Marine Protection for the New Zealand Subantarctic Islands

A BACKGROUND RESOURCE DOCUMENT

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Te Tautiaki i nga tini a Tangaroa

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Introduction

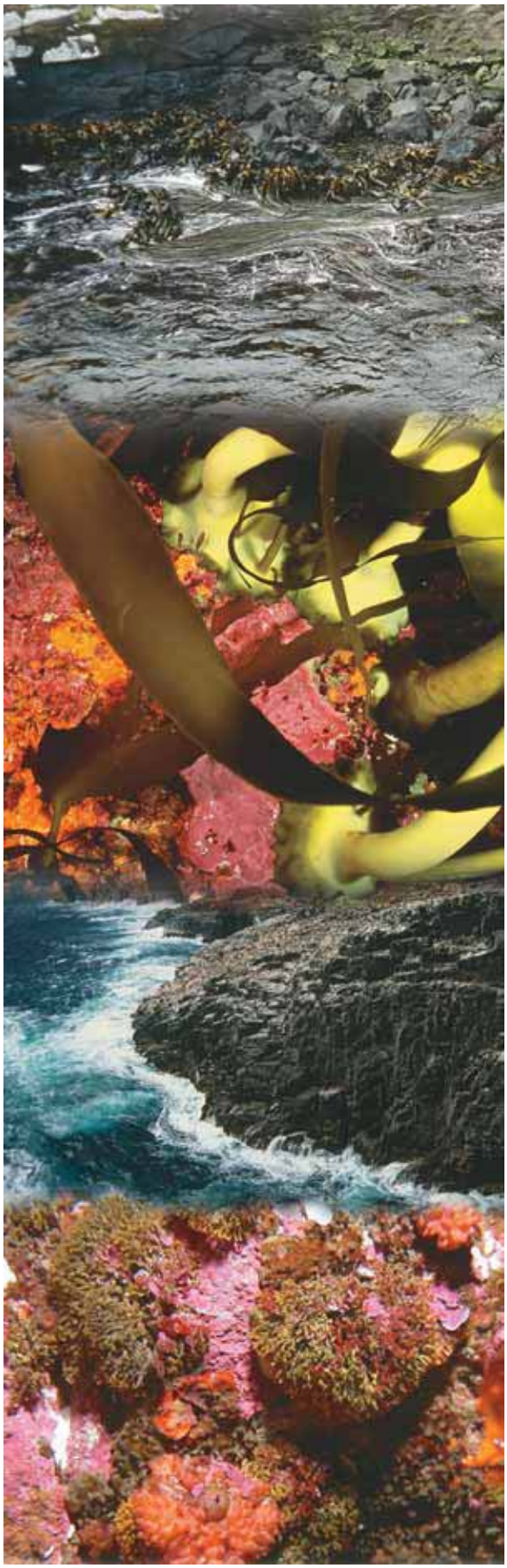
Far off the southern coast of New Zealand, scattered across the Southern Ocean are five island groups we call 'the subantarctics'. These disparate, diverse communities – Snares/Tini Heke, Auckland/Motu Maha, Bounty, Antipodes and Campbell/Motu Ihupuku Islands – together form one of the last bastions of nature on the planet. Now without any human inhabitants, and always to some measure protected by their stormy situation and isolation, they are one of the least modified environments in the world.

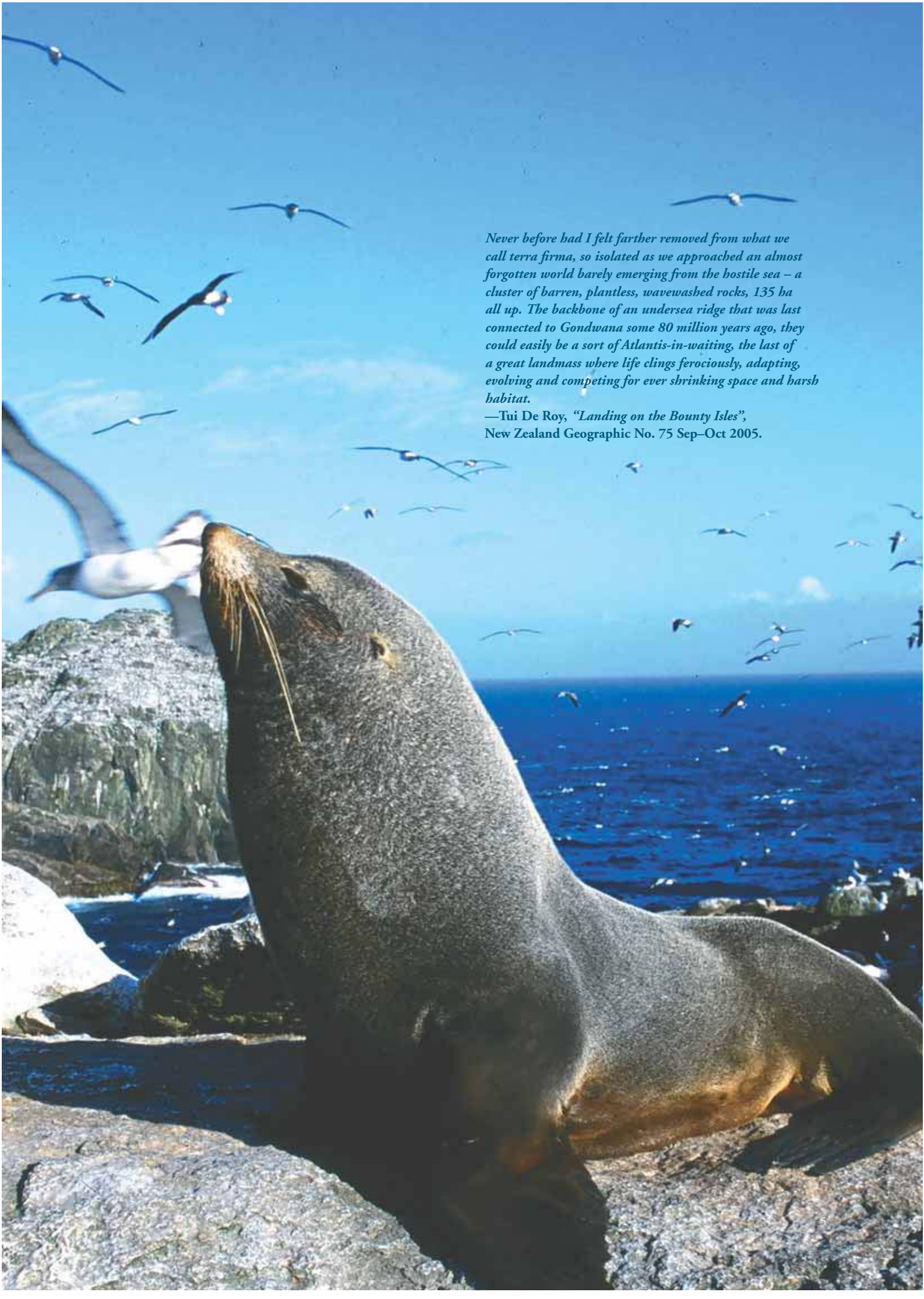
These tiny islands are the stuff of legend: this is where the General Grant was lost with its cargo of gold, where sealers once harvested up to 100,000 animals per voyage, where the Roaring Forties run into the Furious Fifties and that means gales three-quarters of the year, where despite everything albatrosses sit on nests as still as snow, and land plants and seaweed grow to inordinate size, and some of the wildest and grandest inhabitants of the Southern Ocean make their home – albatross, sea lions, penguins, fur seals, great whales.

