing continued until 1860, at which time the animals had also been reduced to such low numbers that such sealing became uneconomical. There were attempts to revive the industry after 1909, but by the 1930s the industry was declared uneconomic, so ending over a century of commercial exploitation of the seals. During this sealing era, many other historically important events took place, including the significant visit of the HMS Challenger, and the first recorded shipwrecks.

FIRST SCIENTIFIC RECORDINGS AND INFORMATION

One of the first documented records of biological observations were those made by Richard Harris, who observed and collected seabirds during a British sealing expedition in 1830 - 31. On the 21st and 22nd of April 1840, the HMS Erebus of Captain James Clark Ross' Erebus and Terror expedition took soundings and made dredges at the Prince Edward Islands that brought up between thirty to forty different types of marine animals. No landing could be made due to bad weather, but the visit is commemorated by the names Cape Crozier and Cape Hooker on Marion Island, and Ross Rocks off Prince Edward Island. On Christmas day 1873, a British Corvette, the HMS Challenger arrived at the islands while on a scientific research expedition, that circumnavigated the globe between 1872 and 1876. Having good weather, it immediately dispatched a cutter the following morning that landed expedition members on the north eastern corner of Marion Island. The party, including H.N. Moseley who later went on to recount his findings in the wonderful "Notes by a Naturalist...", spent the day exploring and collecting samples and specimens while their Captain, G.S. Nares, a noted English cartographer, proceeded to dredge and trawl in the channel between the two islands and around their coastline. In the process, he also made topographical surveys, taking measurements of the islands extent and position. The ship also made soundings that were carefully plotted. The chart that was compiled at the end of their few days' stay remained the only reliable graphic source of information available in the 284 years since the first discovery of the islands and the time of annexation in 1947. Unfortunately, no biological information could be gathered from Prince Edward Island because the party was unable to effect a landing. In fact, Prince Edward Island remained virgin territory to scientists until after the islands' annexation in 1948, and the first scheduled research visits were carried out in 1965.

On 23 January 1939, a French scientific expedition from the Bougainville landed at Ships Cove for a brief visit to Marion while on its way to the French sub-Antarctic islands. A small number of specimens was collected and some photographs were taken.

SHIPWRECKS, CASTAWAYS AND LIVES LOST

Among the more than 60 recorded visits to the Prince Edward Islands between their discovery in 1663 and their annexation in 1947, there is reference to at least eight vessels that are said to have foundered off the Prince Edward Islands, five of them in the vicinity of Prince Edward and three at Marion Island. The sites of the wrecks at Prince Edward Island are not known, and to date, no remains of them have been discovered.

The first reference made to a foundering, known as the "French wreck", was by a Phelps, one of the members of an American sealing expedition, who spent more than two years on Marion Island between 1818 and 1820. Subsequently, in May 1834, thirteen men were found on the northern side of Prince Edward Island, who were marooned from the Cape Town brig, the Merie, that was wrecked nine months prior to their discovery. On the 28th of October 1841, the Uxor was wrecked on Marion Island, at what appears to have been Ships Cove. Subsequently, on the 19th of June 1849 an emigrant ship from Britain, the Richard Dart, ran aground on Prince Edward Island while following a non-stop "composite-sailing" passage from the Thames to New Zealand (a then revolutionary experiment in the course of global navigation, known as the "Great Circle Principle"). Fifty three of the ship's 63 passengers were lost - 52 of them (including five women and ten children), were drowned during the wreck and one (named William Goldsmith) died two months later. The remaining survivors were rescued after 72 days on the island. To date this is the largest known loss of life at either of the Prince Edward Islands and the only known deaths of women and children at the islands. It remains the most tragic incident in the islands' history.

There is further mention of castaways that were brought back from Prince Edward Island after surviving the wreck of the 147 ton Conservative, a local schooner from Algoa Bay, that must have run aground between the end of 1855 and beginning of 1856. On the 17th of May 1857, the bark Maria, from Cape Town, was washed onto the rocks on the eastern side of Prince Edward Island while engaged in sealing activity. No lives were lost and the 28 castaways were returned to Cape Town after nearly seven months on the island. On the 16th of October 1908, the largest of all known wrecks took place when the Norwegian sealing steamer, the Solglimt, beached at Ships Cove while on a sealing mission. The Solglimt was built in 1881, measured 271 feet in length and had a gross weight of 1,810 tons. It was well stocked with 900 tons of coal and other provisions, when it hit a rock pinnacle (now known as Solglimt Blinders) some two miles from the shore. Her Captain had just enough time to head for the shore and ram the bow of the ship onto the beach, where the crew then salvaged as much as they could, before the ship broke in two and slid beneath the surface, leaving only the tip of her stem above the water. The castaways proceeded to build a small village, consisting of a timber hut for every four of the 70 men, including a large one in the centre, used as a cookhouse and storeroom. These sealers must therefore have constructed at least 18 or 19 structures, making their settlement the largest one on the island prior to the annexation and the establishment of a permanent base at Transvaal Cove. After barely a month on the island, all the survivors were rescued and no further attempts at salvaging the wreck were undertaken by the ship's agents.

On the 22nd of October 1912, the last vessel to be lost at the islands sank. It was the 74 ton sealing schooner Seabird from Cape Town, which ran aground very close to where the Maria had gone down some years before. Two of the 22 castaways died. One (named Anderson) died in an accident shortly after the shipwreck, while the other (named Tohure Lundstedt) died some three months later due to illness. Both were buried on Prince Edward Island in the vicinity of Cave Bay. The survivors (that had later moved to Marion Island) were saved nearly six months after being marooned.

There are only two other records of ships that have declared shipwreck in the vicinity of the islands. In neither case were the vessels or any lives lost. The first case involved the Garthforce which, in

January 1922, collided with an iceberg between Prince Edward and Marion Island, and was subsequently towed back to Durban. The second incident involved the sailing research vessel SRV Totorore, that was 'knocked down' in high seas on the 31st of December 1985 while *en route* to Marion and other sub-Antarctic islands during a research voyage in the Southern ocean. The two crew members (a man and a woman) were left on Marion Island under "shipwrecked status" until their return to Cape Town four months later. The Captain proceeded to New Zealand, where he arrived after a little more than nine months at sea.

There has, however, been additional loss of life at the islands, not caused by shipwrecking. The first recorded incident took place in 1818, when a small boat sent from the Pickering capsized off Marion Island drowning three of its five crew members. Another life was lost on the 7th of October 1838 from the American brig, the Athenian, while it was engaged in sealing operations on Marion Island. More than a century later, the last of the known deaths occurred at Marion Island. On the 29th of January 1949, Joseph Daniels, a crew member of the supply vessel SS Gamtoos, drowned when one of the guano boats used to transport supplies from the ship to the boulder beach at Transvaal Cove capsized in the surf. He was buried about 0.5 km east of the Marion base on the slopes overlooking the sea, where a wooden cross marks his grave to this day. A second man was killed in the stormy waters off Marion Island when two boats from the HMSAS Transvaal were destroyed in 1956. What happened to his body is not clear. It has been suggested that the second cross on Marion Island, bearing no inscription and situated about 50 m south east of Marion base, may commemorate his death or that of another man, said to have been drowned in Transvaal Cove on the 13th of April 1963. The only other record of human life lost is that of a bosun, who was murdered on the maiden voyage of the research ship SA Agulhas in 1978.

ANNEXATION

South Africa's interest in the Prince Edward Islands dates back to their discovery and the disclosure that they formed breeding grounds for commercially valuable seals, of which many were harvested by sealers from the Cape. Further interest in the islands was aroused with the development of wireless and the technology for weather forecasting. However, nothing more was done to establish a weather station or lay claim to the islands until after the Second World War, when South Africa became increasingly aware of the islands' strategic position, both for defence and navigation. This sparked an interest in annexation. At that time, a claim to the islands had not been laid. Right of sovereignty or possession was not counted on the basis of their discovery, nor as a consequence of the various visits to, or sealing operations on them. According to international law, three requirements had to be met by one claimant in order to establish clear title to the territory. It first had to be discovered, then entered and formally claimed, and finally it had to be occupied and administered as effectively as local conditions allowed.

After extensive, secretive and hurried preparations, recounted in delightful terms in John Marsh's book "No Pathway Here", South Africa set about annexing the islands in December 1947. The South African frigate HMSAS Transvaal, under the command of Lieutenant-Commander John Fairbairn, was despatched to formalize the annexation. Marion Island was annexed on the 29th of December 1947 when the occupying party landed at Gunner's Point in Transvaal Cove and, at the top of the cliff, raised the flag and read out the Deed of Sovereignty. The Document was then signed, inserted into a brass cylinder, and placed at the foot of the cairn in which the flag-pole had been planted. The whole ceremony was documented photographically. Thirteen men were subsequently landed with supplies and equipment to occupy the island. They were left there for sixteen days until their relief party arrived with stores brought by the frigates Natal, and Gamtoos. Prince Edward Island was annexed on January 4th 1948, and the South African parliament passed the Prince Edward Islands Act (43) of 1948, which became effective from the 7th of October 1948.

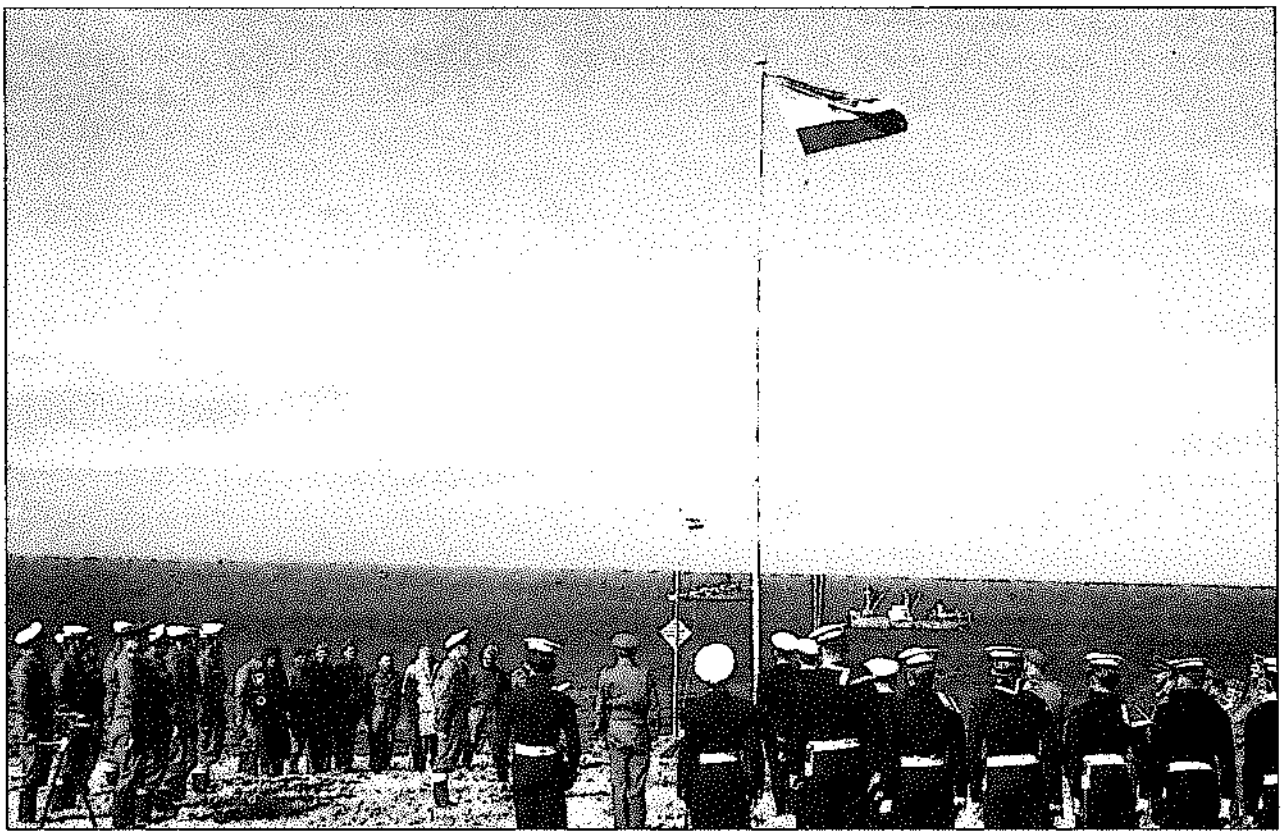


Photo: Courtesy The John H. Marsh Maritime Research Centre, South African Maritime Museum

Annexation of Marion Island in 1948

OCCUPATION

The first team to occupy Marion Island was a meteorological team, led by Allan B. Crawford in February 1948. A meteorological station was set up and from the 20th of March 1948 a continuous record of surface synoptic observations has been collected. Soon after the station was established, an informal post office was also opened at Marion Island. Various postal services have operated since (viz. in 1958 and between 1962 and 1980). Teams of meteorologists and technicians have occupied Marion Island ever since. Members were relieved twice a year up until April 1956 and thereafter on a yearly basis. Such relief voyages were mainly undertaken by frigates of the South African Navy until the national Antarctic research and supply vessel RSA took over in 1962 followed by the SA Agulhas in 1978. The SA Agulhas is still in service. Fixed wing aircraft are not used, because landing facilities are not feasible (as found by a comprehensive Environmental Impact Assessment done in 1987). However, airdrops have been made in emergency situations (such as when the accommodation and communications building at Marion Island burnt down in 1966, and when supplies, such as medicines were in urgent need). However, the SA Agulhas caries two Oryx helicopters, which are used for transporting cargo and personnel.

Although no research programs were undertaken in the first years of occupation, several members of the early teams were active in collecting biological specimens for scientific investigations. One of the first studies on seals and birds was conducted during the summer of 1951 - 1952 by R.W. (Bob) Rand of the 8th team on Marion. However, the first scheduled research visit to both Marion and Prince Edward took place in January 1965. The South African Biological and Geological Expedition was initiated and led by Professor Edward M. van Zinderen Bakker Sr. of the University of the Orange Free State, and coincided with the relief of the 21st Expedition. The research visit of 1965

also marked the first official visit to Prince Edward since it's annexation, because this island was not occupied permanently, nor was any weather station ever erected there. Visits to Prince Edward Island have since only been of a scientific nature, and confined to short periods during the annual relief voyages to Marion Island.

RATIONALE FOR THE SCIENTIFIC STATION (BASE) AT MARION ISLAND

Initially, the meteorological station set up after annexation was the prime reason for the continued staffing and occupation of Marion base. These meteorological activities have also remained one of the most important motivations for the base. They play an important role in weather forecasts for South Africa, and are crucial for understanding the global climate, how it varies from year to year, and how humans are affecting it. The small team of meteorologists going to the island each year are responsible for making sure that the weather data reaches South Africa intact. Although much of the weather monitoring is now automated, upper air (bolug) ascents are still launched by hand twice a day, 365 days a year (irrespective of the weather conditions!).

Results from the early scientific expeditions, such as those of the HMS Challenger, and Bougainville expedition, together with the work of Bob Rand, set the stage for biological investigations at the islands. The collections and observations made during these expeditions, together with the wealth of information collected by the first biological and geological expedition of 1965, spurred further biological interest in the islands. Since then, biological research has been a regular and ongoing activity that, along with the weather monitoring, has produced over 800 scientific publications in addition to many popular articles, films and videos.

Scientific work, and mainly biological research, now forms one of the other major reasons for maintenance of the scientific station at the Prince Edward Islands. The information gained from thirty three years of continuous biological research has resulted in an almost unparalleled understanding of the islands' animals, plants and ecosystems, both in a South African and global context. In consequence, the stage has been well set for addressing many of the environmental management problems at the islands and for examining additional important ideas in ecology. Examples of the former include the very successful cat eradication programme that took place in the late 1980s, and the current studies on the effects of fishing in the southern ocean on bird and mammal species. But perhaps the most important ecological ideas that can be tested using the islands ecosystems are those that have to do with global climate change. Over the past few hundred years a slow, but steady increase in average temperatures has been recorded around the world. This increase has been very rapid in the sub-Antarctic (as much as 1° C in the last 50 years), and the trend seems set to continue. In other words, temperatures are rising faster in the sub-Antarctic than elsewhere, and if we want to predict how ecosystems the world over will respond to higher temperatures, the sub-Antarctic islands will provide a chance to do so.

In sum, Marion base serves the general public of South Africa, and the broader global community, by providing information that can be used to understand weather systems and climate, and by providing research that is necessary to understand how ecosystems work and how species survive in the numbers and places they do. In this context it is important to remember, however, that without the logistic support of everyone, from administration in Pretoria and stores in Cape Town, to the ship's master, officers and crew, helicopter crews, support staff on the island, and public works maintenance teams, the Marion base and its research programmes would be inoperable.

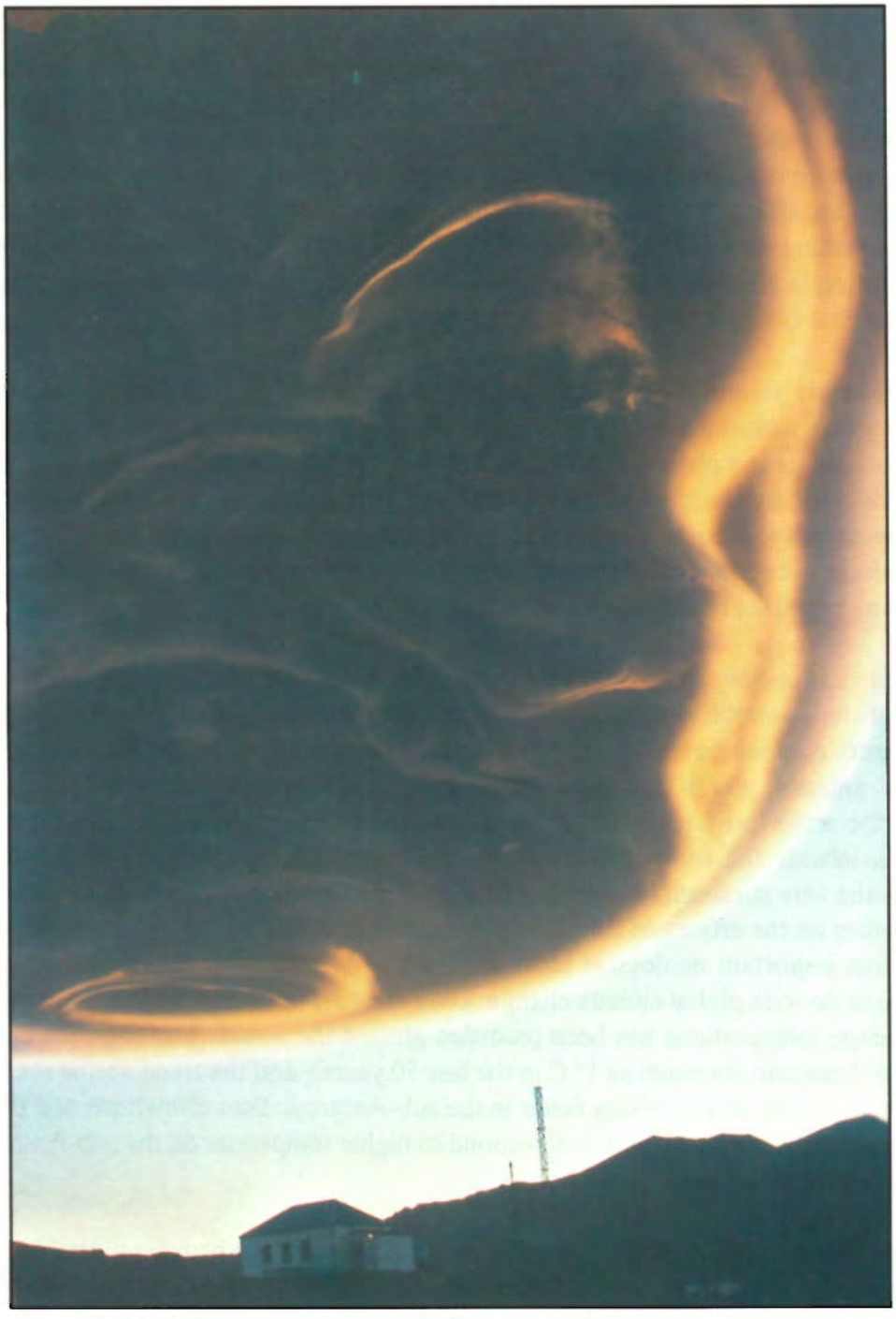


Photo: S Chown

A remarkable cloud formation over one of the biological laboratories on Marion Island

5. ECOLOGY AND CONSERVATION

ECOLOGY

Because Marion and Prince Edward are islands they can be thought of as semi-closed systems, such as lakes or dams in a continental setting. Although the ecosystem in a lake or dam is very different to the one surrounding it (there are fish, crocodiles, algae and so on in the lake), much of the energy required to run this system comes from the outside. Rivers bring nutrients and the sun supplies energy, while crocodiles feed on antelope that come to drink. The ecosystems at the Prince Edward Islands can be thought of in similar terms. Although the ecosystems on these two small pieces of land are rather different to those in the vast southern ocean surrounding them, there is an important interaction between the two. It is partly this interaction that makes the islands such fascinating ecological models.