But there are stories rarely told about 'our' subantarctics – stories of the marine wonderland around these islands. While above the tideline the world of the islands is often bleak, wind and rain lashed, and in some places without even the softening green of plants, below there is a riot of colour, of animals and plants thick in brilliant mosaics on rock walls, crammed into sheltered crevices and caves, or clustered in the very rise and fall of the ocean itself.

The few divers who have visited bring back extraordinary images – thick forests of bull kelp with half-metre diameter holdfasts and 10 m blades swirling like slow motion hair in the swell, platters of pink coralline algae stacked in crazy piles, white-footed paua with giant spider and masking crabs peeking out of narrow cracks, the surreal soft-spined shapes of shell-less nudibranchs, and fish moving so slowly it is as if they are partly frozen. Amongst them all, diving off shore platforms to hunt and harvest are the marine mammals and seabirds that depend so entirely on these rare areas of surface rock and surrounding shallow water.

The islands themselves are protected, to give the surface-breeding creatures a safe base, and to protect the diverse ecological communities that have developed there. All five of the New Zealand subantarctic island groups have the highest level of protection as national nature reserves, and together they were listed as a World Heritage Area in 1998. However, marine protection around the subantarctic islands includes a marine reserve/marine mammal sanctuary reaching out 12 nautical miles around Auckland/ Motu Maha Islands, and commercial fishing restrictions and legal protection provided for various marine animals in New Zealand waters.





Never before had I felt farther removed from what we call terra firma, so isolated as we approached an almost forgotten world barely emerging from the hostile sea – a cluster of barren, plantless, wavewashed rocks, 135 ha all up. The backbone of an undersea ridge that was last connected to Gondwana some 80 million years ago, they could easily be a sort of Atlantis-in-waiting, the last of a great landmass where life clings ferociously, adapting, evolving and competing for ever shrinking space and harsh habitat.

—Tui De Roy, *"Landing on the Bounty Isles"*, New Zealand Geographic No. 75 Sep–Oct 2005.

There is international interest in the islands' marine surroundings being more robustly protected. These are the ocean commons that support the profusion of mammal and seabird life found on these scattered scraps of land. The terrestrial and marine ecological systems of the subantarctics are intertwined, almost seamlessly so – changes to life in the water have profound effect on the land-based communities.

There is also significant national interest involved, not least that these distant, inhospitable islands have provided a refuge for iconic species we might otherwise have lost entirely from around our shores – such as the southern right whales which continued to breed in the sheltered waters of the Auckland/Motu Maha and Campbell/Motu Ihupuku Islands and are now returning to visit the New Zealand mainland for the first time in many years.

There is no doubt that the complete communities, land and sea combined, of our subantarctic islands are of immense scientific and conservation value globally. In this extraordinary zone between subtropical and polar waters, life has evolved in unique ways. While the New Zealand subantarctic islands provide a disproportionate amount of the land and sea habitats that support life in the Southern Ocean, they are also remarkable for the number of species that occur there and nowhere else in the world. Amongst seabirds alone there are five endemic albatross species, two penguin species and three cormorants or shags, including the world's rarest, the Bounty Island shag. In the water, notable endemic species include unique seaweeds, a paua and a burrowing anemone while other organisms grow or link with others in ways not seen anywhere else. Many more marine species remain undescribed or yet to be discovered by scientists.

Knowledge of exactly what is where and how well the different communities are doing is limited by the very isolation and climate that has protected this region for so long. One recently rediscovered subspecies, the Campbell Island snipe, was found only in 1997, while new marine species are encountered almost every time conditions allow diving surveys – rare revelations from one of the last truly mysterious and wild places on our planet.

Action now to protect these marine areas will allow us to safeguard this treasure trove for years to come – keeping whole the dynamic systems that support spectacular life-forms in incredible circumstances, and keeping alive too our own wonder at what lies in our nation's depths.

Those who visit a subantarctic island usually leave with a feeling of having had a significant life experience… a lingering end-of-the-Earth feeling, more elemental than experienced elsewhere in New Zealand, of vibrant life stripped of its fripperies… Life is possible on subantarctic rocky reefs, but only for species hardy enough to make it across vast stretches of ocean and survive in the rugged terrain and cold conditions. Many species are castaways from the mainland, while others live only here, clearly at home in these isolated islands.
—David Shiel and Michael Kingsford *"Subantarctic Islands" in The Living Reef: The Ecology of New Zealand's Rocky Reefs,* eds. N. Andrew and M. Francis, Craig Potton Publishing, Nelson, 2003.

The ocean dominates the islands scattered upon its wild unbroken reaches. Even on the largest of New Zealand's subantarctic islands… one is never far from its overwhelming influence – whether of rapid fronts and squalls sweeping in from the sea, the unleashed wind on the barren high country, or the permanent lanes which gales have carved in the close canopy of stunted scrub and forests. The mammals and birds are those of the ocean.
—Conon Fraser, *Beyond the Roaring Forties: New Zealand's Subantarctic Islands.* GP Publishing, Wellington, 1986.

Purpose of the document

This document is a background paper in preparation towards planning for the protection of the marine environment around the three furthest flung subantarctic island groups located in the Subantarctic Islands Marine Biogeographic Region[1]: the Bounty, Antipodes and Campbell/Motu Ihupuku Islands.

It focuses on ways protection could be extended from the land masses into the inshore marine environment, as a first step; protection for the remainder of the wider sea area above the southern plateau (ie the Campbell Plateau and Bounty Platform) will be explored at a later date as part of the Offshore Marine Protected Area planning process[2].

The first part of this document describes the New Zealand subantarctic region in general, within a global context. It outlines the geological, climatic, oceanographic and biological characteristics of the island groups, and summarises the human history in the area, as well as the way the area is currently managed and used.

Each of the three island groups is then described in closer focus, with emphasis on the marine environment.

The document outlines the issues faced in the subantarctic region including the existing pressures on the natural environment and the potential ecological threats. It also outlines the current management regime: the agencies involved, the laws and policies they work to, and the current systems in place in the region, and then sets out the steps for developing options for protection of the marine environment for the future.

Although a number of references and material was used to provide the information for this document the information was sourced primarily from the *Nomination of the New Zealand Subantarctic Islands by the Government of New Zealand for Inclusion in the World Heritage List*, Neville Peat's *Subantarctic New Zealand: A Rare Heritage* and a report compiled by NIWA.3

[1] Marine protection around the The Snares Islands/ Tini Heke is not being considered here as The Snares Islands group is located in the Snares Island Marine Biogeographic Region which lies atop the Snares Shelf and drops to the Campbell Plateau in the south and the Solander Trough in the west. This region is influenced and surrounded by the Subtropical Front and the cool Southland Current. Marine protection for Snares Island Marine Biogeographic Region will be undertaken as part of the Offshore Marine Protected Area Planning process. The Auckland, Campbell, Antipodes and Bounty islands are located in the Subantarctic Islands Marine Biogeographic Region, an area influenced by cold water from the Subantarctic Front.

Sources:
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Preliminary findings from the Marine Protected Areas Policy Classification Workshop convened by the Department of Conservation and the Ministry of Fisheries, held in December 2005, Wellington.

[2] Department of Conservation and Ministry of Fisheries (2006) Marine Protected Areas Policy and Implementation Plan. Department of Conservation and Ministry of Fisheries, Wellington, New Zealand.

[3] Booth, J. (2004) The marine ecosystem of New Zealand's subantarctic islands and their surrounding plateaus. NIWA Client Report: WLG2004-47, July 2004 – Prepared for the Department of Conservation. National Institute of Water & Atmospheric Research Ltd (NIWA), Wellington, New Zealand.
Government of New Zealand (1997) Nomination of the New Zealand Subantarctic Islands by the Government of New Zealand for Inclusion in the World Heritage List. Wellington, New Zealand.
Peat, N. (2003) Subantarctic New Zealand: A Rare Heritage. Department of Conservation Te Papa Atawhai, Southland Conservancy, Invercargill, New Zealand.

The Government's formal position

The New Zealand Government, as a signatory to the United Nations Convention on Biological Diversity, is committed to protecting a full range of natural marine habitats and ecosystems to effectively conserve marine biodiversity, using a range of appropriate mechanisms, including legal protection. The New Zealand Biodiversity Strategy 2000 is designed to give effect to the Government's international obligations and the Marine Protected Areas Policy and Implementation Plan has been developed jointly by the Department of Conservation and the Ministry of Fisheries as the key means to achieving these goals.

The Marine Protected Areas Policy and Implementation Plan, was released in January 2006[4]. The policy is a new and integrated approach to marine protection that will promote the systematic development of a comprehensive and representative Marine Protected Areas (MPA) network to protect marine biodiversity. The policy seeks to establish MPAs using a range of existing tools such as marine reserves, Fisheries Act measures, and Resource Management Act tools.

The planning process is designed to be inclusive of relevant interests. Planning for marine protection will be science-based, using a consistent approach to habitat and ecosystem classification, and an inventory of MPAs protected areas to determine gaps in the network. The aim will be to achieve biodiversity protection in a way that minimises the impact of new protected areas on existing users of the marine environment and Treaty settlement obligations. Over time, the full range of natural marine habitats and ecosystems will be protected including those that are outstanding, rare, distinctive, or internationally or nationally important.