Energy comes into the islands via the sun (which is noticeably often obscured by clouds), wind (Wandering Albatrosses battle to fly without the assistance of this energy source), and from the guano that is deposited both by nesting seabirds and by breeding and moulting seals. These largely marine animals also supply the island with most of the nutrients that are needed for plant growth. In other words, these animals are crucial to the functioning of the islands' systems, and the islands should not just be seen as breeding platforms for these species. The lush and verdant growth of nitrophilic (nitrogen loving) plant species (e.g. tussock grass) around penguin rookeries and elephant seal haul-out areas is a prime example of the influence of the exchange of nutrients between the ocean and the islands on the local ecosystem.

The immediate effect of the manuring by birds and seals is quite localised, but over time these nutrients spread, in lower concentrations, over much of the island, thanks to transport mainly by invertebrates. Nonetheless, the bulk of the nutrients needed for plants to grow in the nutrient-poor inland areas like mires come from a recycling of dead plant material. When plants or their leaves die these must be broken down either by bacteria or by the work of insects and earthworms because there are no large herbivores (such as antelope) on the islands. Not all of the plant material is recycled and much of it accumulates as carbon rich peat (a distant forerunner of coal). However, at least some of the nutrients needed for living plants to produce new leaves are released by insects, earthworms and bacteria. It is especially caterpillars of the Marion flightless moth, *Pringleophaga marioni*, and earthworms that are responsible for chewing up (and therefore breaking down) dead plant material. They form a bottleneck (somewhat like the turnstile at a rugby stadium), for the nutrients on the island and are therefore incredibly important species in the islands' ecosystems.

In turn, the plants provide food for some of the smaller insect herbivores and these animals in turn form the prey of others, such as mites and spiders, which in turn are eaten by sheathbills and gulls. In this way the birds, seals and sunshine help to drive the terrestrial ecosystem at the islands, by bringing nutrients and energy, from the ocean, ashore. Even more importantly, this terrestrial system also feeds back to affect the ocean surrounding it. Nutrients that are washed off the island by rainfall increase the growth of plankton that form the base of the marine food chain, eventually producing fish and other food sources that are used by penguins, petrels and seals. Food production is also affected by ocean currents, that are altered by the presence of the islands in the area. In addition, because birds and seals can use the islands as a safe haven for breeding and moulting, their populations can be sustained. These populations effectively close the feedback loop that makes the island ecosystem just what it is.

In sum, the terrestrial systems at the islands are tightly integrated with those of the ocean, and are

tightly linked internally. As a consequence they are quite susceptible to internal changes, such as those wrought by the introduction of alien species, or the removal of indigenous ones, but also to externally driven ones. These external impacts can be as obvious as those of a fishing industry on albatrosses and seals which forage thousands of kilometres away from the islands, or as subtle as those involving changes to the planet's climate, effected by industrialized nations.

CONSERVATION

The Prince Edward Islands are unique because they represent some of the only pieces of land in the vast southern ocean, and because they house many species which occur nowhere else, or only on one or two similar islands. The islands are also quite extraordinary because their isolation has prevented so many common continental species, such as predatory mammals, rodents, plant-feeding mammals and small, perching birds, from reaching them. The introduction of alien species, whether mammals, insects, plants, slugs, micro-organisms or diseases, is therefore the single largest conservation concern at the islands. Introduced species can have catastrophic impacts on the islands, and this has already happened at Marion (while to date Prince Edward has been more fortunate.)

Few visitors to the Prince Edward Islands will not have heard the cat saga. Because sealers brought mice to the islands, the early teams were constantly plagued by these rodents. In an attempt to tackle the problem, an early team introduced five cats to Marion base. These included a castrated, orange-striped, male tabby and a black and white female that were introduced in January 1949, followed by a litter of three kittens brought down to the Island in August of that year. The cats soon multiplied and became feral (the first wild cat was seen in 1951 approximately 12 km west of the meteorological station). By 1975 more than 2000 cats had learnt that it was far easier to feed on burrowing petrels around the island, than to hunt mice at the Marion base. In consequence, these 2000 cats ate just under half a million birds in 1975 alone, resulting in the extermination of the Common Diving Petrel *Pelecanoides urinatrix* and virtual extinction of at least three other species (the Greatwinged Petrel *Pterodroma macroptera*, the Softplumaged Petrel *P. mollis* and the Grey Petrel *Procellaria cinerea*) at Marion Island. A control programme using a viral disease, hunting, trapping and ultimately poisoning ensued, and by 1991 more than 3000 cats had been killed. Since then, not a single cat, or sign of a cat, has been seen on Marion Island, making this programme one of the most successful eradication programmes ever. Of course, it is difficult to envisage the hardship endured by the "cat hunters" during the five years (1986 - 1991) of intensive hunting they undertook, but a small exercise might assist in the process: strap a small torch to your head and run from Marion base to Long Ridge, via Hoppies Hell, and back, at night, in the rain and wind, and chasing anything that seems to reflect in your light, but don't disturb any of the local wildlife while doing so.

It is not only such large alien species that have an impact. The mice that plague the team members also have a major effect on the ecosystem at the islands. By eating Marion flightless moth caterpillars, and other important small insect species, mice may effectively be closing off the nutrient bottleneck at Marion Island, hence severely affecting ecosystem functioning. Mice are also capable of altering plant communities and other ecosystem processes. They remove and eat seeds of certain plants, thus preventing their natural propagation, and burrow into vegetation, often causing plants such as *Azorella selago* cushions, to die off. In fact, in recent years a visible increase in the numbers and activity of mice, associated with a general warming of the island, induced by global climate change, has made this impact far more pronounced. The predation of mice on the insects could be a contributing factor not only to the noticeable decline in the findings of adult flightless moths (*Pringleophaga marioni*), but also to a decline in the numbers of many small insect species important in the terrestrial system. It has also been suggested that the decline in sheathbill numbers at Marion Island over the past 20 years, and the large difference in sheathbill numbers between Marion Island and Prince Edward

Island are indirectly due to the impacts of mice. Sheathbills feed on invertebrates and rely on this food source to survive over the winter. Any reduction in invertebrate numbers caused by mouse predation would therefore have a negative influence on sheathbills.

Introduced plants and insects are also having an effect on the terrestrial ecosystem at Marion Island. The pale yellow, longish grass that is common all over the east coast of the island (*Agrostis stolonifera*) was introduced with sheep fodder and is aggressively invading habitats previously dominated by the dwarf-shrub *Acaena magellanica*. Wherever it occurs, *Agrostis stolonifera* outcompetes most of the indigenous plants and forms an uninteresting monoculture, compared to the diverse communities it replaces. Likewise, an insect, the small, Diamond-backed moth, feeds voraciously on Kerguelen cabbages, and in conjunction with an introduced fungus it is posing a significant threat to this rather unique cabbage species.

Photo: C Hänel

Caterpillars of the introduced Diamondbacked moth, feeding on a Kerguelen Cabbage

Because of what we know about the impacts of these alien species on the system, great efforts have been made to reduce the entry of alien species to the islands. Much of this effort depends on the individual visitor to the islands and it is important for clothing to be inspected carefully for seeds etc., for boots to be washed, and for all cargo to be rodent free. This forms the major reason why so much care is taken to ensure that goods taken to the islands are as clean as possible, and why visits to Prince Edward Island have to be made with new clothing, and only after all of the landing gear of the helicopters used has been carefully cleaned. As we have mentioned, Prince Edward Island has not been invaded by mice and cabbage moths and it has few alien plants. Thus such great care is taken to prevent th introduction of these species. However, it should be realized that the first line of defence against alien species is the prevention of their introduction to Marion Island in the first place.

A more recent, though equally important conservation issue is fishing for Patagonian toothfish around the islands. Many boats are now exploiting this valuable resource, and because of the methods they use (long lines with thousands of large, baited hooks) many birds are caught. The most severely affected species are the small albatrosses (Grey-headed and Yellow-nosed Albatrosses) and Whitechinned Petrels. Many of the vessels are licensed to fish in this area by the South African government and take care to reduce the incidental mortality of seabirds as far as possible. However, there are many illegal operators who pay scant regard to regulations and who are not shy of fishing very close to shore. Every visitor to the islands should be aware of these activities and should report all sightings of boats (especially those close inshore) to the Conservation Officer. In addition, visitors, and especially team members, should remember that every additional landing at the islands increases the risks of rats (and other alien species) getting ashore. These rodents have the potential to turn the island into a barren, bird-free island, and, as we have mentioned, other alien species can have large effects. Therefore, despite the temptation to invite crews from these vessels ashore, or to use them to have goods delivered, as little contact should be made with them as possible. This contact is in any case regulated by the Prince Edward Islands Management Plan, and can only take place once permits have been issued. Nonetheless, there are significant risks associated with vessels that may be carrying alien species.

Finally, conservation at the islands is very much an individual endeavour. Most of the items needed for day-to-day human activities at a research station pose some threat to the wildlife. Plastic bags, plastic strapping, long pieces of string, and many other items can entangle birds and seals and cause their death. Likewise, many other seemingly harmless items or behaviours can result in large conservation problems over the longer term. The essential rule in this regard is not to disturb the wildlife as it goes about its daily business, and not to leave anything lying around outside that is not absolutely essential and that is not tied down.

Photo: D Nel

Long-line fishing causes the death of many birds, such as this Whitechinned Petrel, found dead at Marion Island. It died due to the hook it swallowed

6. *ANIMALS*

MAMMALS

Three indigenous seal species and one alien rodent (the House Mouse) breed on Marion Island, whereas only the seals breed on Prince Edward. The only other mammals that have, and could potentially be seen on land, are solitary vagrants. These species visit the islands irregularly and for short periods, but do not breed on them. Nonetheless, the ocean surrounding the islands is rich in seal and whale species, and holds rewarding viewing for those who have the time to do so.

Indigenous species

Seals

One species of Elephant Seal, *Mirounga leonina*, and two species of Fur Seal, the Antarctic Fur Seal *Arctocephalus gazella* and the Sub-Antarctic Fur Seal *A. tropicalis* are common breeding species on the islands. For the most part, the species can be distinguished quite readily (especially the males) and some key features to use for identification purposes are provided in Table I. It should be noted though, that the fur seals (*A. gazella* and *A. tropicalis*) are known to hybridise, which may complicate identifications. Nonetheless, behavioural characteristics, such as the choice of habitat, can also be used to separate the two fur seal species. For example, females and pups of *A. tropicalis* tend to choose jumbled rocky beaches on which to breed, while *A. gazella* more often occurs on flatter and smoother beaches and the vegetated areas behind them. On Marion, high densities of the Sub-Antarctic Fur Seals tend to be spread around the western coast of the island, in areas such as Cape Davis and Mixed Pickle Cove, while the Antarctic Fur Seals can be encountered more frequently in the south east, notably at Watertunnel Stream and Sealers Cave / Landfall Beach, although both species can be seen anywhere around the island.

Elephant Seals tend to use somewhat smoother-surfaced beaches on the eastern coasts of the island for breeding, and move up into the vegetated areas and wallows when moulting (see Table I).

Although both Fur Seals and Elephant Seals are essentially marine, they come ashore to breed and moult, and these activities form the terrestrial phase in their annual cycle. The timing of these activities differs between species (Table I). During their time ashore, the seals are vulnerable, being most sensitive to human disturbance during their breeding season, because bulls defending their harems can squash young pups, and females escaping to the sea do so at the risk of endangering themselves and their suckling offspring. This is of particular concern with respect to the elephant seals because the population at Marion Island has been declining over the last few decades, as opposed to the Fur Seal populations, which have shown a steady increase over a similar period.

Alien species

Mice

The only other mammal species occurring at the PEI is an alien, which is restricted to Marion Island. The House Mouse (*Mus musculus*) is thought to have been introduced through shipwrecks and sealers' expeditions during the early 1800s. This is a somewhat curious situation because mice do not occur on Prince Edward Island, despite a higher incidence of shipwrecking at Prince Edward Island and similar sealing traffic at the two islands.

Mice have been resident on Marion Island for about 200 years. In this time they have colonised the entire island, up to about the 750 m contour line, although individuals are sometimes seen at higher altitudes. Their numbers are highest in tussock grasslands and during summer, reaching a peak

towards the end of summer (April /May) when invertebrate biomass and refuge availability are also high. Thereafter the population drops dramatically during winter and this drop has been linked to food limitation and climate. Nonetheless, the mice are extremely adaptable, being able to breed in a variety of habitats and temperatures, ranging from below -10°C (which on the lower levels of Marion occurs mainly in the freezer units at Marion base), to the high temperatures caused by heat from power generators and incubators on the island. Although the mice eat mostly insects (Table I), their diet and choice of nesting material covers just about everything other than metal, glass and the hardest of objects. Their uncanny ability to gnaw through wood, plastic and soft metal makes them very destructive, especially in and around Marion base and the field huts. The mice are therefore considered pests, not only because they are a nuisance level to humans, but more importantly because of the threat they pose to the plants and invertebrates, and the Marion Island terrestrial ecosystem (see section 5 on Ecology and Conservation).

Past mammalian introductions have also included domestic sheep, pigs, goats, donkeys, and dogs. However, none of these became feral (with the exception of the sheep which roamed parts of the Island), and due to the unsuitable conditions, either died naturally or were exterminated by Base personnel.

Vagrant species

Records of vagrant mammal species on Marion Island have, to date, included Leopard Seals, *Hydrurga leptonyx*, which have been sighted fairly often over the years, a single Weddell Seal, *Leptonychotes weddellii*, and the South African (Cape) Fur Seal, *Arctocephalus pusillus pusillus*, of which only one sighting has ever been noted (see Table II).

Marine species

Apart from the vagrant species mentioned above, cetaceans (whales and dolphins) can often be seen at the islands, both close inshore and further out to sea. These species can be identified by their size, colour patterns, fins, spout and behaviour. Most frequently seen are Killer-Whales, *Orcinus orca*, the largest of the dolphin family. Other species, from the toothed-whale suborder (Pilot Whales, *Globicephala melaena edwardi*) can also be seen, as can species of the baleen suborder (such as the Southern Right Whale, *Eubalaena australis* and the Humpback Whale, *Megaptera novaeangliae*).

TABLE I MAMMALS

INDIGENOUS

	Species Names	Characteristics			Biology		Population	
	Common *Scientific*	Features	Size (length in metres) * = at birth p = pups	Weight (kg) + = at weaning * = at birth A = Adults	Behaviour	Feeding	Marion	P.E.
Pinnipeds	**Southern Elephant Seal** *Mirounga leonina*	Males develop fleshy, trunk-like proboscis that can be inflated in display. Colour dark grey, fading during the year to rusty grey/brown. (Females are darker than males).	♀) 2 - 3 ♂) 4 - 5.8 p) 1.2 Largest of the pinnipeds.	♀) 400 - 660 ♂) 3 500 p)* 34 - 41 p)+ 109 - 119	***Breeding*** Bulls come ashore mid-August followed about a month later by the pregnant females. Births takes place mainly in mid-October. Pups are nursed for 3 weeks. ***Moulting***: Immatures haul out first (Nov. - Dec.), followed by adult females (Jan - Feb.) and finally adult bulls (Mar. - Apr.). Moulting can last 30 - 40 days. Pups shed their black coat soon after weaning (± 3 weeks of age) turning silvery grey and then fading to a dull yellow.	Squid and Fish.	2009[c]	782
Pinnipeds	**Antarctic Fur Seal** *Arctocephalus gazella*	Generally a longer body and a sharper snout, with smaller eyes compared to *A. tropicalis*. Flippers are long compared to body size. Colour grey-brown, males having a grizzled mane.	♀) 1 - 1.4 ♂) 1.7 - 2 p)* 0.65	♀) 25 - 50 ♂) 125 - 140 p)* 6 p)+ 13.5 - 17	***Breeding*** : From late October bulls return to establish breeding territories, followed by pregnant females towards end of November that nurse their pups until April. ***Moulting***: Adults moult on land from February to April.	Feed on fish, squid and crustacea.	1205[d]	200[a]
Pinnipeds	**Sub-Antarctic Fur Seal** *A. tropicalis*	Short compact bodies with smaller heads, but larger, eyes compared to *A. gazella*. Older males have a prominent black "crest" (tuft of upright hair) on their foreheads. Face and chest are yellowish, with ginger-brown belly.	♀) 1 - 1.4 ♂) 1.5 - 1.8 p)* 0.6	♀) 30 - 50 ♂) 97 - 158 p)* 3.9 - 4.5 p)+ 13.7 - 16	***Breeding*** : Males return to colonies in Sept. to establish breeding territories, followed by the pregnant females that give birth between November and February. Between June to Sept. most adults have gone to sea. ***Moulting*** - same as *A. gazella* adults.	Fairly general feeders on fish squid, and krill. Penguins may also be part of their diet.	48658[d]	25786[b]

Year in which seal census was carried out : a) 1981/82 b) 1988/89 c) 1990 d) 1994/95 Mouse population estimate : (e) 1996/97

ALIEN

Rodent	**House Mouse** *Mus musculus*			A) 21 *grams*	Mice can be found all over the lower parts of Marion, (all habitats and up to altitudes of ± 750m), however, their numbers are highest in tussock grasslands and during summer (until Apr.).	Mainly large insects. (Moth larvae, weevils and spiders).	1.6 [milion e]	0[e]

TABLE II MAMMALS

Species Names	Characteristics			Biology		Sightings
Common *Scientific*	Features	Size (length in metres)	Weight (kg)	Behaviour	Feeding	Marion
U N U S U A L F O R M S						
Hybrid Fur Seal	A cross between *A. tropicalis and A. gazella.*					< 1 % of population
White-coated Elephant Seal *M. leonina*	White coloured coat					1
White-patched Mouse *M. musculus*	Some mice have white patches of various sizes and shapes on different parts of their body.					< 1 % of population
V A G R A N T S (Temporary - non-breading - visitors)						
Leopard Seal *Hydrurga leptonyx*	Bodies long and slender with dark spots. Head is large box-like (with no forehead). Snout long with huge jaws. Large pointed canines and incisors (used for killing warm-blooded prey), and lobed (tricuspid) cheek teeth (unique to the species) specialised for sieving krill. Eyes relatively small.	♀) ± 3.6 ♂) ± 3 - 4 Females slightly larger than males.	♀) 500 ♂) 450	Solitary species, breeds on pack ice. When approached, agitated animals will characteristically raise the front third of their body and gaze at the source of their discontent. The species is well know for its long, haunting drones which can be heard from beneath the water.	Krill, penguins, and other birds, young seals, fish and cephalopods.	0 - 3 (approx p/year)
Weddell Seal *Leptonychotes weddellii*	Bodies round, blue-black on top grading to grey silver-white underneath with irregular silver-white splashes and spots on the sides and belly. Head is small in relation to body. Large brown eyes. Muzzle short and blunt, appearing to grin permanently.	A) 2.1 - 3.3 p) 1.5 Amongst the largest of seals.	A) 320 - 550 p) 29 Females slightly larger and heavier than males.	The most southerly of the Antarctic seals; their distribution being circumpolar in the Antarctic. Appear fearless, typically rolling onto their sides and lifting their heads to watch. Pups are born between Sept. and Nov. Adults moult from Dec. - Mar., while pups moult ± 9 - 21 days after birth.	Mainly fish, although they also take squid and crustaceans.	1
South African (Cape) Fur Seal *Arctocephalus pusillus pusillus*		♀) 1.5 - 1.8 ♂) 2.3 Largest of the fur-seals.	♀) 120 ♂) 200 - 350	Breeding territories are established from Oct. and pups are born from Oct. to Jan. with most pups born around 1st Dec. Lactation period up to 12 months.	Mainly pelagic shoaling fish, some squid and crustaceans.	1

BIRDS

The islands as breeding platforms

Of the few sub-Antarctic islands that serve as the only breeding platforms for a host of seabirds (and in the case of some islands - for landbirds too), the PEI are the second most important island group in terms of species numbers. In addition, some of the largest bird colonies in the world can be found on the islands, of which the penguin coloney at Kildalkey Bay is the foremost example. Indeed, Marion Island is the 2nd most important breeding locality for King Penguins in the world, catering for 30% of the global population, while the population of Macaroni Penguins on the PEI represents 7.5% of the world's total population.

Twenty nine species of birds are known to use the Prince Edward Islands for breeding and moulting purposes. Most of these are seabirds (i.e. species that spend large amounts of their time foraging at sea). All of the bird species that breed on the islands are indigenous to them, (occur there naturally) although none are currently thought to be endemic to the Island group (i.e. occurring on these islands and nowhere else), except for the Lesser Sheathbill, which is an endemic sub-species, and the only true land bird on the islands. Nonetheless, genetic studies have suggested that there are quite large differences between the albatross populations (of at least some of the species) on these islands and those elsewhere. From a conservation viewpoint these differences are as important as species level differences. No birds have been introduced into the natural environment of the PEI, although, four domestic species were kept at the meteorological station for various periods between 1948 and 1974. The imported birds were: domestic chickens (that were first sent to Marion Island to supplement the diet of the team members); a small flock of domestic geese (brought from Tristan da Cunha to Marion Island in 1948); an African Grey Parrot (that was present at the meteorological station in 1962); and an Amazon Parrot (that was present at Marion base in 1963).

Bird groups represented

From an ecological perspective, the birds nesting on the PEI can be grouped into three categories: inshore feeders, pelagic feeders and terrestrial feeders. The inshore birds seldom move out of sight of land and normally spend the night (roost) ashore, while the pelagic species spend many months far from land, obtaining their food from the open ocean. The terrestrial species are somewhat of a mixed bag. Lesser Sheathbills forage mostly in penguin colonies, but also forage for insects and other invertebrates inland. Kelp Gulls will also search the mires for invertebrates, and the opportunistic skuas will take mice on land if given a chance. Most of the birds on the PEI are of the pelagic type, that breed in summer, and leave the islands when not breeding. Only a few species do not breed during the summer months, such as Gentoo Penguin and the Greatwinged and the Grey Petrel, which are winter breeders. During the winter months it is these species, together with the inshore Kelp Gulls, cormorants and sheathbills, that are most conspicuous. Nonetheless, Wandering Albatross and King Penguin chicks, and the adults that return to feed them, can also be seen during the winter months because it takes some time (up to 12 months) before the young birds are ready to go to sea for the first time. In addition, some other species (such as the Blue Petrel) are also known to visit their nest sites outside of their breeding season.

Coexistence of birds on the islands

On land, the birds coexist by virtue of different habitat preferences and different seasonalities. Broadly speaking, penguins usually occupy the coastal slopes; cormorants and smaller albatrosses the cliffs, and larger albatrosses the higher, flatter ground, while the small petrels honeycomb the island surface with their burrows (see Tables III, IV, V, VI). In this way a few million birds are accommodated. Of these, the penguins form the largest proportion, with over three quarters of a million breeding pairs, followed by the night bird community of burrowing petrels (and prions) that make up about a quarter

of a million breeding pairs. Tables III to VI provide an overview of the numbers of birds that nest on the PEI. Of course, these counts are subject to some variation annually because of the different reproductive biologies of the species concerned. For example, Wandering Albatrosses breed biennially (once every two years), and therefore only return to the island every second year. Thus the annual population figure given in Table IV, probably represents only half the populations' actual size. On the other hand, for many species the population sizes are not known because of the difficulty of counting these birds. Therefore the numbers presented here are educated guesses.

Vagrants

Not counted amongst the 29 seabirds, but sometimes appearing at the islands, are the vagrant species. These are individual stray birds that arrive at the islands, usually stay for very short periods, and do not breed there. Some 51 vagrant species have been recorded to date, of which 23 were non-breeding seabirds and 28 were terrestrial and/or wading birds (see Table VII). The most commonly seen vagrant birds are Cattle Egrets (which are often aggressively pursued by skuas) and European Swallows. A curious anecdotal observation is that the higher the number of keen birdwatchers there are on the island, the higher the list of vagrants is for a particular year.

The role of birds in the islands' ecosystems

Birds are amongst the most important contributors to the functioning of the islands' terrestrial and oceanic ecosystems, and form the major link between the two. Through them, nutrients are introduced to the islands, recycled and redistributed. In other words, they fertilize the islands' terrestrial ecosystem. These nutrients are crucial for the maintenance of many vital processes. For example, during any particular year, the eggs of just the surface breeding birds (i.e. not including the thousands of burrowing petrels) contain sufficient energy to drive a small car eight times around the world, or to sustain an active human for 300 years. Together, the birds' eggs, feathers, decomposing carcasses, and guano promote plant growth because of their high nitrogen content. Since the soils on the Prince Edward Islands tend to be nitrogen deficient, the influence of birds can be seen most clearly by the growth of the lush tussock grass (*Poa cookii*) that surrounds Wandering Albatross nests in otherwise quite nutrient poor mires. Much of the nutrient input to the islands is also washed out to sea from the major penguin colonies, which stimulates growth and production of plankton in the surrounding waters. This plankton forms the basis of the marine food web on which the breeding birds rely heavily.

Birds can also cause erosion in various ways. For example, removal of soil and vegetation for their nests on cliffs and slopes can lead to peat-slips if the slopes become too unstable. Likewise, trampling can remove vegetation and peat along regular paths and this can most clearly be seen at Bullard Beach during the winter months (when the Macroni Penguins are away and cannot be disturbed). Here, the peat has been worn away for nesting sites and a peat ledge of up to 2 m can be found at the edge of this rookery. In addition, many of the rocks along the path to this penguin rookery have been eroded by centuries of penguin feet, the claw marks of which are quite clearly etched into the rocks.

Because of their remarkable powers of flight, birds can of course also disperse seeds and small insects and other invertebrates. In fact, some plants are adapted to exploit birds for the purpose of dispersal, as can be seen from the adhesive seeds of the indigenous *Acaena magellanica* and *Uncinia compacta* on the Prince Edward Islands. Not only do the seeds of these plants attach themselves to the feathers of birds, but they can also bore their way through the thickest of woolly clothing, much to the irritation of unwary visitors to the islands. Likewise, plant species can also have sticky seeds which can readily be dispersed by birds.

Conservation status and issues

Although the numbers of individuals listed for many of the seabird groups identified here (e.g., penguins, albatrosses) are rather impressive, this is not a reliable indicator of the conservation status of many of the species. In each group there are birds that have rather small populations at the islands. Small populations are always a conservation concern. In some cases these small populations are a consequence of natural circumstances. For example, Gentoo Penguins are at the limit of their range at the PEI. In other cases, population declines were precipitated by human actions, such as the introduction of feral cats to Marion Island in the late 1940s. Although the cats have been eradicated on the island, the populations of many of the burrowing petrel species that formed their major prey items are still small. Indeed, six of these species are listed as threatened in the South African Red Data book, and one species (the Common Diving Petrel *Pelecanoides urinatrix*) is thought to be extinct at Marion Island (see details describing the effect of cats on the burrowing birds under the section "Ecology and Conservation"). More recently, longline fishing for Patagonian toothfish around the islands, and for other fish species elsewhere, has started to have a major impact on populations of the medium-sized albatrosses (such as Grey-headed and Yellow-nosed Albatrosses) and petrels (such as Whitechinned Petrels).

In a similar way, disturbance of the birds on the islands during their breeding season is also a major conservation problem, at least in the case of some species. Southern Giant Petrels and Gentoo Penguins are particularly vulnerable to human disturbance and should never be approached closely. Although most of the bird species appear reasonably undisturbed by humans, it is difficult to calculate the effects of repeated contacts on the birds. The fact that very few Gentoo Penguins are found at Gentoo Lake is an indication that cumulative disturbance is harmful to this and other species. It is for this reason that the Prince Edward Islands Management Plan prescribes limited approach distances for some bird colonies and also states that birds (and other wildlife) should not be disturbed. In this context the responsibility for ensuring a "bird-friendly" viewing distance lies with the visitor to the island. Although both individual birds and bird species differ in their tolerance levels, a safe guide to such a "bird-friendly" viewing distance is 15 m and if further away than 15 m simply this: when a bird stops what it is doing to notice you, you are too close.

Photo: S Chown

A Gentoo Penguin and its chick

TABLE III BREEDING BIRDS

PENGUINS

Species Names	Characteristics			Biology		Population sizes (Annual)	
Common *Scientific*	Features	Size (Height)	Weight (kg) A = Adults C+ = Chicks at fledging	Behaviour	Feeding	Marion	P.E.
King Penguin *Aptenodytes patagonicus*	Marion is the second most important breeding locality in the world.	94 cms	A 9 - 21	Breeding cycles annual or longer, (or twice every 3 years), in large colonies at the coast. Nesting behaviour unusual as there is no fixed nest site. (Feet of adults used to incubate egg and brood chick). Eggs laid November - March. Incubation 55 days. Chick rearing 10 - 13 months. Moult between September - March.	Feeds predominantly on fish, foraging up to a range of 300 km (most pelagic of the 4 penguin species)	215 000	5 000
Gentoo Penguin *Pygoscelis papua*	Rarest species on the islands. Is easily disturbed, especially when breeding.	76 - 81 cms	A 5.1 - 6.2 C^+ 4.4 - 4.8	Winter breeder in vegetated areas a little distance from the coast. First breeds at ± 3.5 years. Eggs laid beginning July and hatch mid to late August. Chicks in crèches end September and fledge November - December. Adults then moult December - March.	Feeds inshore (15 - 40 km) i.e. smallest foraging range of the 4 penguin species. Diet includes mainly krill and fish.	1 050	650
Macaroni Penguin *Eudyptes chrysolophus*	To be classed as "Near threatened" by IUCN criteria.	66 - 76 cms	A 3.3 - 4.3 C^+ 2.3 - 3.2	Breeds in large colonies on the more sheltered east coast, in areas of grey lava, and high up on slopes. Adults arrive at colony end October. Eggs hatch December. Chicks in crèches mid January and fledged by end February.	Feeds predominantly on crustaceans, but also on fish and cephalopods.	398 000	17 000
Rockhopper Penguin *Eudyptes chrysocome*	To be classed as "vulnerable"	55 - 60 cms	A 3.2 - 3.5 C^+ 1.4 - 1.7	Breed all around the coasts. Adults arrive by 20 November. Eggs hatch end December-beginning January. Chicks in crèche end January and fledge February - mid March. Moult after breeding. Leave May - November.	Diet is dominated by crustaceans. Some squid and fish are also taken.	173 000	35 000

TABLE IV BREEDING BIRDS

ALBATROSS

Species Names	Characteristics			Biology		Population sizes (Annual)	
Common *Scientific*	Features	Size (Height) L = Length (cm) WS = Wingspan (m)	Weight (kg) * = at hatching + = at fledging A = Adults C = chicks	Behaviour	Feeding	Marion	P.E.
Wandering Albatross *Diomedea exulans*	Able to fly up to 900 km per day, and so cover huge distances (>14,000 km)	L 120 - 130 WS 3.5	A) ± 9 c) 0,350 c)+ 10 - 13	Biennial breeder (every 2nd year), on the marshy plains around the coast. One egg laid December - January and hatches March - April. Incubation 11 weeks and chicks reared for 40 weeks. Chicks fledge November -February and remain at sea for ± 5 years. Age of 1st breeding : 10 - 12 years.	Feeds on squid and fish (also some carrion and crustaceans). Are voracious scavengers on discarded bait and offal from fishing boats.	1 500	1 300
Grey-headed Albatross *Thalassarche chrysostoma*	Threatened by long line fishing.	L 71 - 82 WS 2	A) 3.8	Biennial breeder, predominantly on east-facing cliffs of Marion and north facing slopes on PE. Breeding adults return early September and incubate a single egg which hatches ca. mid. December - begin. January. Chick is brooded for 3 - 4 weeks and fledges by end April - May, during which time adults depart from the colony.	Feeds mainly on fish, and cephalopods, and some crustaceans. Also carrion.	6 600	1 500
Atlantic Yellow-nosed Albatross *Thalassarche chlororhynchos*	Threatened by long line fishing.	L 74 - 86 WS 2	A) 2.5	Annual breeder, on northern cliffs of Prince Edward Island. Adults return in August to breed. 1 egg is laid by September/ October and incubated for ca. 70 days. Nestling period lasts ca. 4 months and chicks fledge by March/April, after which adults desert colony for the winter period.	Diet consists of fish and squid. Also actively scavenge offal from fishing vessels.	0	7 000 ?
Sooty Albatross *Phoebetria fusca*	Marion houses the 3rd largest of the world's breeding colonies.	L 81 - 86	A) 2.5	Biennial breeder, on cliffs in small colonies or singly. Breeding adults return August - September and lay 1 egg early October. Incubation lasts ca. 70 days and chick rearing ± 20 weeks. Chicks fledge mid - late May, during which time successful adults leave, followed by non-breeders departing by June.	Diet is mainly squid. Fish, crustaceans and scavenged material (such as small seabirds and seals).	2 055	700
Light-mantled Albatross *Phoebetria palpebrata*		L 71 - 90	A) 2.8	Considered biennial breeder (although some only breed every 3rd year); on cliffs in small colonies or singly. Has one of lowest breeding production rates (1 chick every 5 years!) . Breed between October - June. Adults return in October. Eggs laid October - beginning November and incubated 67 days. Hatch end December- beginning January and chick brooded 3 weeks. Nesting period 170 days. Fledge mid May - mid June, during which time adults depart from colony.	Cephalopods and euphausiid krill, but also fish and carrion (incl. seabirds and seals). Also scavenge from fishing boats, but not as frequently as Wanderers.	> 250	50

TABLE V BREEDING BIRDS

PETRELS

Species Names	Characteristics			Biology		Population sizes (Annual)	
Common *Scientific*	Features	Size (in cms) L = Length WS = Wingspan	Weight (kg)	Behaviour	Feeding	Marion b = breeding	P.E.
Northern Giant Petrel *Macronectes halli*	Rarer of the two giant petrels.	L 81 - 94 WS 200	3 - 5.9 kg	Breeds earlier in smaller groups and more sheltered localities than it's congener. Eggs laid in August and incubated 60 days. Chicks reared ± 16 weeks.	Diet includes marine prey and scavenging on penguins seals and other sea birds.	400	180
Southern Giant Petrel *M. giganteus*	Very sensitive to human disturbance.	L 86 - 99 WS 200	3 - 5.9 kg	Breeds in colonies around coastline and often concentrated near seal and penguin (esp. King Penguin) breeding colonies. Eggs laid September - October and incubated 61 days. Chicks reared 17 - 18 weeks.	Diet includes marine prey and scavenging on penguins seals and other sea birds.	> 1 200	400
Fairy Prion *Pachyptila turtur*	Voice: cooing and cackling.	L 23 - 28 WS 56 - 60	98 - 126 g	Breeds in burrows, along cliffs. Nocturnal at nesting places. Eggs laid end November and incubated 49 days. Chicks fledge between 52 - 63 days.	Feeds on zooplankton, crustaceans and fish. Also some cephalopods.	> 100	> 100
Salvin's Prion *Pachyptila salvini*	Common on Marion. Bill broader than other Prions.	L 24 - 28 WS 58	164 g	Only breeds on the Prince Edward and Crozet Islands. Eggs laid late November and incubated 49 days. Chicks reared for 52 - 63 days.	Feeds on crustaceans and fish. Also cephalopods.	> 100 000	> 10 000
Blue Petrel *Halobaena caerulea*	Voice at nest: pigeon-like cooing.	L 28 - 30 WS 58 - 66	170 - 226 g	Breeds in dense colonies close to the coast. At Marion, mainly on the west coast. Eggs laid late October and incubated for 49 days. Chicks fledge after 53 days, between January - February.	Feeds mainly on krill. Also some fish and cephalopods. Chance feeding on insects at sea is also possible.	> 10 000	> 100 000
Greatwinged Petrel *Pterodroma macroptera*	Voice: whistles, screams, grunts and brays.	L 38 - 42 WS 97 - 107	570 g	Breeds in winter. Eggs laid late May and incubated for 56 days. Chicks fledge after 118 days.	Feeds mainly on cephalopods, and also on crustaceans and fish.	> 10 000	> 1 000