The Subantarctic Marine Protection Project was initiated in 2003 through the Department of Conservation's Subantarctic Islands Conservation Management Strategy (1998–2008) which advocates for the further protection of marine ecosystems in this region and notes that the coastal marine areas around the subantarctic islands also warrant further protection to ensure their values are protected for future generations.

The Subantarctic Marine Protection Project planning process is well advanced and Ministers have agreed that this project is a priority for early progress. The Department of Conservation and the Ministry of Fisheries will continue this project in a way which aligns with the Marine Protected Areas Policy, to the extent possible.

We are jointly investigating marine protection options for the New Zealand subantarctic island groups of the Southern Ocean, for the protection of biological diversity and ecosystem functioning.

The overall goal is to enhance effective stewardship and lasting protection of the subantarctic waters of New Zealand, giving due consideration to the interests of and implications for all who use and care about our marine environments.

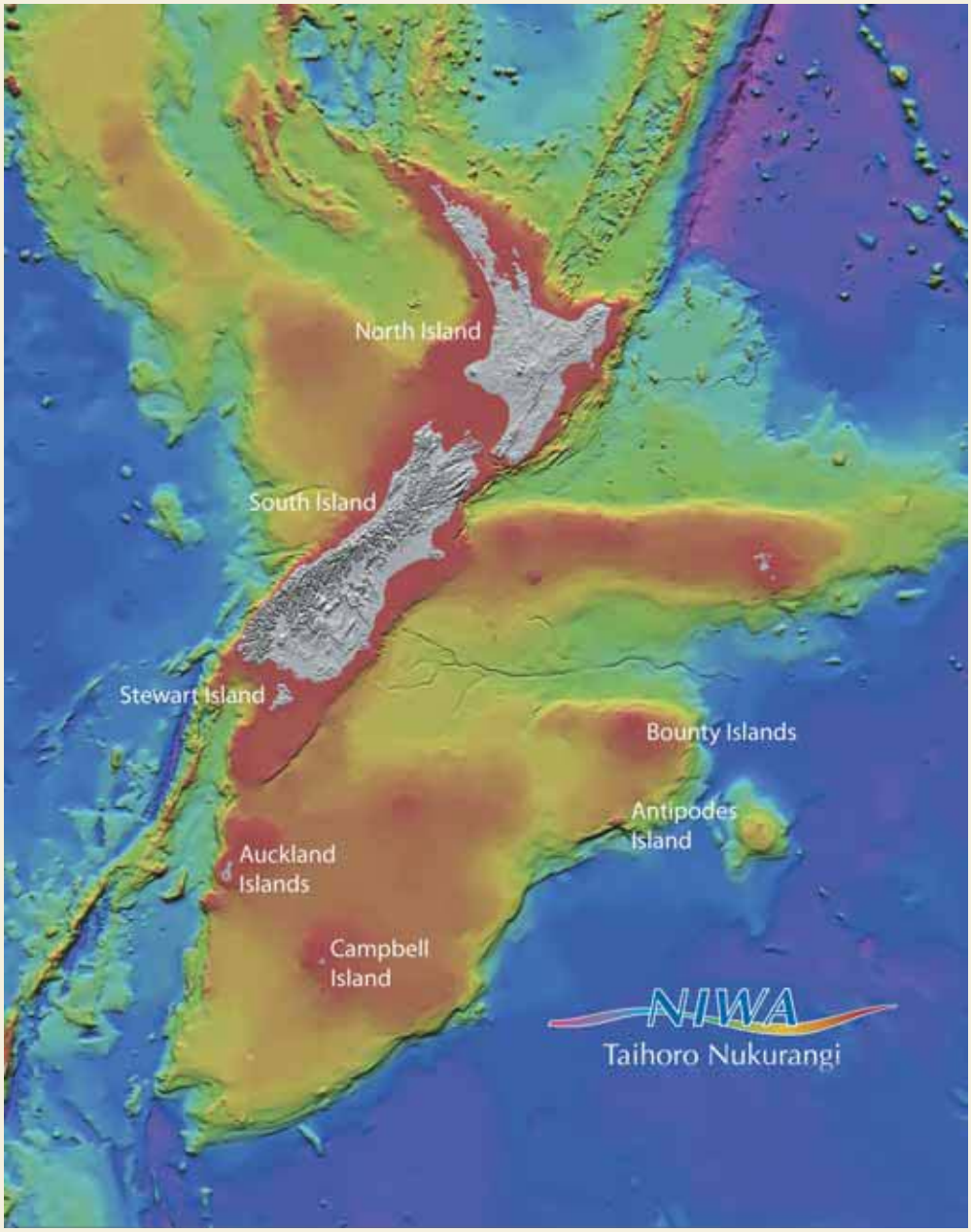
[4] Department of Conservation and Ministry of Fisheries (2006) Marine Protected Areas Policy and Implementation Plan. Department of Conservation and Ministry of Fisheries, Wellington, New Zealand. www.biodiversity.govt.nz

Marine Protected Areas (MPAs)

By protecting special or representative marine habitats, we can 'bank' some of our biological wealth, as an investment for future generations. To this end, the New Zealand Government is creating a network of marine protected areas (MPAs), extending across our EEZ, to ensure all unique, rare and significant habitats and species are 'banked', as well as a range of areas representative of our more common coastal, offshore and deepwater habitats and communities.