Softplumaged Petrel *Pterodroma. mollis*	Voice : moans and whistles.	L 32 - 37 WS 83 - 95	202 - 304 g	Summer breeder. Eggs laid mid-December and incubated 50 days. Chicks fledge after 91 days.	Feeds on cephalopods and crustaceans.	> 1 000 > 1 000
Kerguelen Petrel *Lugensa brevirostris*	Easily disturbed. Fly off nest when approached. Voice hoarse screeching alarm.	L 33 WS 66 - 69	312 - 340 g	Summer breeder. Eggs laid early October and incubated 49 days. Chicks fledge at 61 days.	Feeds on cephalopods, crustaceans and fish.	> 10 000 > b
Grey Petrel *Procellaria cinerea*	Rare on Marion, but more abundant on PE.	L 48 - 50 WS 117 - 127	1.3 kg	Breeds in winter. Eggs are laid in April and incubated 55 days. Chicks fledge at 93 days.	Feeds on cephalopods, fish and offal. Gathers at fishing boats and around whales.	> 1 000 > 1 000
Whitechinned Petrel *P. aequinoctialis*	Largest of the burrowing petrels on the two Islands.	L 51 - 59 WS 134 - 147	1.5 kg	Summer breeder. Eggs laid in November and incubated for 58 days. Chicks fledge at 94 days.	Feeds mainly on fish, krill, cephalopods, other crustaceans offal.	ca.10 000 > 1 000
Black-bellied Storm-petrel *Fregetta tropica*	Highly pelagic (rarely approaches land).	L 19 - 22 WS 48	52 g	Summer breeder.	Feeds on cephalopods, crustaceans and fish.	b 1 000
Grey-backed Storm-petrel *Garrodia nereis*	Is nonmigratory (unlike other southern Ocean storm petrels).	L 16 - 19 WS 39	38 g	Summer breeder.	Shallow and deep water feeder, taking crustacean zooplankton and notably specialized in exploiting young stalked barnacles.	b b
South Georgian Diving Petrel *Pelecanoides georgicus*	Small compact species.	L 18 - 21 WS 30 - 33	90 – 150 g	Summer breeder.	Feeds mainly on planktonic crustaceans.	> 100 b
Common Diving Petrel *P. urinatrix*	Difficult to separate from *P. georgicus*.	L 20 - 25 WS 33 - 38	86 - 185	Summer breeder.	Feeds mainly on planktonic crustaceans, (krill), and some small fish and young cephalopods.	b b

TABLE VI BREEDING BIRDS

OTHERS

Species Names	Characteristics			Biology		Population sizes (Annual)	
Common *Scientific*	Features	Size (in cms) L = Length WS = Wingspan	Weight (kg)	Behaviour	Feeding	Marion	P.E.
Imperial Cormorant *Phalacrocorax atriceps*	Also known as Blue-eyed or Red-footed Shag.	L 68 - 76 W 130		Breeds in small colonies on the coastal cliffs of the islands. Eggs can be found from June - December and incubated 29 days. Chicks fledge at 75 - 80 days.	Feeds mainly on fish in territorial inshore waters.	540	120
Sub-Antarctic Skua *Catharacta antarctica*		L 61 - 66 WS 150	1.8 kg	Breeds territorially on the coastal plains during summer. Egg-laying coincides with that of nearest penguin colony. Incubation is 29 days and chicks fledge at 50 - 65 days. Most birds leave during winter, but a few may remain to scavenge.	Preys on burrowing petrels, young penguins and their eggs. Also robs other birds of their prey and scavenges on offal.	900	60
Kelp Gull *Larus dominicanus*		L 50 - 60 W 130	950 g	Summer breeder. Eggs laid late November and December and incubated 28 days. Chicks reared at 56 days.	Feeds on limpets and bivalves in the intertidal zone and invertebrates and scavenged material from vegetated coastal plains.	200	30
Antarctic Tern *Sterna vittata*	Easily disturbed. Flies off nest when approached.	L 38 - 41 WS 79		Summer breeder. Breeds on rocky ridges.	Feeds inshore on small fish and forages over kelp wrack and coastal marshes	< 25	< 25
Kerguelen Tern *S. virgata*	One of world's rarest and most threatened tern species. Listed as 'Vulnerable'.	L 33 WS 71 - 79		Breeds on rocky ridges. Eggs laid October-November. Little known about breeding cycle. Incubation possibly 30 days and chick rearing possibly 25 days.	Feeds inshore on small fish and forages over kelp wrack and coastal marshes.	> 10	20
Lesser Sheathbill *Chionis minor marionensis*	Has no webbed feet, i.e. only land bird on the islands. Thus vulnerable to introduced land predators.	L 38 - 41 WS 74 - 79	450-760 g	Eggs laid during December and incubated for 28 - 33 days. Chicks fledge at 50- 60 days. Subspecies is endemic to PEI.	Land-based foods, such as invertebrates, algae and food scavenged from seal and penguin colonies (including excreta, blood, etc).	2 850	420

U N U S U A L F O R M S
Penguins
Whitefaced Macaroni Penguin *Eudyptes chrysolophus* **Albino** Macaroni Penguin *Eudyptes chrysolophus* **Melanistic** (black) King Penguin *Aptenodytes patagonicus* **Isabelline** (pale brown) King Penguin *Aptenodytes patagonicus*
Albatross
Silver-grey Wandering Albatross (chick) *Diomedea exulans*

TABLE VII VAGRANT [Non - breeding] BIRDS

SEABIRDS		NON-MARINE	
NAMES			
Common	*Scientific*	Common	*Scientific*
Chinstrap penguin	*Pygoscelis antarctica*	Cattle Egret	*Bubulcus ibis*
		Yellowbilled Egret	*Egretta intermedia*
		White Stork	*Cinconia ciconia*
Royal Albatross	*Diomedea epomophora*	Corncrake	*Crex crex*
Black-browed Albatross	*Thalassarche melanophris*	Kerguelen Pintail	*Anas eatoni*
Shy Albatross	*Thalassarche cauta*	Brownthroated Martin	*Riparia paludicola*
Salvin's Albatross	*Thalassarche salvini*	House Martin	*Delichon urbica*
Southern Giant Petrel (White-phase)	*Macronectes giganteus*	Ringed Plover	*Charadrius hiaticula*
Antarctic Fulmar	*Fulmarus glacialoides*	Threebanded Plover	*Charadrius tricollaris*
Antarctic Petrel	*Thalassoica antarctica*	Whimbrel	*Numenius phaeopus*
Pintado Petrel	*Daption capense*	Terek Sandpiper	*Xenus cinereus*
Whiteheaded Petrel	*Pterodroma lessonii*	Common Sandpiper	*Tringa hypoleucos*
Wilson's Stormpetrel	*Oceanites oceanicus*	Greenshank	*Tringa nebularia*
Antarctic Prion	*Pachyptila desolata*	Wood Sandpiper	*Tringa glareola*
Slender-billed Prion	*Pachyptila belcheri*	Pectoral Sandpiper	*Calidris melanotos*
Cory's Shearwater	*Calonectris diomedea*	Curlew Sandpiper	*Calidris ferruginea*
Sooty Shearwater	*Puffinus griseus*	Little Stint	*Calidris minuta*
Little Shearwater	*Puffinus assimilis*	Turnstone	*Arenaria interpres*
Arctic Tern	*Sterna paradisaea*	Cape Turtle Dove	*Streptopelia capicola*
		Laughing Dove	*Streptopelia senegalensis*
Arctic Skua	*Stercorarius parasiticus*	African Cuckoo	*Cuculus gularis*
Lesser Blackbacked Gull	*Larus fuscus*	Whitethroat	*Sylvia communis*
Franklin's Gull	*Larus pipixcan*	European Swift	*Apus apus*
Sabine's Gull	*Larus sabini*	European Swallow	*Hirundo rustica*
		Redbacked Shrike	*Lanius collurio*
Autralasian Gannet	*Morus serrator*	Mountain Chat	*Oenanthe monticola*
Gray Phalarope	*Phalaropus fulicarius*	Willow Warbler	*Phylloscopus trochilus*
		Yellow Wagtail	*Motacilla flava*

Photo: C Hänel

Wandering Albatross engaged in a mating dance on Marion Island

INVERTEBRATES

Diversity

Because of the vast expanse of sea that separates oceanic islands from the continents, terrestrial (land-bound) species do not have easy access to such islands. Thus, sub-Antarctic islands, and in particular Marion and Prince Edward, are characterised by very few indigenous, terrestrial vertebrates. The Lesser Sheathbill (or Paddy) is the only indigenous terrestrial vertebrate on the Prince Edward Islands. Although Marion Island has mice, these were introduced by sealers a few centuries ago. Therefore, the indigenous terrestrial fauna at the Prince Edward Islands is represented almost entirely by insects, mites, earthworms, a snail species, and various micro-invertebrates and micro-organisms.

Although there are not nearly as many invertebrate species at the Prince Edward Islands as there are in continental areas (such as South Africa) the fauna is surprisingly diverse. In addition, it is characterised by many, rather odd looking species, which at first are rather difficult to associate with the groups they belong too. For example, although the Marion flightless moth *Pringleophaga marioni* is most closely related to clothes moths, it looks far more like a cockroach because it has reduced wings. Likewise some of the larger flies, especially the kelp flies, have reduced wings: "Fly walks" are therefore not an uncommon feature of the islands' beaches in summer.

This rather unusual invertebrate fauna can be classified in a number of ways. The most common way is by placing the species which are most closely related to each other in the same group and this is largely the way in which the species are listed in the Tables (Tables VIII and X). Thus all of the insect species are placed together and these can be recognised by their three pairs of legs, three major body segments, and two pairs of (often reduced) wings. The most common insect groups on the Prince Edward Islands are the beetles and flies. Amongst the flies, the alien, bathroom flies, or psychodid midges, are very commonly seen on calm, sunny, summer days.

Although Collembola, or Springtails, also have three pairs of legs, they lack any trace of wings. Mites have less well-differentiated body segments and can be recognised by four pairs of legs in the adult stage and an absence of wings. Spiders are easily recognised by their four pairs of legs and large pedipalps, and earthworms by their segmented worm-like body form. Although many other terrestrial invertebrate groups can be found on the islands, these are mostly very small and require specialists to identify them. Nonetheless placing a small piece of moss under the microscope will immediately reveal a world filled with wonderful animals with rather difficult names: tardigrades (water bears), rotifers (wheel animals), nematodes (round worms), testate rhizopods, and many others.

A further way in which the invertebrates can be classified is according to the habitat in which one is most likely to find them. Although the plants can be used to divide the island up into six different communities, the invertebrates do not follow this system entirely. Rather, they see the island as being composed of an intertidal zone (between the high and low water mark), a supralittoral zone (just above the high tide mark), rock faces in lowland habitats, fellfield areas, vegetated areas that are covered in mosses and flowering plants (essentially five of the six communities recognized by the botanists), waterbodies (freshwater ponds and streams), and the Marion base area. Table XI gives a clear indication of the preferred habitat of each of the insect species found on Marion Island, in addition to their taxonomic classification.

Of course, humans have complicated matters even more by introducing a number of species to the islands that previously did not occur there. In addition, some species occasionally manage to get blown to the islands from other continents (mostly Africa). Therefore, a further distinction is drawn between indigenous, alien and vagrant species. Some of the aliens have managed to establish breeding

populations at the islands and these are called naturalized aliens, whereas others come and go and are called transient aliens. Tables VIII and IX also show which species are indigenous and which are alien.

Identification

Because most of the invertebrates on the islands are so small, a magnifying lens is usually required to tell them apart, and even then, many species cannot be separated easily. The best way to achieve an accurate identification is to use the keys to the fauna that are provided in the book edited by Van Zinderen Bakker or in the South African Journal of Antarctic Research 1986 publication on the insects by Crafford and colleagues. Nonetheless, because there are so few species of large invertebrates it is relatively straightforward to get to know at least the major groups on the islands. For these, a summary of the main characteristics are given in Table X.

Important invertebrates

This booklet started out with a short discussion of how the Prince Edward Islands' ecosystems work, and why they should be conserved. To answer this question the reader should refer back to that page. However, to recap: indigenous invertebrates, and particularly caterpillars of the flightless moth and earthworms, recycle nutrients in the Marion Island ecosystem, thus keeping plants fertilized and the whole system turning over. Alien invertebrates, like the slug and Diamondbacked moth, can eliminate indigenous species by feeding on them or by transmitting disease. They can also compete with indigenous species thus driving them out of certain environments. By introducing alien species or destroying indigenous ones, humans have the potential to ruin ecosystems and this is nowhere more true than on these islands. Look out for the local bugs and leave your pet ones at home!

TABLE VIII INSECTS

Note: This table does *not* provide a complete list of all the invertebrates that can be found. (i.e. it does not include spiders, earthworms, snails, slugs, mites and springtails). For details on these, refer to Table X and the text in section 7 on invertebrates.

Areas where insects can be found

1. Intertidal
2. Supralittoral
3. Rock faces
4. Fellfield
5. Vegetated area
6. Waterbodies
7. Marion base

Common name		Family	*Scientific name*	1	2	3	4	5	6	7	TOTAL
INDIGENOUS SPECIES											
Beetles	Weevil	Curculionidae	*Bothrometopus elongatus*				✓				8
	Weevil	Curculionidae	*Bothrometopus parvulus*			✓	✓				
	Weevil	Curculionidae	*Bothrometopus randi*			✓	✓				
	Weevil	Curculionidae	*Ectemnorhinus marioni*					✓			
	Weevil	Curculionidae	*Ectemnorhinus similis*					✓			
	Weevil	Curculionidae	*Palirhoeus eatoni*		✓						
	Rove beetle	Staphylinidae	*Halmaeusa atriceps*		✓	✓	✓	✓			
	Hydraenid beetles	Hydraenidae	*Meropathus chuni*	✓	✓	✓		✓			
Flies	Large flightless kelp-fly	Helcomyzidae	*Paractora dreuxi mirabilis*	✓							5
	Small flightless kelp-fly	Tethinidae	*Apetaenus litoralis*	✓							
	Small kelp-fly	Tethinidae	*Listriomastax litorea*	✓							
	Fungus gnat	Sciaridae	*Lycoriella aubertii*					✓			
	Flightless midge	Chironomidae	*Telmatogeton amphibius*		✓						
Moths	Marion flightless moth	Tineidae	*Pringleophaga marioni*					✓			3
	Flightless moth	Tineidae	*Pringleophaga kerguelensis*					✓			
	Tussock grass moth	Yponomeutidae	*Embryonopsis halticella*					✓			
Wasp	Parasitic wasp	Eucoilidae	*Kleidotoma icarus*		✓						1
Psocid	Psocid	Elipsocidae	*Antarctopsocus jeanneli*			✓	✓				1
Total:		**11**	**18**								**18**
NATURALIZED ALIENS											
Thrips	Thrips	Thripidae	*Apterothrips apteris*					✓			1
Flies	Blow-fly	Calliphoridae	*Calliphora vicina*		✓			✓			5
	Lesser house fly	Fanniidae	*Fannia canicularis*					✓			
	Vinegar fly	Drosophilidae	*Scaptomyza* sp.					✓			
	Moth fly (Bathroom fly)	Psychodidae	*Psychoda parthenogenetica*					✓			
	Midge	Chironomidae	*Limnophyes minimus*					✓	✓		
Moths	Diamond-backed moth	Yponomeutidae	*Plutella xylostella*					✓			2
	Cutworm / Noctuid moth	Noctuidae	*Agrotis ipsilon*							✓	
Butterfly	Painted lady	Nymphalidae	*Vanessa cardui*					✓		✓	1
Aphids	Potato aphid	Aphididae	*Macrosiphum euphorbiae*					✓			3
	Aphid	Aphididae	*Myzus ascalonicus*					✓			
	Oat aphid	Aphididae	*Rhopalosiphum padi*					✓			
Total:		**10**	**12**								**12**
TOTAL (Indigenous and Alien)		**21**	**30**								**30**

TABLE IX TRANSIENT ALIEN (VAGRANT) INSECTS

Note: This table does *not* provide a complete list of all the invertebrates that can be found. (i.e. it does not include spiders, earthworms, snails, slugs, mites and springtails). For details on these, refer to Table X and the text in section 7 on invertebrates.

Areas where insects can be found

1. Intertidal
2. Supralittoral
3. Rock faces
4. Fellfield
5. Vegetated area
6. Waterbodies
7. Marion base

Common name		Family	*Scientific name*	1	2	3	4	5	6	7	TOTAL
Beetles	Shot hole borer (flour weevil)	Anobiidae	Anobiidae sp.							✓	
		Dermestidae	Dermestidae sp.							✓	3
		Chrysomelidae *								✓	
Bug	Shield-backed bug	Scutelleridae	*Cryptacrus comes* #							✓	1
Flies		Lonchaeidae	*Lamprolonchaea smaragdi* #							✓	
		Anthomyiidae	*Anthomyiidae* sp.#							✓	2
Moths	Noctuid moth	Noctuidae	*Chrysodeixis acuta*							✓	
	Noctuid moth	Noctuidae	*Cosmophila sabulifera*							✓	
	Noctuid moth	Noctuidae	*Spodoptera exigua*							✓	
	Cutworm (lawn caterpillar)	Noctuidae	*Agrotis segetum*							✓	7
	Moth	Pyralidae	*Nomophila sp.*#							✓	
	Cereal moth	Noctuidae	*Trichoplusia orichalcea*							✓	
	American bollworm	Noctuidae	*Helicoverpa armigera*							✓	
Ant		Formicidae	*Lepisiota capensis* *							✓	1
Roach	German cockroach	Blattellidae	*Blatella germanica*							✓	1
Total		10	15								15

Key : * Only a single dead specimen found.
Only a single live specimen found (possibly has occurred before, but has not been recorded).

TABLE X INVERTEBRATE CHARACTERISTICS (For some of the most commonly found insects)				
Species Names	Characteristics		Biology	Where found
Common *Scientific*	Features	Size (in mm) (body Length)	Behaviour	Area/habitat
FLIES (DIPTERA)	Have six legs and two sets of transparent wings, the hind set of which is very much reduced to two drumstick-like structures called halteres. On the PEI the forewings may also be reduced, making identification slightly more difficult. Nonetheless the most common species are easily identified.			
Kelp fly *Paractora dreuxi*	Cannot fly. Appear hairy.	Large ± 9-13mm	When disturbed they drop off kelp and roll down amongst the stones or rocks.	Common on rotting kelp at boulder beaches, where the maggots make a living by digesting this material.
Bathroom midge (Moth-flies) *Psychoda parthenogenetica*	Hairy body and wings, which they fold over their backs roofwise when at rest. Hence miniature moth-like appearance.	Small ± 3 mm	Form large swarms on calm days.	Especially amongst coastal vegetation and on boulder beaches.
Midge *Limnophyes minumus*	Appear delicate. Mostly black with clear wings.	Tiny ± 1-2 mm	Both species are active fliers.	Common all over the islands.
Lesser House Flies *Fannia canicularis*	Usually breeds in wastes associated with human habitation. On Marion, also associated with birds nests.	Slightly smaller than common "house flies" in South Africa	Can fly actively.	Commonly found inside the buildings of Marion base.
Vinegar Fly *Scaptomyza* sp.	Can be distinguished by their reddish eyes and fondness for alcoholic beverages, especially cheap wine.		Tend to be sluggish and seldom fly.	
Blow Fly *Calliphora vicina*	A recent introduction to Marion Island. Usually seen during summer. This is an important alien species to watch and notes should be kept whenever these flies are seen. They are known only from Kildalkey. Metallic blue abdomen.	Large. Adults 10-12 mm	Fly strongly. Look almost identical to the "brommer" or bluebottle flies seen on dung or carcasses in South Africa.	Common only (at least in 1997) at Kildalkey Bay where they are usually seen during summer.
BEETLES (COLEOPTERA)	Characterized by six legs, and the outer wings which are hardened to form leathery sheaths known as elytra.			
Weevils (Curculionidae)	Three major beetle groups can be distinguished on the PEI. Weevils can be recognized by their club-shaped antennae. They vary in colour from metallic green to black and brown.	Range from 2 to 8 mm		Found in almost every habitat from the supralittoral zone to the highest peaks.
Rove beetle *Halmaeusa atriceps*	Looks slightly like a small earwig. Red and black in colour. Elytra are very short and abdomen is cigar-shaped, extending out beyond the elytra.	Small, elongate (3-4 mm)		Common amongst rotting kelp, in tussock grass and soils.
Hydraenid Beetle *Meropathus chuni*	Least likely to be seen by the non-expert. Black.	Small (2-3 mm)		Occur mostly on coastal rocks. Also in *Crassula* vegetation.
MOTHS AND BUTTERFLIES (LEPIDOPTERA)	Usually identified by large numbers of scales covering their two pairs of wings. However, the two indigenous moth species are very odd because they do not resemble moths at all.			
Marion Flightless Moth *Pringleophaga marioni*	Rarely seen on Marion, but plentiful on PE. Adults look much like crickets or cockroaches. Larvae are dull grey patterned, with brown head and large hairs on the body.	Large caterpillars (up to 30 mm)		Larvae (caterpillars) occur in mires, tussock grasslands and abandoned albatross nests.
Tussock Grass Moth *Embryonopsis halticella*	Adults are flightless and can jump great distances. Adults looks simply like a miniaturized version of *Pringleophaga marioni*. Larvae are creamy white with two prominent brown stripes.	Adults ± 5 mm	Larvae feed almost exclusively on tussock grass.	Most common in areas where tussock grass predominates.