Government policy defines a MPA as "*An area of the marine environment especially dedicated to, or achieving, through adequate protection, the maintenance and/or recovery of biological diversity at the habitat and ecosystem level in a healthy functioning state*". Some sites we select as part of a marine protected area network will already be in a near-pristine state; others may have been impacted by a range of human activities, and need some recovery.

MPAs are now regarded internationally as a pivotal tool to conserve examples of our marine realms in an undisturbed state, much like national parks and reserves do on land. MPAs are needed as an insurance policy to guarantee that future generations can continue to enjoy and draw profit from the marine environment.



What's been done so far?

Preliminary background investigations of the marine environment around the Bounty, Antipodes and Campbell/Motu Ihupuku Islands have already been made, and some consultation has commenced with key stakeholders. These are outlined here.

Investigation process

Initially, national and international literature relating to all aspects of New Zealand's subantarctic island marine environment was collated. This information has been used to create a comprehensive bibliography, which is available in a published form. This information is also available on CD and forms part of the Department of Conservation's subantarctic marine database. The literature search has provided over 400 peer-reviewed scientific papers, which indicates the emphasis placed by the international and national scientific community on the scientific importance of the subantarctic islands' and the marine environment.

Further to preparing a bibliography the department commissioned the National Institute of Water and Atmospheric Research (NIWA) to provide a 'desktop report' synthesising existing knowledge on the structure and function, risks to the biota and usage of the marine ecosystem of the southern plateau (Campbell Plateau and Bounty Platform combined), with a particular focus on the conservation values and biodiversity within the 12 nautical mile (territorial sea) region of the Auckland/Motu Maha, Campbell/Motu Ihupuku, Antipodes and Bounty Islands.

It is envisaged that this NIWA report will be used as a basis for the development of marine protection options for the subantarctic islands (see CD published with this report). It is also proposed to supplement this information through further discussions with key scientific researchers and stakeholders with an interest in the subantarctic islands and Southern Ocean.

Subantarctic Marine Protection Workshop November 2004

The Department of Conservation held a workshop in November 2004 designed to bring together academics, scientists, stakeholder representatives, government departments, non-governmental organisations and Ngài Tahu representatives with expertise and interest in the area to share existing knowledge of the remote and rugged Southern Ocean and in particular the near-shore environment of the subantarctic islands.

The workshop was for participants to openly talk about the values of the marine area, identify and explore ways to manage risks and threats and that these discussions would help provide direction on future marine protection for the subantarctic islands.

There was a general consensus from the workshop that protection of the marine ecosystems of these oceanic islands should be sought. It was agreed that the workshop provided a strong foundation on which to build the process.

Where in the world

In the Northern Hemisphere… between the latitudes 50° and 60°… the ratio of land to sea is approximately 1.3 to 1. Within the same latitudes in the Southern Hemisphere, the only land is Punta Arenas and Terra del Fuego in the south of South America. The rest is ocean. The ratio of sea to land is approximately 53 to 1. The islands, mere specks of land separated by enormous distances, seem infinitely remote outposts, dominated by unrestrained winds and the surrounding sea.

—Conon Fraser, *Beyond the Roaring Forties:*

The Southern Ocean is the great, almost uninterrupted swirl of sea that encircles the globe to the north of Antarctica. It is driven west-to-east on the Antarctic Circumpolar Current, and swept by the strongest average winds on earth – these are the stormy latitudes of the Roaring Forties and Furious Fifties.

Sprinkled across this huge expanse of subpolar ocean (20,327,000 km^2) are just 22 island groups, administered by six nations. Five of those island groups are in New Zealand waters: the Snares/Tini Heke, Auckland/Motu Maha, Campbell/Motu Ihupuku , Bounty and Antipodes Islands. Only one other, Australia's Macquarie Island, is in the Pacific sector.

The Subantarctic islands of New Zealand play an internationally important role because of their location and relatively natural condition. In the Pacific sector, the New Zealand islands lie between 47° and 53°S (Macquarie is at 54° 30'S). In comparison, the five South Indian Ocean sector island groups tend to be in the lower latitudes and are more spread out between 36° and 52°S. Many of the islands of the South Atlantic sector are more polar and are located between 51° and 63°S, although Gough Island lies at 40° 19'S. Thus, the New Zealand Subantarctic islands occupy the mid-latitudinal range among the Subantarctic island groups.

The subantarctic islands serve a vital ecological role in the Southern Ocean. Land here is rare compared to the same latitudes in the Northern Hemisphere, and shallow water habitats are generally restricted to areas around those very occasional islands.

At the same time, New Zealand's five island groups are deemed of special value amongst all the Southern Hemisphere's subpolar islands – the United National Environmental Programme has described them as "the most diverse and extensive of all subantarctic archipelagos", and they are noted for their distinctive ecosystems and the high number of life-forms found nowhere else (ie endemic species).

Each island group being widely separated and of very different geological age has its own unique assemblage of marine algae, invertebrates and fish. Each assemblage has a reasonable level of endemism and is as distinctive as the terrestrial flora and fauna. Diving surveys around the Bounty and Antipodes Islands in April 2005 showed these areas support as many species as renowned areas in the north Pacific such as Galápagos Island and Puget Sound. Early analysis suggests that the variety of rockwall invertebrate species occurring at these islands may be a third higher than areas around New Zealand's mainland coast including the Hauraki Gulf.

New Zealand's subantarctic islands

Geology

New Zealand's subantarctic island groups lie far to the south and east of our main islands. They are the surface-breaking tips of the Campbell Plateau and Bounty Plateau, on the submerged shelf of the southern New Zealand continental region.