Diamondbacked Moth *Plutella xylostella*	Alien pest species. Has become troublesome due to impact on the indigenous Kerguelen Cabbage. Adults are light grey with three darker diamond shapes on their wings (especially visible when closed). Larvae are light green.	Small. Adults ± 5 mm. Larvae reach 8.0 mm.	Larvae feed voraciously on Kerguelen cabbages during the summer months.	
Lawn Caterpillar (Noctuid moth) *Agrotis* sp.	Larvae look like typical lawn caterpillars. Adults are attracted to lights at night. Colour is generally grey-brownish with larger wings charcoal coloured. Largest moth on Marion.	Adults 20 mm. Larvae even longer !	Only recently recorded as breeding species at Marion base.	Distribution of this species outside the Marion base area is not known.
Painted Lady Butterfly *Vanessa cardui*	The only butterfly species recorded from the islands, now presumed breeding on Marion, due to great numbers seen yearly since ± 1992 (although larvae have not yet been collected). Adults mottled orange-red, black and white.	Large. Adults ± 16 mm Wingspan ± 50 mm.	Seen late summer to early autumn months (January to April).	All around Marion Island (except in the South between Kildalkey and La Grange Kop.
B U G S (HEMIPTERA) There are no true bugs indigenous to the island. However, aphids were introduced with sheep fodder in the 1950s and are common everywhere.				
Aphids	Green to purple, they lack wings, but do develop these during their reproductive phase. They have long antennae and structures that resemble "exhaust pipes" on their abdomen.	Small. Adults ± 2 mm.	Feed on plants - (can be seen in large numbers on Kerguelen cabbages).	All over the island.

COCKROAHCES (BLATTODEA) AND OTHER BASE-BOUND INSECTS Cockroaches, flour weevils, and other small insects that are associated with stored products and human dwellings are occasionally seen at Marion base. When these insects are found they should be killed. If the specimens look rather unusual they can be kept in 70% alcohol (methylated spirits, cane spirits or gin will do if nothing else is available) and sent to the Transvaal Museum, Pretoria for identification. This is necessary to prevent further alien species from colonising the islands, and to provide the islands' Management Committee with information on new species that are being introduced.

S P I D E R S (ARANEAE) Four spider species occur on the Prince Edward Islands. Two of these are small, "shiny" black and difficult to tell apart. The other two species are larger, more hairy and patterned. The smaller of the two *(Myro kerguelensis)* is often found in and around the Marion base buildings, while the very much larger, and often darker species *(M. Paucispinosus)* is common in fellfield areas under stones and on rockfaces elsewhere.

M I T E S (ACARI) Sixty mite species have been recorded from the Prince Edward Islands. These animals are undoubtedly the commonest species on the islands. They occur in all habitats, from the marine zone to the highest peaks, and can be seen under every rock on the islands. The commonest mites are undoubtedly those in the genera *Podacarus* and *Halozetes*. These are pin-head, or slightly larger sized, black or brown mites that can be found in tussock grassland, on rockfaces and in many of the other vegetation communities. Often, the more fast moving prostigmatid mites are seen running about the rocks, but specialist knowledge is required to identify these species.

SLUGS AND SNAILS (MOLLUSCA) The only terrestrial snail at the PEI is *Notodiscus hookeri* which is indigenous to the islands. It can be seen commonly under stones in fellfield areas. On the other hand the slug *Deroceras caruanae*, is an introduced species that is common in most vegetation communities, but especially amongst the dwarf-shrub *Acaena magellanica*. The slug is thought to have been spread around the island by helicopter. Its habit of hiding under and clinging to wooden boxes "koskassies" and steel and plastic drums are meant that it was probably slung to the huts as cargo. (Another example of an inadvertent human impact on the islands).

E A R T H W O R M S (ANNELIDA)
R O U N D W O R M (NEMATODA) Earthworms are very common in the soils of both Marion and Prince Edward Islands, but the species are poorly known. The largest individuals are thought to be *Microscolex kerguelarum*, but the fauna has not been well studied. In addition there are smaller, pale species from the earthworm family *Enchytraeidae* and many species are roundworms. Not much is known about these species on the islands.

7. VEGETATION

Plant diversity at the Prince Edward Islands is very much lower than one would expect in a similar area in South Africa, largely because the islands are very isolated and are cold. Nonetheless, 22 indigenous vascular species (i.e. flowering plants and ferns), and some 165 species of lichens, mosses and liverworts can be found on the islands. Of these 187 known species, nine (5%) are endemic to the Prince Edward Islands (meaning they only occur on these islands and nowhere else in the world). And since there are a further 34 (18%) endemic plants that occur outside of the PEI group, but not beyond the South Indian Ocean Province, this makes a total number of 43 plants that are endemics to the province. With such a high proportion of plants being restricted to such a limited area within the sub-Antarctic, it is understandable that the dangers of introduced alien species make these plants vulnerable to extinction. On Marion Island, 12 species of alien plants have already become established, some of which have spread around the island within a short period.

For the most part, the species of mosses, liverworts and lichens are rather difficult to identify unless an expert is available to assist. However, almost anyone visiting the islands can quickly come to know the most common flowering plants and ferns listed in Tables XI and XII. A small herbarium with specimens of these species and an identification key is available on Marion Island and is usually housed in the Microbiology Laboratory.

"PRIMITIVE" PLANTS

Bryophytes

A large part of the plant cover of the Islands consists of bryophytes (mosses and liverworts). These are generally small, low-growing plants, without a vascular (= water-conducting) system, as is found in ferns and flowering plants. They mostly grow in damp conditions, where there is a permanent supply of moisture, or form tight cushions, thus minimising evaporation of water from within the cushion. The wet climate of the island is very suitable for bryophytes, and they form large mats in much of the lowland vegetation. In the upland areas not only are the flowering plants (such as *Azorella*) mostly represented by cushion-forming species, but so are the bryophytes.

Ferns and club mosses

Five species of ferns (Table XI) are found at the Prince Edward Islands. *Blechnum penna-marina* is most common and this species covers most of the protected slopes in lowland areas. *Polystichum marionense* is the other species which is most commonly seen under small overhangs and in lava tubes. This species looks most similar to the ferns that are commonly grown indoors in South Africa. The other three fern species are small or difficult to see and not often encountered unless one is specifically looking for them. Two species of *Lycopodium* club-mosses are common on the islands. The larger of these species is *Lycopodium saururus* which is an erect plant that can reach 15 cm or more in height. The other species, *L. magellanicum*, is much smaller, but produces erect fruiting bodies which are often quite noticeable.

FLOWERING PLANTS

Indigenous species

Twenty two flowering plant species are indigenous to the Prince Edward Islands, while the status of a further two species is still unclear (whether indigenous or alien introductions) (see list of vascular plants, Table XI). These plants vary considerably in growth form and appearance, from the cushion-

like *Azorella selago* to the dwarf-shrub *Acaena magellanica* with its very spiky and sticky flower heads and seeds.

Probably the most common flowering plant species are *Agrostis magellanica*, the grass common in all of the mires, and the tussock grass, *Poa cookii*, which surrounds most penguin colonies and petrel nesting sites. Other common species include the feathery-leaved *Cotula plumosa* which also grows in coastal areas, often close to seal haul-out areas and penguin rookeries, and the reddish-green *Crassula moschata* which is very abundant close to the edges of coastal cliffs, especially on the exposed west coast.

The Kerguelen Cabbage, *Pringlea antiscorbutica*, is the most interesting of the plants from a historical point of view. Because this cabbage-like plant contains reasonably high levels of vitamin C, it was regularly eaten by sailors and sealers to prevent scurvy. Currently this plant is threatened by an introduced moth and a fungus and utilization of the plant is prohibited by the Management Plan. Nonetheless, some fine examples of this species can be seen around the "blowholes" on the way to Trypot Beach.

Alien species

As a consequence of their activities on the islands, humans have introduced approximately eighteen other flowing plant species to the Prince Edward Islands. On Marion Island, 12 species of alien plants have already become established and are referred to as Naturalized Aliens (see Table XI). A further six species (referred to as Transient Aliens) have been recorded, but only on isolated occasions (see Table XII). Of these aliens, most are grasses, of which *Agrostis stolonifera*, the large very yellow species with a feathery flower head, and *Agrostis gigantea*, a very large grass restricted to the Marion base area, are perhaps the most significant because of their rapid, or potentially rapid, rate of spread on the island. In fact, *Agrostis stolonifera*, together with two other grass species (*Poa pratensis*, and the "lawn forming" *Poa annua*), and the moss-like *Sagina procumbens*, have invaded many habitats and caused a decline in the numbers of indigenous species in these habitats. Much of the area to the immediate south-east of Marion base and just above Paddy Rocks is almost entirely covered with these alien species and is rather unnatural.

These alien species, and many of the others, such as the red, sheep sorrel, *Rumex acetosella*, are easily spread by seed and by the attachment of small parts of their stems to human footwear and clothing. For this reason great care is taken when visits are made to Prince Edward Island (one seed is sufficient to spread an alien plant species), and all visitors should make every attempt to avoid walking through areas infested with these alien plants. In addition, the rapid spread of the aggressive alien species has taught the valuable lesson that as much care as possible must be taken to prevent the introduction of other alien plants to the islands.

Individual visitors can be particularly helpful in this regard by cleaning their footwear, clothing and their equipment before bringing it to the islands, and by keeping an eye out for strange-looking species, especially in the vicinity of Marion base. If strange plants are seen these should be reported to the Conservation Officer and careful notes should be made of where they were seen. If possible, a photograph of the plant is also very useful for future identification.

Of course, not all alien species spread as rapidly as the grasses and forb *Sagina procombens*. Two fascinating species in this regard are the large-leaved water plant, a *Potamogeton species*, which is found in just two of the Albatros Lakes (most commonly in the large lake just above the Fault), and the large rush, *Juncus effusus*, which only grows in four spots on the Island (at Trypot Beach, on the Van den Boogaard River, at Prinsloomeer and just to the north of Ship's Cove in the Zone 4 Wandering

Albatross study colony). Whether these two species are in fact alien or indigenous is still undecided.

Fortunately, there have also been some species that were not able to adapt to the environment and thus died soon after their introduction to the island in 1950 and 1951. These included trees (viz., the maritime pine *Pinus pinaster*, and the Lawson cypress *Chaemaecyparis lawsoniana*), as well as vegetables that were planted in soil imported from South Africa. Although a greenhouse was also used for the propagation of vegetables, none of the plants grown in island soil managed to progress past the seedling stage.

Vegetation communities

Each of the indigenous plant species on Marion (and Prince Edward) Island tends to have specific requirements in terms of the amounts of nutrients in the soil, degree of waterlogging, slope, aspect, temperature and so on. As a result, various plant species tend to be found growing together and consequently at least 41 plant communities have been recognized for the islands. These plant communities can also be grouped into six distinct community complexes that are easily recognized (see Table XIV).

Photo: C Hänel

The yellow grass, *Agrostis stolonifera*, thought to have been introduced to Marion Island through hay and sheep fodder, can be seen growing all along the banks of the Van den Boogaard River near the Marion base

TABLE XI VASCULAR PLANTS

(Higher plants - viz. flowering plants, including grasses and ferns)

INDIGENOUS *(Species that arrived by natural agents of dispersal)*

	Type of plant				Where found
	Flower	Grass	Fern	Water	Areas on Marion Island
Acaena magellanica	+				Damp lowland slopes.
Agrostis magellanica		+		(+)	Everywhere in mires.
Azorella selago	+				Everywhere in fjaeldmark areas.
Blechnum penna-marina			+		All lowland slopes, and in dry mires.
Callitriche antarctica	+			(+)	Seal wallows.
Colobanthus kerguelensis	+				On *Azorella* cushions.
Cotula plumosa	+				Along the coast near bird colonies or in saltspray areas.
Crassula moschata	+				Saltspray areas, e.g., at Paddy Rocks.
Elaphoglossum randii			+		In *Blechnum* slopes.
Grammitis kerguelensis			+		Sheltered crevices or small caves in black lava.
Hymenophyllum peltatum			+		Sheltered crevices or small caves in black lava.
Juncus scheuchzerioides		+		(+)	All very wet areas in mires.
Juncus cf. effusus #		+			Trypot, Van den Boogaard River, and beyond Ship's Cove.
Lycopodium saururus			+		Fjaeldmark areas.
Montia fontana	+			(+)	Entrances to bird burrows, edges of streams.
Poa cookii		+			All biotically influenced areas.
Polystichum marionense			+		Sheltered sites at foot of rock faces in lowland areas.
Potamogeton spec. #	+			++	Albatros Lakes.
Ranunculus moseleyi	+			++	Very rare in ponds.
Ranunculus biternatus	+			(+)	All wet mire areas.
Uncinia compacta		+			Most dryish mires.
Total number :	11	4	7		**22**
	+	+			+
	1#	1#			**2** # # status (introduced or indigenous) is not known

NATURALIZED ALIENS *(Species introduced by humans either accidentally or deliberately, that have established themselves.)*

* *Agropyron repens*		+			Ship's Cove, near cave.
Agrostis castellana		+			Very difficult to discern from *A. stolonifera*.
* *Agrostis gigantea*		+			Met. Station, slope toward Gentoo Lake, with potential to spread.
Agrostis stolonifera		+		(+)	On damp slopes and riverbanks.
* *Alopecurus australis*		+			One tuft at Mixed Pickle Cove, near the old sealer s hut.
Cerastium fontanum	+				Open ground along streams.
* *Festuca rubra*		+			Near shipwreck cave at Ship's Cove.
Poa annua		+			All trampled biotic areas (*e.g.*, near Gentoo Lake).
Poa pratensis		+			Lowland slopes, *e.g.*, between Marion base and Trypot Beach.
* *Rumex acetosella*	+				Gentoo Lake, rocky outcrops on inland side nearest Marion base.
Sagina procumbens	+				Along coastal track to Trypot Beach, *e.g.*, on Golf Course.
Stellaria media	+				In *Acaena - Poa cookii* slopes; Ship's Cove.
Total number	4	8			12 [* = Restricted (5)] [Rest = Widespread (7)]

TABLE XII VASCULAR PLANTS

(Higher plants - viz. flowering plants, including grasses and ferns)

TRANSIENT ALIENS *(Species introduced by humans that only appear sporadically)*

	Type of plant				Where found	
	Flower	Grass	Fern	Water	Areas on Marion Island	
Avena sativa		+			# 1965/66	
Holcus lanatus		+			# 1953; 1965	
Hypochaeris radicata	+				# 1953, 1965/66; 1996/97	(In area of meteorological station)
Plantago lanceolata	+				# 1965/66; 1988/89; 1996/97	(In area of meteorological station)
Senecio sp.	+				# 1988/89	(Near the ionospherics laboratory at Marion base)
Sonchus sp.	+				# 1983/84	(Van den Boogaard River and Marion base)
Total number :	4	2			6	# = Dates when found on Marion

TABLE XIII "PRIMITIVE" PLANTS

	Type of plant					Identification	Where found
	Moss	Liverwort	Lichen	Fungi	Algae	Basic visual hints	Areas on Marion Island
Andreaea species	+					Black/ round velvety cushions	Fellfield areas
Ditrichum strictum	+					Green / round velvety cushions	Fellfield areas
Drepanocladus uncinatus	+					Green-yellow/ "frilly fronds"	Mires
Racomitrium lanuginosum	+					White-grey / "bushy" look	On new lava flows
Total no. species	**79**						
Blepharidophyllum densifolium		+				Reddish-brown green	Mires
Jamesoniella colorata		+				Red-brown / straight stemmed	Mires
Marchantia berteroana		+				Olive green / flat leaf-like	Manured sites
Total no. species		**36**					
Mastodia			+			Black	Rocky shore
Caloplaca spp.			+			Yellowish-orange	On rocks along the coast
Usnea ("old man's beard")			+			Grey-white	Wooden box (Below Juniors Kop)
Total no. species			**50**				
Mushrooms (with gills):							
"flat" ± 1.5 - 2 cm diam.				+		Cream / yellow	In mires and most lowland vegetation
"Dome-cap" ± 0.5 - 1 cm diam				+		Rust	In high altitude, moss/scoria areas
Total no. species				**?**			
Durvillaea antarctica (Bull-kelp)					♦	Dark-green / huge thick blades	Along shore/coast. On rocks
Macrocystis pyrifera					♦	Light-brown / long strings	Off-shore
Total no. species					**?**		♦ = Marine

TABLE XIV PLANT COMMUNITIES

PLANT COMMUNITIES *Vegetation complex*	CHARACTERISTIC PLANT SPECIES	AREA WHERE FOUND
1. SWAMP COMMUNITIES (Mainly mosses and graminoid-species)		Possibly the most common vegetation complex at low altitudes. It forms on wet peat.
a) Juncus scheuchzerioides-Blepharidophylum densifolium **bog** (Wet, unstable, stagnant peat's with little lateral drainage)		In small basins within hummocky black lava flows.
b) Agrostis magellanica **mire** (Deep waterlogged peat's with some lateral water flow)	*Blechnum penna-marina* *Uncinia compacta* *Ranunculus biternatus* Mosses and liverworts	Gently sloping ground.
2. SALT-SPRAY COMMUNITIES		
a) Crassula moschata **halophytic herbfield** (Dense mats of small succulent herb)		Shore zone areas, within a few hundred metres of the sea's influence. Generally all along the West coast of the island, and areas such as East Cape, Duiker's Point and Storm Petrel Bay.
b) Cotula plumosa **herbfield** (Feathery leafed herb, forming luxuriant stands)		Generally in shallow manured soils, consisting of fibrous peat and clay.
3. TUSSOCK GRASSLANDS (Nitrogen-loving plants)		On wet peaty and more or less heavily manured soils. Hence it forms mostly around seal haul-out areas and penguin rookeries (*e.g.*, Macaroni Bay and Bullard Beach), but also where burrowing petrels nest in well-drained slopes (although this inland form of biotic complex is more common on Prince Edward Island, as there have been no cats to decimate the petrel populations).
Callitriche antarctica-Poa cookii	*Poa cookii* (and *Poa annua*) *Callitriche antarctica* *Montia fontana*	
4. DRAINAGE LINES		Wherever there is considerable movement of water, either below the soil surface or along streams etc.
Acaena magellanica Brachythecium **complex**	*Acaena magellanica* *Brachythecium subplicatum* (or *B. rutabulum*)	Along river banks, in springs, flushes, water tracks and drainage lines. In some areas the entire mat of flowering plants and bryophytes is literally afloat on moving water below.
5. FJAELDMARK COMMUNITIES		This complex forms on rocky areas exposed to wind (viz. "wind desert" areas) where it is scattered between loose rocks and boulders.
Andreaea-Racomitrium crispulum **complex**	*Azorella selago* *Andreaea* spp. *Ditrichum* spp.	These areas occur all around the island and on extensive parts of black lava flows, especially along the west-coast which is directly exposed to the predominant westerly winds.
Azorella selago **fjaeldmark**	*Agrostis magellanica* *Blechnum penna-marina* *Poa cookii* "Mossballs" Lichens	Areas above 500 m are dominated by lichen growth.