This 'southern plateau', as it is commonly called, is a major undersea structure covering approximately 433,620 km^2 – similar in area to the whole of mainland New Zealand and includes the Campbell Plateau and Bounty Plateau (or Platforms), Pukaki Rise, Campbell Rise, and the Auckland Shelf. It creates a rare zone of shallower sea in the Southern Ocean, which is generally between 4,000 and 5,000 m deep, while the waters over the southern plateau are between 600 and 1000 m deep, shoaling to 250 m. The seabed itself is made up of a number of broad rises and depressions, with a dramatic eastern edge in the steep Antipodes Scarp – this plunges 4,000 m to the floor of the Southwestern Pacific Basin.

There are at least 50 seamounts in the region, most on the edge of the plateaus and particularly near the Auckland/Motu Maha and Antipodes Islands.

The basement rock of the southern plateau is granite and metamorphic rock more than 100 million years old. Before the Southwestern Pacific Basin began to form about 80 million years ago, the Campbell Plateau would have been connected with Antarctica. The tiny basement rock outcrops of the subantarctic islands are therefore crucial pieces in the Gondwanaland jigsaw puzzle. The Bounty Islands are entirely formed of granite, while the Auckland/Motu Maha and Campbell/Motu Ihupuku Islands are basalt shelf volcanoes, and the Antipodes group is a complex of volcanic cones and vents.

The total land area of these four island groups is less then half that of Stewart Island/Rakiura.

The New Zealand islands, lying midway between two great oceanic boundaries – the Antarctic and Subtropical Convergences – are scattered like knucklebones across the Southern Ocean as if sent sprawling by a clumsy geological hand… The islands are the protruding high points of huge underwater tablelands known as the Campbell Plateau and Bounty Platform – extensions of the continental shelf around mainland New Zealand. These shelf areas bulge south and east of mainland New Zealand, providing relatively shallow water for marine life. The western trio of The Snares, Auckland and Campbell Islands are perched on the Campbell Plateau; the Bounty and Antipodes Islands are lined up to the east on the Bounty Platform. The edges of the Campbell Plateau and Bounty Platform are typically steep and they fall away to abyssal depths. The Antipodes group, at the edge of the Bounty Platform, is only a few kilometres from ocean that is several thousand metres deep.
—Neville Peat, *Subantarctic New Zealand: A Rare Heritage.* Department of Conservation, Invercargill, 2003.

The geological history is… varied and fascinating. The northernmost groups (The Snares and Bounty Islands) are chips off the old block. They are made of the parent seabed rocks: granite and metamorphic rocks more than 100 million years old. In the case of the Bounty Islands, only stark granite tips are showing. The other three groups are of quite different construction. They are volcanic and much younger. The Auckland Islands represent the eroded remains of a volcano that erupted progressively between 25 and 10 million years ago. Campbell Island's hilly terrain developed from volcanic activity eleven to six million years ago, and the Antipodes group, youngest of all, began to form five million years ago. The last volcanic activity was less than a million years ago.
—Neville Peat, *Subantarctic New Zealand: A Rare Heritage.* Department of Conservation, Invercargill, 2003.

Oceanography

New Zealand's subantarctic islands lie in a mixing zone of polar and subtropical water. Not only are they situated between the ocean temperature boundaries of the Antarctic Convergence and the Subtropical Convergence, but the flow of currents around the Southern Ocean is also set swirling by the sharp relief of the southern plateau.

Generally, sea surface temperatures are lower, and the water saltier than in other areas of New Zealand – the only other zone of such subantarctic water is the Bounty Trough that lies between the southern plateau and the Chatham Rise extending off the Canterbury coast. Sea surface temperatures range seasonally among the islands between 7–11°C, with salinity of 34.5 parts per thousand.

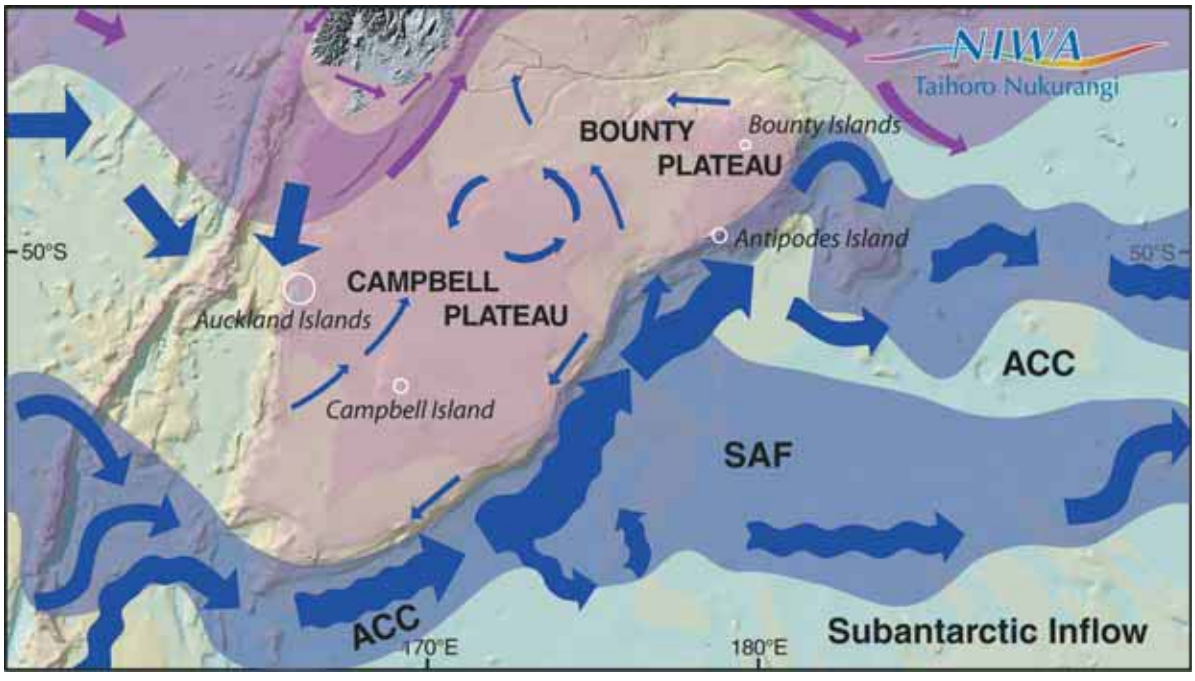
As for the New Zealand mainland, the islands are dominated by two tides per day. The spring tidal range is about 1.28 m and 0.46 m for Campbell/Motu Ihupuku Island; for the Bounties 1.06 m and 0.54 m; and for the Antipodes 0.98 m and 0.46 m.

Climate

"Cold, wet and windy" fairly sums up subantarctic weather, although there are occasional fine calm days, sometimes even several in a row. The oceanic climate is dominated by persistent westerly winds and the frequent passage of cold fronts. These westerly winds increase in intensity the further south you go, and are more frequent during spring than other seasons. Gale force winds buffet the region over three quarters of the year and gusts in excess of 96 km/hr (50 knots) occur on at least 100 days annually. The winds drive before them oceanic swells – the waves that consistently pound these islands average 2–4 m, and 10–12 m swells are not uncommon.

Cloud cover increases markedly as you head south. On Campbell/Motu Ihupuku Island, the most southerly of the New Zealand groups, the annual sunshine total is about 600 hours. For comparison, on mainland New Zealand, Invercargill can expect about 1,620 hours, Christchurch about 2,000 hours, and Auckland about 2,100 hours annually.

Rainfall is frequent, although not always heavy. On Campbell/Motu Ihupuku Island, where there is a longstanding weather station, rainfall is recorded on more than 300 days a year, yet the average annual total of 1,360 mm is only 200–300 mm more than in Wellington and Auckland. Annual rainfall varies considerably among the islands – the Auckland/Motu Maha Islands have about double the amount of rain that falls on the Antipodes. Light snowfalls can occur at any time of the year but are more common during the colder seasons at the Auckland/Motu Maha and Campbell/Motu Ihupuku Islands.



Ecology

All of New Zealand's subantarctic island groups have a vital role to play in the wider Southern Ocean ecosystem. Each of these interconnected land–sea systems is crucial to the survival of a large number of endemic, threatened or endangered species. Not only do many animal species depend on these rare areas of dry land to rest and breed, but the health of the surrounding ocean is paramount to their survival, as they depend on inshore and offshore areas for foraging while breeding, resting and rearing young.

Overall, the biodiversity of these island groups is very high – a legacy of a relatively rich marine environment and a distant, discouraging position that has limited human impacts on land and at sea.

The range, density and rarity of land-based species has long been recognised, and were a key aspects of the United Nations listing of the five New Zealand subantarctic island groups as a World Heritage Area.

More recently, marine biodiversity is also being recognised as being higher around the islands than previously thought. A recent study synthesising the existing research available about the marine environments of Auckland/Motu Maha, Bounty, Antipodes and Campbell/Motu Ihupuku Islands – carried out by the National Institute of Water and Atmospheric Research suggests there are significant biodiversity differences between the islands and that all four island groups have high levels of endemism.

Surveys of subtidal ledges of the Bounty and Antipodes Islands in April 2005 showed the species diversity and density there is comparable to areas in the tropical and north Pacific (ie Galápagos Island and Puget Sound). On a national scale, the patterns of diversity in those subtidal invertebrate assemblages are about 25% higher than the Hauraki Gulf, and about 20–30% lower than in Fiordland (one of the most intensely diverse biological regions in the world).

Between primary elements of the marine ecosystem such as krill and phytoplankton and high order fauna such as whales, seals and seabirds, there are fish in huge numbers. Their economic value to New Zealand is underlined by the presence of fleets of distant-nation deep-sea fishing vessels in the subantarctic seas, especially in the waters over the Campbell Plateau. Thanks to the wide spacing of the five subantarctic island groups, New Zealand has a 200 nautical mile (370 km) exclusive economic zone that is the fourth largest in the world. It covers 430 million hectares – more than 15 times the land area of New Zealand (see map). The zone also hints at the significance of the marine biodiversity to New Zealand. As much as 80 percent of the country's biodiversity is found in the sea.
—Neville Peat, *Subantarctic New Zealand: A Rare Heritage.* Department of Conservation, Invercargill, 2003.

The contribution of the New Zealand quintet [of subantarctic islands] to the biodiversity of the Southern Ocean is out of all proportion to their size. With the aid of a comparatively mild climate and a productive ocean environment, the New Zealand groups support an assemblage of marine and terrestrial species that is decidedly rich compared to most other subantarctic groups.
—Neville Peat, *Subantarctic New Zealand: A Rare Heritage.* Department of Conservation, Invercargill, 2003.

Flora and fauna

While the plant and animal species found in and around our subantarctic islands have quite a lot in common with the flora and fauna of other parts of New Zealand, there are many startlingly unique aspects to life here.

Not only do species come together in these island groups in ways that are distinctly 'subantarctic' in nature, and which are markedly different from group to group, but there are also a remarkable number of species that occur here and nowhere else.