6. FERN SLOPE COMMUNITIES		Forms on well-drained (dryish) lowland slopes.
***Poa cookii - Acaena magellanica* mixed herbfield**		High coastal cliffs (and patches on inland slopes).
	Blechnum penna-marina *Acaena magellanica* *Azorella selago*	
Blechnum penna-marina		Generally slopes inland of salt-spray zone.
	Poa cookii *Acaena maellanica* *Azorella selago*	
7. FRESH WATER COMMUNITIES		
a) **Standing waters**		
	Ranunculus moseleyi	Form small mats on the floors of lakes and lakelets.
	Limosella australis	
	Potamogeton spp.	Forms a semi-floating mat on the surface of the water (*e.g.*, Albatros Lakes).
.....		
b) **Running waters**		
MARINE COMMUNITIES		
Giant kelp beds	*Macrocystis pyrifera*	500 m - 1000 m offshore, in protected coves, water 10 - 20 m deep.
.....	.....	.....
Encrusting alga	*Lithothamnion sp.*	Intertidal zone.
.....	.....	.....
Bull kelp	*Durvillaea antarctica*	Shore-line cliffs.
.....	.....	.....
	Porphyra sp.	Spray zone boulders.

8. FRESH WATER SYSTEMS

WATER TYPES

A variety of fresh water types can be found on the islands, including both standing and flowing systems. Flowing or 'lotic' water types include intermittent and permanent streams while standing or 'lentic' waters have been classified into four types, namely lakes, lava-lakelets, crater lakes, and wallows.

Lentic waters

Lakes: According to the classification used above, it can be misleading to use the term 'lake' on Marion, as most standing water bodies are mere ponds or pools that are restricted to areas of low relief, close to the sea. However, the term 'lake' has been used for convenience to indicate the larger water bodies. Their sizes vary considerably, ranging in surface area between 1 000 - 100 000 m^2 (the latter being the approximate size of Prinsloomeer, the largest lake on Marion). The lakes tend to be fairly shallow, with depths normally lying between 0.4 and 2.4 m. They can also be distinguished on the basis of their occurrence, being found mainly on the impervious grey lavas.

Lava-lakelets: These occur predominantly on black lava flows below an altitude of 500 m. (Lava-lakelets have also been referred to as 'tarns', but because they are not found in the mountainous areas of Marion, the term could be misleading). These mostly have a surface area of between 10 - 1000 m^2, and a maximum depth of 1.9 m.

Crater lakes: On Marion, crater lakes are found in the craters of scoria cones which occur at mid to low altitudes (< 400 m), (e.g., Junior's Kop, Hendrik Fister Kop, Fred's Hill), and are mostly restricted to the eastern side of the island. Crater lakes are small, ranging in surface area between 50 - 1500 m^2, with depths seldom exceeding 2 m.

Wallows: These are depressions made in the peat by the activities of Elephant Seals (*Mirounga leonina*), which can rapidly fill with water, and become a pungent mud-bath. Although these start at the size of an Elephant Seal, they can enlarge considerably, especially if they link up. Such wallows are usually found in the shore zone, close to the haulout sites of the seals (< 600 m from the sea). In addition to these wallows, small coastal pools and muddy ponds can also be found on the islands, and these are usually heavily influenced by the activities of penguins, skuas and Kelp Gulls.

Lotic waters and their quality

Since the annexation of the islands, no one has spent a full year at Prince Edward Island, so it is not known whether there are perennial rivers on the island. Nonetheless there are strong streams and large waterfalls in the vicinity of Albatross Valley (immediately north west of Boggel). Marion Island has at least three rivers that are perennial, although one of these (the Van den Boogaard River) does not always flow near the coast. On the other hand, Soft Plume and Bullard rivers are perennial along their entire length. Although the rest of the streams do not flow all year round, the term 'river' has been used in naming the more perennial of these (see Fig. 2). Most of the rainwater reaches the ocean via underground drainage.

The high rainfall ensures a constant supply of fresh, crystal clear water, which except in the salt spray areas (including seal wallows), is first class in quality, and highly drinkable. This is supported by recent analysis done on the properties of the water, that revealed a conductivity of below 100 milli-

Siemens per centimetre in most cases, which when compared to most South African cities, is at least half their waters' value.

CHEMICAL COMPOSITION

The waters are generally acidic, have low alkalinity and vary widely in ionic content. The chemical composition is dominated by NaCl (sodium chloride) and an ionic dominance order of $Na > Mg > Ca > K : Cl > SO_4 > HCO_3$, which is the same as for sea water. These ions are oceanic in origin, and enter the island's chemical cycles through rainfall or as the washout component during wet fallout (i.e. saltspray is blown inland). The supply of these ions is affected by distance from the sea, wind direction, and amount of precipitation. The chemical composition of the flowing waters differs little from the still waters, except for higher bicarbonate levels, which are attributed to greater geochemical modifications of the water because higher Ca^{++} and HCO^{-}_{3} concentrations were measured in spring waters. However, marked daily differences in conductivity, alkalinity and NaCl content were found in the Van den Boogaard River.

BIOTA

Considering the many birds and seals that frequent the island, and the resulting biotic enrichment caused by them to the various water bodies, there are very few water indigenous freshwater plants or animal species. Of those present, few are endemic, and species diversity is low. As far as the fauna is concerned, there are no fish, which makes the zooplankton the highest level in the food chain in the freshwater environment. Two species of copepods are dominant in most of the waters. These are *Pseudoboeckella volucris* and *Daphniopsus studeri*. Other species include a number of mites and the freshwater midge *Limnophyes minimus*.

With regard to the vegetation there are several species that are found associated with the standing waters on Marion. These include three flowering plants, one of which (the large pond weed *Potamogeton* sp.) forms a semi-floating mat on the surface of the water, while the other two (the dwarf buttercup, *Ranunculus moseleyi*, and the small water plant, *Limosella australis*) form small mats on the floors of the lakes and lakelets. In addition, mosses and sedges also grow submerged. Depending on the shape of the water body, encroaching vegetation may form a swinging mat or raft, although the strong prevailing winds tend to hinder this (especially in crater lakes where the coarse scoria offers little support to any form of plant growth which is also hampered by exposure to strong winds that sweep through the craters). Vegetation surrounding a lake is also dependent on the distance from the sea, e.g., those receiving large amounts of sea-spray are usually bordered by dense stands of the halophytic plants *Crassula moschata* and *Cotula plumosa*. Algal growth also occurs, of which the benthic species *Chlorella* and *Scenedesmus* are most abundant. However, low levels of nitrogen and phosphorus have been found to limit algal growth.

SENSITIVITY AND IMPACT

The very pure, nutrient poor and acidic nature of Marion's freshwater systems make them very sensitive to pollution by effluents, in particular by increases in pH from alkaline or calcareous sources. The waterways are also vulnerable to disturbance by humans. For example, there has been a large, erosive peat slide just below the dam on the Van den Boogaard river, caused by mechanical disturbance to the soil. Similarly, introduced species can alter the environment, but it is not known what the extent of such changes were when two species of fish (Rainbow Trout, *Salmo gairdneri* and Brown Trout, *S. trutta*) were introduced to the Van den Boogaard River in 1959 and 1964, respectively. These alien fish have since been eradicated, and are considered extinct (the last sighting was in

1984). No further species have been introduced into the freshwater system. However, a freshwater mite (Family Halacaridae) has been collected from the Van den Boogaard dam, which, being the first record of a freshwater species of halacarid from the sub-Antarctic region, is thought to be an alien that may have been introduced with the trout.

9. MARINE ZONES

As mentioned elsewhere in this booklet, the marine and terrestrial ecosystems at the Prince Edward Islands are interdependent. However, most visitors to the islands will not have the opportunity to gain first hand knowledge of the plants and animals of the deep sea systems around the islands, except when in transit on the research and supply vessel. For this reason we have restricted our treatment of the marine system to the rocky shores and boulder beaches of Marion Island. Nonetheless, a few of the offshore marine species that are found at the islands are mentioned.

ROCKY SHORES AND BOULDER BEACHES

Most of the shores on the islands are rocky and comprise vertical cliffs, whereas there are far fewer boulder beaches and only two sandy ones. The western shores are very exposed to wave action, and occasionally heavy storms cause large waves on the east coast too. However, the tidal range is rather small (71 cm) and is hardly noticeable. Nonetheless, there is a distinct zonation of littoral communities which is quite similar on both the rocky shores and boulder beaches. In general, the upper supralittoral zone is dominated by a crustose black lichen (*Verrucaria*) and a more leafy dark green to blackish species known as *Mastodia*. On the rocky shore at Macaroni Bay these species are replaced higher up by a bright orange/yellow, *Caloplaca* species. Lower down the shore the *Porphyra* zone is dominated by brown/green algae which gives the zone its name.

Beyond this, most of the rocky shores are characterized by the large bull kelp, *Durvillaea antarctica*, which can be recognized by its large hold-fasts attached to the rocky substrate. This kelp is often dislodged during storms and forms large "wrack beds" on boulder beaches such as Trypot Beach. This kelp has thick leathery fronds of deep green colour (when fresh), and large basal holdfasts. The other offshore kelp species at Marion Island, *Macrocystis pyrifera*, grows some 500 to 1000 m offshore in deep water, and is a browner kelp species, has thinner, more leaf-like fronds and many small, elongate "floats" attached to the fronds. This species can also be washed up to form wrack beds, and at Trypot Beach this happens mostly after rough, easterly storms.

The lowest zone on the shore is the red zone, which is dominated by red algae, and extends from below the kelp zone, ending in the truly marine systems.

MARINE ANIMALS

The rocky shores and boulder beaches house a wealth of invertebrates and chordates, including mites, crabs, amphipods, brachiopods, starfish, anemones, tunicates and limpets. Although some of these species can be seen during low tides in rocky pools such as those at Paddy Rocks, they are usually quite difficult to see. However, many of them are washed ashore during heavy seas, and Kelp Gulls often bring limpets (*Nacella delesserti*) ashore.

Below these littoral or tidal areas, there is a well-developed marine community, with many species of molluscs (shell bearing species), crustacea, other marine invertebrates and marine plants. Although at least thirty three fish species have been recorded around the islands, twenty of these occur beyond the 50 to 100 meter wide zone of giant kelp, and only three are regularly seen close inshore. These are two fairly large species (*Notothenia coriiceps* and *Paranotothenia magellanica*) and the smaller *Harpagifer georgianus*. The approximately 300 mm long *N. coriiceps* is a poor swimmer and is usually found resting motionless on rocky bottoms where it is hard to distinguish from its environment due to its similar dark grey or black colour. *P. magellanica* appears to be more nocturnally active,

and can be variously found amongst the kelp, in the open, or amongst rocks, where its colour depends on its stage of development.

One of the most important fish species occurring at the PEI is *Dissostichus eleginoides*, or the Patagonian toothfish. The flesh of this species is prized on the international market and a legal (and illegal) fishing industry has developed rapidly over the past few years. It seems quite likely that this resource will soon be exhausted by overexploitation, resulting in the disappearance of the many fishing vessels seen in and around the islands' territorial waters. Nonetheless, for the time being this fish species continues to attract these vessels and the attendant conservation problems brought about by seabird bycatch on the long lines set to catch these fish.

10. REGULATION OF ACTIVITIES

THE MANAGEMENT PLAN, ZONES AND SPECIAL NATURE RESERVES

The Prince Edward Islands were proclaimed Special Nature Reserves, in terms of the Environmental Conservation Act (Act 73 of 1989), on the 3rd of November 1995. This Act requires the development of a Management Plan for such reserves and a Management Committee must be established to implement the provisions of the Management Plan. This procedure has been followed for the Prince Edward Islands and a Management Plan was published in 1996. This Management Plan forms the basis for regulating all activities at the islands, although many other South African Acts of Parliament are applicable to the islands (see Section 11 below). The Management Committee advises the Department of Environmental Affairs and Tourism on activities on the islands and both a Conservation Officer and Team Leader are appointed to each relief team to the islands. Together these personnel are tasked with the day to day "management" of the islands in terms of the Management Plan. Nonetheless, the DEA&T remains the responsible authority and all decisions concerning the islands must ultimately rest with the Department and its advisory bodies.

The Management Plan includes many provisions and regulations that have been implemented to ensure that activities on the islands take place with the minimum of environmental disturbance. Visitors to the islands should familiarize themselves with these regulations, but Section 13 below provides some guidelines on aspects which are not clearly spelled out in the Management Plan.

One of the major provisions of the Management Plan concerns zoning of the islands (see Figures 2 and 3). Four zones have been designated on the islands. Zones 1 and 2 are restricted to Marion Island. Zone 1 (Service Zone) includes Marion base and a small area surrounding it. Zone 2 is a buffer zone which extends in a roughly triangular shape from "The Fault" at Trypot Beach to the peak of Junior's Kop and to Ship's Cove. Areas around the field huts are also considered Zone 2 areas because of limited human impact. The rest of Marion Island is a Zone 3, or Wilderness Zone, with the exception of all Southern Giant Petrel Colonies, Gentoo Penguin Colonies, three Wandering Albatross Study Colonies, and the Grey-headed Albatross Colony at Grey-headed Albatross Ridge (with the exception of the traverse through it to Rook's Bay). These colonies are Zone 4 or Protected Zone areas as is the whole of Prince Edward Island. Entry to these Zones is controlled by a permitting system. The permits are issued by DEA&T on the advice of the Prince Edward Islands Management Committee. Generally all visitors to the islands receive permits for Zones 1 and 2. Personnel involved in field research are permitted for Zone 3 and some for work in bird colonies that have Zone 4 status. Team members are usually given permits to Zone 3 during their stay at the island and can also accompany research personnel doing field work on the permits of the research personnel involved. Visits to the Prince Edward Island's Zone 4 area take place only with special permission and under strict conditions. These include careful efforts to reduce the risk of alien introductions to Prince Edward Island. Collection of any material from the islands is also regulated by a permit system, as is camping on the islands. Both entry permits and collection permits must be applied for well in advance of a visit to the islands. The permitting system was introduced to regulate human activity and reduce disturbances on the island. Nonetheless, application by any visitor can be made (and this should preferably be done in advance) for permits to enter any of the Zones. These are always given fair consideration.

11. *VISITING MARION ISLAND*

HOW ONE GETS THERE

Most personnel that are given permission to visit Marion Island either as a staff member of, or by the Department of Environmental Affairs and Tourism (albeit for a short take-over period or for a year-long stay as a team member), are usually responsible for arranging their own transport to the port of departure (Cape Town). From Cape Town, transport to Marion Island is by ship - usually the mv *SA Agulhas*. Because the ship has to cross international waters, all personnel must be in possession of valid passport documentation, and for overwintering team members travel documents should not expire in advance of the return date (usually 13 months later).

The *SA Agulhas* is a well-equipped research and supply vessel, measuring 109.45 m in overall length and 18 m in breadth, with a draft of 6.05 m, gross tonnage of 5353.13 ton and net tonnage of 2 599.44. The ship was built to the highest possible standards of Lloyds of London and rated +100 Al Strengthened for navigation in ice. Sleeping quarters are in the form of cabins with two double bunks, a small table with four chairs, a small desk and cupboard. An *en suite* shower and toilet are provided for each cabin. These cabins can become quite crowded if personnel travel with large amounts of personal effects. The ship has recreation facilities (bar and lounges) with televisions, video machines and small (hi-fi) music systems. A very small gymnasium is available (for use by passengers and crew), as is a small recreation room with a few video games. A small library is also available. All meals are provided on the ship, and a limited canteen service is available.

Because of the ship's design and nature of the southern ocean (especially the roaring forties), the motion of the ship can cause unsecured objects to move around and seasickness of various kinds in people. Inexperienced passengers should inform themselves of the hazards of ocean travel in advance of departure and take their own medication for motion sickness. However, the ship always carries a doctor who can attend to these and other medical complaints.

Once at the islands, ship-to-shore transport is usually by Oryx helicopter, but very occasionally boats are also used. In both cases personal effects and equipment are usually exposed to high winds and rain and these items should be carefully packed and waterproofed.

WHAT IS PROVIDED

Team members and other personnel are provided with virtually all of their basic requirements for living and working at the island. (Exceptions do exist, but personnel will be notified of the arrangements by DEA&T on application to visit the island). Accommodation and domestic supplies (including food), basic medical care (as well as search and rescue services), clothing (protective rain and cold weather garments such as: waterproofs, Wellington boots, a thermal jacket, a few thick shirts and pairs of long trousers, thick socks, gloves and balaclava) and zippered bags for the transport thereof, are provided free of charge. Bedding (sheets, blankets and a sleeping bag for some personnel) are also issued free of charge for use during the expedition. Certain additional items (such as a very basic sewing kit, a pocket knife and sunglasses) needed by overwintering team members, may also be provided. However, some of these items (such as bedding) must be returned at the end of the expedition. In the case of personnel visiting only for the relief, all of the protective clothing must also be returned. A contract between the DEA&T and each person stipulates which items may be retained and which should be returned on completion of the expedition.

The use of recreation facilities is also provided for the duration of the expedition (during the voyage to and from the islands, as well as for the time on the island). The amenities available on the island are described in the Infrastructure Chapter (below) and are accessible to personnel visiting the island in accordance with the conditions of their visitors' permits that are issued by the DEA&T, and in accordance with the provisions of the Prince Edward Islands Management Plan.

Long-term personnel (team members overwintering on the island) are also provided with courses in first aid, fire fighting, and cooking, as well as lectures on "Life under sub-Antarctic Island Conditions", as part of a two week team-training period prior to departure for the islands.

WHAT ONE IS RESPONSIBLE FOR

Essentially this amounts to your personal effects. While all visitors are responsible for the supply and packaging of their personal effects, the onus is also on each individual to inform themselves of the regulations concerning visits to the islands, and the conditions that can be expected (e.g., climate). All of the regulations pertaining to visits to the islands are contained in the Prince Edward Islands Management Plan, as is much useful information on the climate, wildlife and history of the islands. The following lists cover most of the items that team members find useful on the island.

Some of the most important items *not* provided by DEA&T

TOILETRIES*	e.g., toothbrush and paste, soap, shampoo, shaving gear (optional), towels, etc.
CLOTHING ITEMS*	General in and outdoor clothing, footwear, underwear, etc.
HOBBIES/RECREATION*	Materials and specialised tools, games, etc.
MUSIC*	Musical instruments, sound-systems*, tapes, CDs, videos, etc.
PHOTOGRAPHIC EQUIPMENT*	Cameras, films, developing chemicals, paper, etc.
TECHNICAL EQUIPMENT*	Other than that provided for official use and communication.
ALCOHOLIC BEVERAGES AND TOBACCO*	Alcoholic or specific non-alcoholic drinks, brewing kits, cigarettes, etc.

* Although a communal hi-fi is available in the lounge, bringing one's own portable system allows for private listening elsewhere. A "walkman" or stereo set with plug in earphones is most suitable for the close living quarters. Reasonably specialised radios can receive international short-wave broadcasts at the island (such as the BBC World Service). Commercial FM and medium-wave reception is non-existent.

Some useful items for visitors spending time on Marion Island

TOILETRIES	
Lip-ice	Protection against the elements.
Sun-screen (high SP factor)	Protects against the elements viz. wind and sunburn (radiation can be intense, especially in summer, with the glare from the sea and snow).
Make-up (males and females)	Useful for parties and dressing up.
CLOTHING	
Shoes:	
Slops/strops	Easy footwear for walking inside the buildings.
Warm/furlined slippers	For winter and living in huts.
Walking shoes (with good sole profile)	Cat-walks are slippery (wet or frozen).
Hi-heels	Party gear.
General:	
T-shirts	Inside the buildings, for summer, etc.
Shorts	
Track-suits	
Smart clothes	For special occasions / parties, etc.
Swimming costume	For brave / or sun-seekers / or party gear.
Party-gear:	
Wigs/hairpieces/colourants/etc.	
Costumes	
Gadgets/decor/special effects	(e.g. balloons, streamers, etc.)
Use your wildest imagination	
PHOTOGRAPHIC EQUIPMENT:	Usually very important even if you have never possessed a camera. Most people develop a keen interest in photography! There is an abundance of spectacular scenery, beautiful wildlife and events to photograph!
Camera	Ideally, a versatile 35 mm one, and an instamatic would be handy.
Under-water camera (additional)	Photography in the rain and snow.*
Video and digital cameras	Can also be used for scanning pictures into computer programs and sending by e-mail. Find out about the facilities needed and what is available on the island.
Binoculars/telescope	Viewing/identifying of wildlife/whales/unknown objects etc. (can be done from inside the Marion base under any conditions!).
Accessories:	
Tripod	Bearing in mind the usually windy conditions outside, and for self-timer shots.
Flash	For indoor and special effect pictures.
Lenses	Zoom (telephoto) lens to avoid close approaches to wildlife, wide angle lens for scenery, etc.
Films (plenty!)	Budget for more than you think you will ever take! You are bound to run out, and if not, there are others who will.

Chemicals, paper, slide mounts	Enough to cover for what you have in film.
Storage sheets	For storing slides / pictures.
HOBBIES:	
Music	
Instruments	
Walkman/stereo set	
Wide music selection	Tapes (including blanks), CDs, videos.
Handcrafts:	Inform yourself of the facilities available.
Games:	Other than those provided on the Island.
Books: +	Other than those selected by the team.
Swimming/snorkeling: *	
Wet/dry suit/goggles/flippers/weight-belt/etc.	
Technical equipment: #	If you envisage spending lots of time using equipment (e.g. computers for playing games etc.), bring your own. [The facilities on the island are there for scientific and communication purposes].

* Driving / snorkeling in the sea is usually not permitted by the DEA&T. However, application for a permit for these activities can be made in advance to the DEA&T.

\+ For overwintering team members the DEA&T usually organises a visit to one of the state-owned libraries, where reading material can also be selected. These books are shipped to the island by the DEA&T.

\# Radio communication equipment on the Island is used by team members under the acceptable operating conditions of the DEA&T. Radio-hams need to apply for permission from the DEA&T, obtain relevant permits, and have their own approved equipment to carry out such hobbies.

Personal effects of overwintering team members are usually transported to the Island in metal trunks. Team members are responsible for the purchase of these trunks. It is best to securely padlock the trunks and breakable items should be **very** securely packed, or transported by hand onto the ship.

PROHIBITED ITEMS

The following list provides a guide to the items that are prohibited on the islands, and to the items that may not be removed from the islands. All regulations pertaining to non-acceptable items are contained in the Prince Edward Islands Management Plan. Because the islands fall within the magisterial district of Cape Town, all South African laws are enforceable on the islands, including those pertaining to theft, drug-abuse, and so on.

Items prohibited on Marion and Prince Edward Islands

Animals	
Plants	
Seeds	
Polystyrene beads and other small pieces of plastic packaging	
Motorised, amphibious or air-cushioned vehicles	
Firearms	
Radioactive material	(unless authorised in writing by DEA&T)
Poultry (including eggs)	(totally prohibited on Prince Edward. On Marion only irradiated poultry is permitted)
Any biological material	(unless the necessary quarantine control permits have been obtained)
Soil, water and geological samples	(unless authorised in writing by the DEA&T)

Prohibited export from Marion and Prince Edward Islands

Nothing may be removed from the natural environment of either Marion or Prince Edward Islands unless a special permit has been granted by the DEA&T. This includes rocks, stones, animals, plants and historical artefacts. In addition, domestic supplies and maintenance and laboratory equipment remain the property of either the DEA&T or the responsible researchers. These items may not be removed from the island without prior permission.

The following acts are enforceable at Marion and Prince Edward Islands and should be consulted for further information. In addition, the Directorate Antarctica and Islands, Department of Environmental Affairs and Tourism, Private Bag X447, Pretoria 0001, may also be consulted in this regard.

Prince Edward Islands Act,	1948 (Act 43 of 1948)
South African Citizenship Act,	1949 (Act 44 of 1949)
National Parks Act,	1962 (Act 42 of 1962)
National Monuments Act,	1969 (Act 28 of 1969)
Sea Birds and Seals Protection Act,	1973 (Act 46 of 1973)
Fishing Industry Development Act,	1978 (Act 86 of 1978)
Dumping at Sea Control Act,	1980 (Act 73 of 1980)
Sea Fisheries Act,	1988 (Act 12 of 1988)
Environment Conservation Act,	1989 (Act 73 of 1989)
Maritime Zones Act,	1994 (Act 15 of 1994)

WHAT TO READ AND VIDEOS TO WATCH

With well over 900 publications on various topics to do with Marion and Prince Edward Islands, and many more forms of information available, (such as photographic, cinematographic, video and other visual displays in museums, archives and libraries) it is not within the scope of this booklet to list all the possible references that may be of interest to the reader. Such a complete bibliography is available and can be requested / obtained from the DEA&T.

However, listed below are a few of the most popular and useful references that not only deal with Marion Island *per se*, but that may also prove to be useful to visitors as guidelines to topics of interest while on the island.

PUBLICATIONS

- **POLICIES AND GUIDELINES GOVERNING THE PRINCE EDWARD ISLANDS**

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- **BIOLOGICAL, ENVIRONMENTAL AND OTHER INFORMATION**

  VAN ZINDEREN BAKKER EM (Sr), WINTERBOTTOM JM & DYER RA. 1971. **Marion and Prince Edward Islands: Report on the South African Biological and Geological Expedition 1965-1966**. AA Balkema, Cape Town. 427 pp.

  HEYMANN G, ERASMUS T, HUNTLEY BJ, LIEBENBERG AC, DE F RETIEF G, CONDY PR & VAN DER WESTHUYSEN OA. 1987. **An environmental impact assessment of a proposed emergency landing facility on Marion Island - 1987**. Report to the Minister of Environment affairs. *South African National Scientific Programmes Report* No 140 - 1987.

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- **BIRDS**

  HARRISON P. 1983. Seabirds: **An Identification Guide**. Beckenham, Kent. 448 pp.

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  GOSLING M. 1997. **Hooks of Death**. *African Wildlife*. Vol. **51** No.3. pp 28 - 31.

- **MAMMALS**

  * ***Whales***

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* ***Seals***

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RIEDMAN M. 1990. **The Pinnipeds: Seals, Sea Lions, & Walruses**. University of California Press.

* ***Mice***

VAN AARDE R, FERREIRA S, WASSENAAR T & ERASMUS DG. 1996. **With the cats away the mice may play**. *South African Journal of Science*. Vol. 92. No.8. pp 357 - 358.

- **INVERTEBRATES**

CRAFFORD JE, SCHOLTZ CH & CHOWN SL. 1986. **The insects of sub-Antarctic Marion and Prince Edward Islands, with a bibliography of entomology of the Kerguelen Biogeographical Province**. *South African Journal of Antarctic Research*. Vol.16 No.3. pp 42 - 84

- **PLANTS**

GREMMEN NJM. 1981. **The vegetation of the sub-Antarctic islands Marion and Prince Edward**. DR W. Junk Publishers, The Hague.

- **HISTORICAL**

  * ***Sites and expeditions to the Islands***

COOPER J & AVERY G. 1986. **Historical sites at the Prince Edward Islands**. *South African National Scientific Programmes Report* No 128.

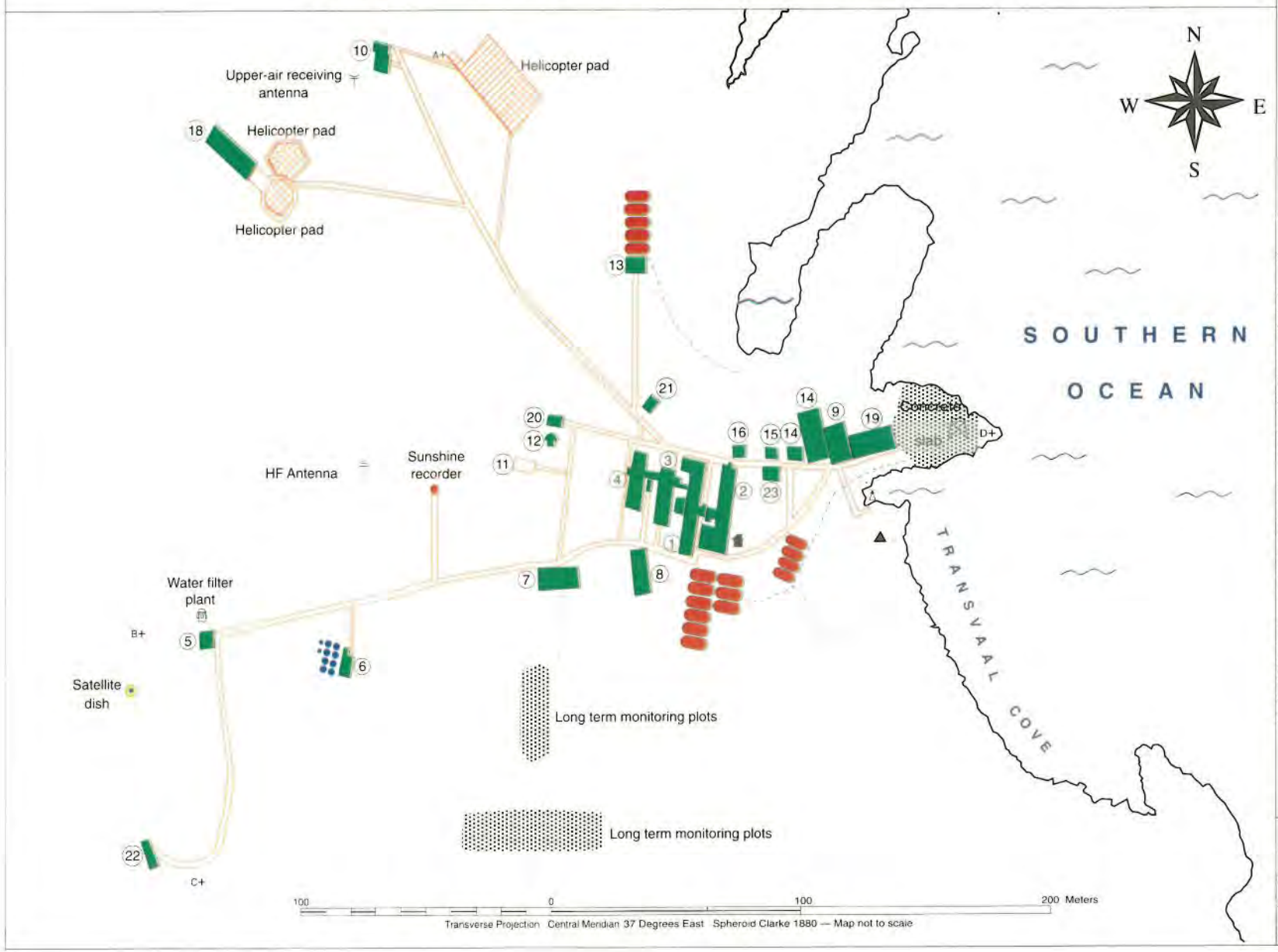
* ***Annexation and general background***

MARSH JH. 1948. **No Pathway Here**. H.B. Timmins, Cape Town.

VIDEOS

1. **Marion Cat Program**	Filmed by Johann Joubert for SABC in 1986. Screened on "50/50" (TX 19/04/87) in two parts. (Production No. 63813 A870.5) SAUK MCMLXXXVII. Producers: Ernst Marais, Tommy McClelland, Pieter De Vos and Johann Joubert. Executive Producer: Danie Van der Walt.
2. **"South Trap"**	Featuring **Marion**. Film by Derrick Louw. 27.07.1990. Trilion, The Movie Studio, SABC (Skenia telematics).
3. **SA Island Series**	a) **"Gondwanaland - Discovering the South"**. 1994 Filmed and produced by Fanie van der Merwe, Dirk Hunter, and Henk van der Merwe, Prentjieswinkel Film Makers for TSS. Post production supervisor Laura van der Merwe. Editor Miki Redelinghuys. Archival material : Prentjieswinkel Lynx films, SABC. Written and directed by: Jan Lampen. Pro Vision. b) **"Marion Eiland - Kern van Natuur Kennis"**. 1994 By Prentjieswinkel film Makers - [Same as a) above]
4. **"Musculus and Marioni"**	Filmed (May 1997) and produced by Mike Vincent for SABC. Screened on "50/50" October 1997 and January 1998.

FIGURE 4: LOCATION OF BUILDINGS AT MARION BASE



LEGEND

- Historical Site
- Monument
- Crane
- Catwalks
- Pipelines
- Fuel tanks
- Water tanks
- Burner

1. Marion House (Administrative /Living Quarters)
2. Kitchen, Dining and Sleeping Quarters
3. Ablution/Laundry Block
4. Accommodation Block
5. Emergency Base and Environmental measuring Laboratory
6. Mammal Laboratory
7. Botany/Invertebrate Laboratory
8. Ornithology/Geomorphology Laboratory
9. "Wet" / General Laboratory
10. Meteorological Upper-air Building
11. Meteorological Instruments
12. Meteorological Equipment
13. Power Hut
14. Power Hut
15. Power / Regulator Hut
16. PWD Office / Room
17. "PWD" Mechanic's Store/Workshop
18. Helicoper Hanger
19. Food Store
20. Flammable Store
21. Satellite Dish
22. Doris Beacon
23. Gymnasium

REFERENCE POINTS:

A+	46.87509 S	37.85801 E
B+	46.87804 S	37.85722 E
C+	46.87909 S	37.85699 E
D+	46.87665 S	37.86132 E

Amendments: C Hänel and C Jacobs, 1998

Source: DJ van Schalkwyk, DEA&T, 1996

Original Source: Public Works Department

Map Composition: DW Marais, DEA&T-GIS

12. INFRASTRUCTURE

Of the two islands, only Marion provides an infrastructure. Prince Edward (being a Zone 4 area in terms of the Management Plan) has no infrastructure and construction thereof is prohibited.

On Marion Island, the main human constructions are those forming the Base or Scientific Station at Transvaal Cove, and a few field huts placed at regular intervals around the island. This infrastructure serves the needs of the overwintering teams (between 6 to 35 people) and the relief (or takeover) personnel (a maximum of 64 people are allowed). "Cat-walks" (which are walk-ways made of metal grids), interconnect the various base buildings, provide easy access and operating routes to and from buildings, and minimise and localise human impacts.

THE SCIENTIFIC STATION (MARION BASE)

Marion base which is situated in the Management Zone 1 comprises the following structures:

18	Buildings
2	Helicopter landing platforms
1	Crane
18	Fuel storage tanks (with capacity of 14000 l each)
10	Water storage tanks (8 with capacity of 2000 l each for cold water, 2 with capacity of 750 l each for hot water)
various	Water-pipelines
1	Water filtration plant
various	Meteorological instruments
	Satellite communication structures
	Radio masts and antennas
1	Paper-waste burner
	Cat-walks that interconnect all the structures
several	Historical structures

Associated with the Base infrastructure, but situated in Management Zone 2, are the following:

1	Dam (across the Van den Boogaard River near Junior's Kop)
1	Small concrete building with some dismantled remains of a hydroelectric turbine.

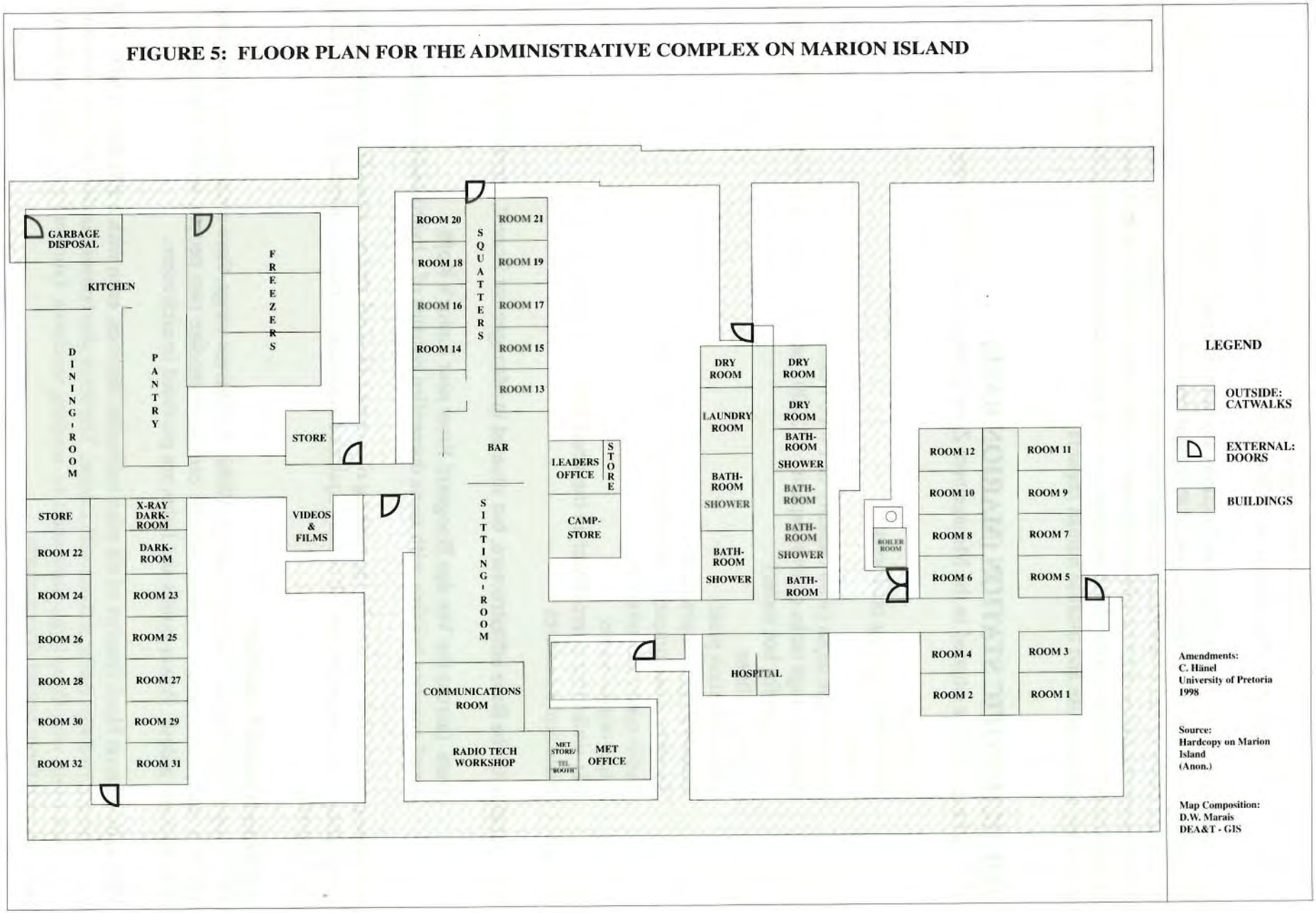
The Base is structured to cater for the running of a meteorological station, scientific programs, and the housing of the necessary staff. It is fully equipped according to modern standards, and provides the following:

Administration Complex

This complex includes the sleeping quarters. Within its different wings, there are a total of 32 sleeping quarters, each comprising a small room that can accommodate two people, with a double-bunk, cupboard and a desk. Power points and lights are provided in each room.

The main ablution block consists of six main bathroom facilities, each with a sink and a toilet, five with showers, two with baths, and one with a urinal. The block also houses laundry facilities consisting of a wash room with three large sinks and two washing machines, (automatic or semi-automatic-twin-tub) and three heated drying rooms.

FIGURE 5: FLOOR PLAN FOR THE ADMINISTRATIVE COMPLEX ON MARION ISLAND



There is a fully-equipped kitchen with modern cooking and storage facilities, including two electric stoves (one industrial and one household), a microwave oven, a household fridge, three walk-in freezers, a pantry, and various electrical gadgets (such as a blender, cake mixer, coffee percolator and industrial toaster etc.). Cooking utensils and cutlery of various sizes and types are also provided, as well as a small collection of cookery books. A double sink with cleaning materials is available for dishwashing.

All waste material is gathered in the "blikkie-kamer", which is a small room leading from the kitchen to the outside that provides bins for the different types of kitchen and household waste, from where the waste is then processed (see Guidelines for Conduct section below).

The dining room adjoins the kitchen. Apart from tables and chairs, it has notice and display boards, (including a black-board), a video machine and television, and a pull-down screen for the viewing of slides and films (a slide projector, 16 mm film projector and a collection of ancient, mostly atrocious, but enjoyable 16 mm films are provided).

Located centrally is a lounge/sitting room area, with adjoining bar that provides facilities for recreational purposes. This includes reading material (in the form of a collection of books and articles that remain permanently on the island) and space for library-borrowed material brought by each team; a second video machine/TV combination; a hi-fi system (with tape, CD and LP player; and again with a suitable collection of ancient, enjoyable and atrocious LP records); a pool/snooker table; a dart-board and a collection of other board and card games stored in the adjoining camp store. The bar has a sink, water, an ice machine, a soda stream maker, and is decorated with an assortment of interesting features, including various historical artefacts.

The camp store houses camping equipment, such as backpacks, camping mattresses, tents, small gas cookers and gas lights, flasks, and safety equipment. There is also an electric, household sewing machine, as well as various games.

A well-equipped medical and dental surgery and medical store is also housed in the administration complex, as is the radio room, which is equipped with various communication systems. These include a satellite telephone and fax system, computers with access to electronic mail and the internet, and long and short range radios. Adjoining the radio room is an electronic technicians office and the meteorological office.

The administration complex also includes a few small offices that are used for administrative purposes by the Team Leader and relief co-ordinator. In addition, a dark room that is equipped with developing tanks, developing trays, an enlarger, a water bath, a basin, film clips, and a few other items necessary for developing films and prints is available. No chemicals, paper or other film material is supplied. Although it is not located within the administration complex, a well-equipped, but small gymnasium is located close (10 m) to this complex.

Laboratories

There are four separate buildings that serve as laboratories on the island. These are the "Mammal Lab", the "Microbiology Lab", the "General Purpose Lab", and the "Wet Lab". These laboratories are used by various scientific groups depending on the projects currently supported by the Department of Environmental Affairs and Tourism. The "Wet Lab" includes three store rooms for scientific equipment. Each of these labs has some basic equipment (e.g., benchtops, sinks, some glassware), 24 hr 220 v power and lighting. However, no further equipment is provided and this has to be supplied by the researchers in question. This means that some equipment may stand over for a year

in the absence of overwintering researchers. This equipment is usually private property and should be used only after consultation with the appropriate researchers.

A small Ionospherics laboratory, which includes some atmospheric monitoring equipment, and which serves as a small emergency base (with food, radios, spare clothing and blankets) is located some distance from the rest of the buildings.

Store rooms

There are various buildings that provide storage. One of the largest of these is the Food Store in which all the crated food and general household goods supplied by the DEA&T are stored. This building also includes a small room in which spares for the crane are housed. All other spares and maintenance equipment are kept in the "PWD Store" which is the responsibility of Public Works Department. These spares and the equipment housed in this store are the property either of the PWD or the DEA&T. They should not be used without permission of the Diesel Technician, Team Leader, and/or Officer In Charge. A small Flammable Store, also located some distance from the other buildings, is used for storage of chemicals and flammable goods.

Helicopter hanger

A large helicopter hanger is located close to the upper air building and some distance from the administration complex. Support helicopters are occasionally parked overnight in this building, but mostly the building is used for recreational purposes by overwintering teams. The main doors of this building have a locking system which can easily trap a person in the building, and caution should be taken to ensure that the bolts are securely fixed in the open position when entering the building by the main doors.

Upper air building

This building houses the computer and other equipment necessary for the upper air balloon ascents that the meteorologists use for recording high altitude pressure, wind and temperature patterns at the island.

Power shacks and electricity supply

There are two buildings housing the generators that are used to supply the power for the entire Base. The larger one is the "ADE" shack, which has two larger generators, that are particularly important when the Marion base is running at full capacity (such as during the relief). The smaller "Deutz engine room" has two smaller generators, that serve as "emergency" or "stand-by" generators, but are often used during the overwintering periods because one of these generators can cater to the needs of a smallish team. The generators all run on diesel fuel, and this fuel is stored in large storage tanks close to the power shacks.

Power is supplied to the Marion base 24 hours, with electrical heating facilities in all buildings. The voltage is 220V and the standard South African three prong plug system is installed. Because of the nature of the power supply system, power surges are not uncommon, especially when the generators are being overhauled. Sensitive equipment should preferably be run through an uninterrupted power supply (UPS) (to be supplied by the user).

FIELD HUTS ON MARION ISLAND

The field huts are small, container-like units, that are placed at strategic sites as needed by the field workers for specific scientific programs. The number of huts present on the island depends on the

projects being undertaken. Generally there are nine that are serviced and used. None of the huts have electricity, but candles are provided for light, and a two-plate gas burner for cooking. Each hut contains four beds (two double bunks), basic provisions, cooking utensils, cleaning materials, a first aid box and a field radio. A generator with a small amount of fuel is also provided for the purpose of re-charging batteries of the field radios. Only a very basic toilet facility exists in the form of a "long drop" in the vicinity of each hut.

Take note: When weather conditions are bad at the huts and the battery power for the radios is low, it may be tempting to run the generator at the door of the hut. This should not be done because carbon monoxide can still build up in the huts and cause suffocation and death.

13. GUIDELINES FOR CONDUCT AT THE ISLANDS

In the interests of preserving and protecting the islands' natural and historical features, all visitors should familiarise themselves with, and adhere to the regulations and policies set out in the most up to date edition of the Prince Edward Islands Management Plan (first published in 1996 and available from the Director General, Department of Environmental Affairs and Tourism, Private Bag X447, Pretoria 0001). In essence, the guidelines set out below are to assist visitors in adhering to the Management Plan, but do not supersede or replace the regulations set out in the Management Plan which takes precedence over all other documentation in this regard. The Management Plan is legally binding under the Environment Conservation Act (Act 73 of 1989). Any questions or requests with regard to the Management Plan can be directed to the Prince Edward Islands Management Committee (c/o Directorate Antarctica and Islands, Department of Environmental Affairs and Tourism, Private Bag X447, Pretoria 0001, South Africa).

ANIMALS

While various animals on the island appear to be fearless or "tame" because they do not run away when approached (e.g., Elephant Seals, albatrosses, other seabirds), there are others that attempt to flee at the mere sight or sound of a person (e.g., Gentoo Penguins). There are also those (e.g., skuas) that are curious and quick to learn that human habitation generally presents a source of interesting and useful items (such as food or nesting material). Since most animals spend their time on the island fulfilling an important function (such as breeding or moulting etc.), disturbance can be detrimental to them and/or their offspring. Close approaches to animals usually puts them on the defensive and they either attempt to flee (often with little regard for bad terrain or the conspecifics around them), or they attempt to attack and defend themselves. In both cases the animals may be injured, and in the case of larger species (seals, albatrosses) human injury can also result. Seal bites tend to become septic very quickly and are extremely difficult to cure. To avoid such unnecessary and negative interactions, the following policies should be followed:

* **Approaches to animals should follow the guidelines set out in the Management Plan for certain species, and for all other species should be in a manner that causes least noise and interference (no closer than 15 m)**

Eggs, chicks or pups deserted by parents fleeing are left vulnerable to predators that are always waiting for a meal; penguins often trample their own eggs in excited distress, or seal pups can be squashed to death by defending bulls. While all the animals indigenous to the islands are vulnerable to disturbance, particularly during their breeding cycles, the following species have been afforded special protection on Marion, due to their vulnerable status and sensitivity to human interference:

<u>Gentoo Penguins</u>	***May not be approached within 100 m***
<u>Southern Giant Petrels</u>	***May not be approached within 100 m***
<u>Wandering Albatross demographic study colonies</u>	***May not be approached within 200 m***
<u>The Grey-headed Albatross Colony at Grey-headed Albatross Ridge</u>: (with the exception of the route from Santa Rosa Valley to Rook's Bay, traversing the ridge)	***May not be approached within 200 m***

* **Any fenced off or demarcated study sites** ***Should be avoided and not entered***

Where it is necessary, approaches to animals (their colonies or harems), should be done slowly and quietly, and not to within defence range of the animals. In other words, do not approach closer than 15 m and if further away than 15 m and the animal reacts to you, you are too close.

* **No food should be given to or left for any animals**

Animals can become dependent on food provided by humans and this may cause considerable harm to them if the food supply is suddenly withdrawn. Unnaturally high concentrations of predator and scavenger species around a source of food often places higher pressure on natural prey species in the area.

At Marion base, and at the huts around the island, birds (such as skuas in particular), hang around and scavenge anything left outside or fed to them. The temptation to throw out scraps or left-overs (especially from the Base kitchen or dining room windows) can be large, but should not be given in to for any reason (be it entertainment, a quick way of disposing of something on your plate, or sentiment). The Management Plan prohibits the feeding of animals. Food disposal should be undertaken according to the guidelines under "waste disposal" in the Management Plan (see also below). Where any edible (fresh or frozen) items have not been packed away, or have been left unattended (especially during the relief), these items should be covered securely (bearing in mind that house mice on the island are most active at night and can gnaw through wood and soft metal).

* **After dark, curtains and blinds must be drawn to prevent light from shining out of windows**

Burrowing petrels are most active at night and are therefore often referred to as "night-birds". The majority of these species become disorientated by bright lights, especially on misty nights, and are attracted to them. They often fly into the lights and buildings and are injured or stunned. Skuas have also learnt to expect this at the Marion base and often kill stunned birds (another reason for not feeding scraps to skuas). At certain times, bird strikes can be high. Under such conditions, a minimum of lights should be left on in any buildings, and the use of outside lights should be avoided completely. In general, the catwalk and outside lights are not turned on at the Marion base because of bird strike. For this reason it is important always to carry a torch with you at night.

* **Treatment of injured or ailing animals**

Where nature is prevented from taking its natural course due to human intervention (such as when seals or birds become entangled in plastic strapping etc.), assistance to these animals can be provided, but this should be done preferably in consultation with the Conservation Officer or a biologist who is familiar with the reactions of the species in question. Usually it is impossible to assist animals without at least two or three people present to restrain the animal and in many cases this can be dangerous. Assistance to animals should be provided with great caution and discretion, and in many cases this will prove to be impossible.

PLANTS

On Marion and Prince Edward Islands, a number of alien plants has established themselves, some of which are spreading and displacing the indigenous vegetation at a rapid rate. The indigenous flora (especially mosses and smaller plants) also tends to be slow-growing, which adds to it's vulnerability,

especially to human trampling. In addition, damage to or destruction of the natural vegetation by trampling can result in waterlogged, muddy areas that are devoid of vegetation and are difficult to traverse.

To avoid dispersing seeds and plant material (which cling to clothing and footwear), and to prevent the effects of trampling , constructed paths (i.e. cat-walks around the Marion base area) should be used and where well-demarcated routes have been established, these should be followed (e.g., the coastal route from Marion base to Trypot Beach). At the same time visitors should be aware of any fenced off or demarcated study sites that *should be avoided and not entered.*

Because of an increase in temperature at the islands over the last few years, many alien species that were previously not considered problem species have started spreading. In addition, some of the more nasty alien grasses are now spreading at a faster rate. To avoid compounding this problem, visitors should make every attempt to avoid walking through patches of alien plants. The relevant biologist or Conservation Officer can be asked for assistance with regard to the identification of these species. Nonetheless the most important species that should be avoided are: *Agrostis stolonifera* (the tall yellowy grass that often grows on river banks and slopes in the Base area); *Rumex acestosella* (the red sorrel that can be found just below the Marion base at Gentoo Lake and in a few other patches around the island); and *Sagina procumbens* (a dense, flat creeping, lime green weed that could be mistaken for a moss, and is almost impossible to avoid in the Base area, but which can be side-stepped where it grows in small patches on other parts of the island).

HISTORICAL SITES AND ARTEFACTS

There are many historical sites and artefacts along the coastline of both Marion and Prince Edward Islands, all of which are protected from human interference under the Management Plan by their Zone 4 status. Those artefacts older than fifty years are also afforded protection by the National Monuments Act. These sites and artefacts represent a natural archive for re-discovering and constructing the history of human activities on the islands. However, the value of these sites is highest when experienced archaeologists can investigate the objects in exactly the place they were found. Thus visitors coming across any unrecorded sites or objects should leave them undisturbed, but can document any details photographically and report the relevant details (see below).

WHEN FINDING NEW AND UNRECORDED SPECIES AND ARTEFACTS

Where possible, photographic evidence, with as much information about the date, place, prevailing conditions, nature of the find, biological information, colours, textures, etc. should be gathered, and brought to the attention of the Conservation Officer, Team Leader and Prince Edward Islands Management Committee. The items and/or site should not be disturbed. **Only if you hold a permit allowing you to examine the site or remove the items may you do so.**

WASTE: DISPOSAL AND CARE

For the protection of the islands' environment, as well as for aesthetic, practical and health and safety reasons, it is important that all visitors abide by the guidelines and regulations for waste disposal set out in the Prince Edward Islands Management Plan. The details set out below will assist visitors in doing so and provide some tips and background on how to minimise threats to the environment posed by waste.

First, care should be taken not to let non-waste items become a hazard. For example, sudden strong gusts of wind often blow unsecured items away. Not only could this cause the death of animals (e.g., if plastic items are blown to sea and ingested by birds, or if seals become girdled by netting or unused plastic strapping), but it could be a serious setback to the person concerned (e.g., if an orientation map blows away during a field trip, someone unfamiliar with the area or terrain can end up in trouble). The wind tends to worry away at all items left outside, and even reasonably secure items can eventually be torn to shreds or be blown away. All of these items immediately become waste.

Photo: M. Bester

Fur seal darted to remove plastic strapping from it's neck

Marion base

At the scientific station, the following disposal procedures are followed:

Waste is separated into the following categories:

1)	FOOD	*Excluding* oil and all poultry products.
2)	OIL	All cooking, salad and other household oil.
3)	POULTRY	Any poultry products including eggs, egg-shells, bones, and meat.
4)	BURNABLES	All non-toxic items that can be burnt. (e.g., paper, wood and natural fabrics).
5)	PLASTICS	All types of plastics, rubber, foam, polystyrene, nylon, film, etc.
6)	GLASS	a. All recyclable glass b. Light bulbs and toxic glass
7)	METAL	a. All cans from food and beverages, metal lids, aluminium foil, etc. b. Industrial steel, hardware, etc.
8)	CHEMICALS	a. All chemicals (incl. photographic waste), aerosols, paints, etc. b. Industrial oils and fuels, gas-bottles, etc.
9)	HAZARDOUS	Batteries, radio-active waste, medical waste, etc.

Collection sites for day to day working purposes are variously distributed throughout the Marion base area (Zone 1), in laboratories, work-stores, living quarters, etc., from where the waste is processed (or "disposed of") on a regular basis as follows:

1. All food (*excluding* poultry and oil) is discharged directly into the ocean from a site at Marion base. This is done *after dark*, to avoid birds scavenging from the offal (e.g., Giant Petrels that tend to sit on the water during the day, as do the keen-eyed skuas). *Should a closed incinerator be installed on the island, incineration of food will replace the discharge method of disposal.*

2. Domestic oil is collected in 10 or 20 litre containers, and stored for shipment back to South Africa. (Oil-residues thrown into the sea spread a thin film on the water that contaminate marine life e.g., birds whose feathers become water-logged, etc.).

3. All poultry waste is collected in tins (or other sturdy, mouse-proof containers). The tins are clearly marked, sealed and frozen. These tins are returned frozen to South Africa.

4. All burnables are burnt outside in a basic incinerator ("Smoky"), that must be kept closed to prevent garbage or burning residues from blowing out. The ash is collected and stored (in closed tins), for shipment back to South Africa. *Should a forced-draught incinerator be installed on the island, this will be used for incineration of burnables.*

5. Plastics are compressed and bagged, and stored in the orange mini-shipping containers set aside for this purpose. These mini-containers are then returned to South Africa.

6. Glass is crushed manually (safety glasses must be worn and the necessary precautions taken). The glass is then sealed in tins, which are crated and stored in the appropriate mini-shipping container for shipment back to South Africa.

7a. Metal cans are compressed (using a crushing machine) and stored in the relevant mini shipping container to be shipped back to South Africa.

7b. Leaking or rusted drums, paint-tins and other large metal items are crushed manually and containerised together with other large or heavy metal waste, to be returned to South Africa for re-cycling.

8a. Chemicals are first sorted so that dangerous reactions between chemicals do not take place. These chemicals (such as the liquid waste from film processing, and laboratory alcohol etc.) are stored in 10 or 20 litre, clearly-marked plastic drums, and are containerised for shipment back to South Africa. Under no circumstances should chemicals be disposed of through the plumbing system. This system discharges directly into the sea.

8b. Generator oil, diesel, and other fuel waste is stored in 200 litre drums, which are shipped back to South Africa.

9. Hazardous waste is stored in appropriate and clearly marked containers and is returned to South Africa.

Field huts and camping sites

At huts, all waste (other than food and sewage) is stored in sealable containers suitable for transport by helicopter back to the supply vessel (and return to South Africa). Food is discarded into the nearby toilet. It should not be discarded into the field for "composting", because this attracts and habituates birds such as skuas.

Camping is usually not allowed, but permits for camping can be obtained for research purposes on both Marion and Prince Edward Islands. In the case of camping, all waste is to be kept for disposal at Marion base, with the exception of grey water (i.e. dishwater and human sewage).

14. ACKNOWLEDGEMENTS

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