Most obvious are the seabirds and marine mammals that rest and breed on these rare chunks of land in the Southern Ocean. These include several relatively rare species such as the New Zealand (Hooker's) sea lion, southern royal, Antipodean and Gibson's albatrosses, yellow-eyed, erect-crested, eastern rockhopper penguins, and Campbell Island and Bounty Island shags (which is the world's rarest shag). Overall, the seabird fauna of the New Zealand subantarctic is described as globally significant, while these islands are also home to rare land birds – the world's rarest duck, the Campbell Island teal, and the recently discovered Campbell Island snipe are some of the 15 endemic land bird species found here.

The islands are also the home to some other endemic birds, such as the Campbell mollymawk, and are vital breeding bases for the white-capped and Salvins mollymawks, as well as for New Zealand fur seals, and southern right whales, which use shallow waters for winter breeding and calving.

Under the surface, notable endemic species include a bull kelp *Durvillaea* sp, other large kelps of the *Lessonia* family, and a brown seaweed *Marginariella parsonii* sp. nov. restricted to the Bounty and Antipodes Islands (the genus *Marginariella* is endemic to New Zealand).

The common intertidal invertebrates vary from island to island. Amongst invertebrates there is an endemic sub-species of paua, the whitefoot or virgin paua (*Haliotis virginea huttoni*), and a burrowing sea anemone – how many more unique species might be lurking in these inaccessible waters is almost anyone's guess.

While these special individual species are eye-catching, and demand special care, overall it is the uniqueness of the assemblages of different life-forms on and around these islands that is of most ecological significance. While we don't know much about exactly what species are found here, we know even less about the interactions between species in their particular habitats. Ongoing studies will help to increase our understanding of the community structure and species distributions, across all the diverse land and sea environments here.

Each of the… groups lays claim to a unique assemblage of fauna and flora. Seabirds and members of the seal family, the pinnipeds, dominate the fauna, and most of them are faithful to the islands where they breed. Once established, they do not usually stray to distant breeding groups as 'island-hopping' is inhibited by the extent of ocean between the groups. Diversity and endemism – the latter describing life forms found nowhere else – are recurring themes in this region, and when played together, the two themes conjure up one superlative after another.
—Neville Peat, *Subantarctic New Zealand: A Rare Heritage.* Department of Conservation, Invercargill, 2003.

The land birds indicate, through their diversity, just how long these islands have been isolated, both from mainland New Zealand and from each other. No fewer than 15 species are subantarctic endemics, with one species – the Campbell Island snipe – an astonishing discovery in recent times. One of the world's rarest ducks, the flightless Campbell Island teal, survives at the Campbell group… At the Antipodes, four endemic land birds include the Antipodes Island parakeet, which is often seen foraging in and around penguin colonies – an unusual association.
—Neville Peat, *Subantarctic New Zealand: A Rare Heritage.* Department of Conservation, Invercargill, 2003.

Land–sea connections: foraging areas

Different foraging areas are used by different species at different times. When lactating marine mammal females or nesting birds are rearing young, foraging can be limited to the sea close to the islands, while non-breeding or younger animals may search far and wide for an available food source.

Dietary samples collected at Campbell/Motu Ihupuku Island in the summer of 1997 indicated that southern blue whiting *Micromesistius australis* formed the bulk of the food of campbell-browed mollymawk *Thalassarche impavida* during the chick-rearing period. Satellite tracking showed that, when performing trips of short duration, adult mollymawks foraged within the 1000 m depth contour in the subantarctic zone north of Campbell/Motu Ihupuku Island. The feeding ecology of mollymawks suggests that juvenile southern blue whiting are pelagic and occur in dense schools in the top five metres of the water column over the Campbell Plateau during the summer months. The high reliance of birds on juvenile southern blue whiting during the chick rearing period has implications for the management of the southern blue whiting fishery and the conservation of campbell mollymawks and other marine predators occurring in the New Zealand subantarctic area. Therefore, any substantial reductions in the abundance of the fish stock in the future could pose adverse impacts on seabirds. Although southern blue whiting have very high recruitment variability the last three stock assessments indicate that the current biomass has been declining under recent catch levels.

Many marine mammal and seabirds leave the islands at the end of their breeding season and disperse widely across the ocean, but return to the same islands for the next breeding season. If the health of the southern ocean ecosystem is degraded or there are shifts in prey populations, foraging excursions may need to extend beyond known grounds. Behaviour alterations like these may reduce breeding success – if the adults have poor diet they may bear and rear less successfully, putting both young and adults at risk of disease and starvation. If a species is already endangered any localised catastrophe such as disease may in time lead to species extinctions or cause populations of marine mammals or birds to reach critically low levels.

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Land–sea connections: from the bottom up

Many subantarctic land-based animals and plants are dependent on the surrounding sea. They directly benefit from, and in some cases survive only because of, a close connection to the ocean, created through, oh so prosaically, the faeces and decaying matter of marine animals. This is no more apparent than at the Bounty Islands, where there is no soil, and virtually no plants above the tideline.

Every available rock of the Bounty Islands that is not regularly swept by the sea is covered in New Zealand fur seals and seabirds. Upwards of 21,500 fur seals inhabit the group, making the surrounding ocean a very important foraging area for the species. Seven breeding seabird species use the group, including the endemic Bounty Island shag, the world's rarest cormorant (estimated population 500–600). The Bounty Islands are also the main breeding ground of the Salvin's mollymawk and the Snares cape petrel, and are now the stronghold of the endemic erect-crested penguin (*Eudyptes sclateri*) following a rapid decline in the population at the Antipodes (its only other breeding area).

In the height of summer the Bounty Islands are a bustling, noisy breeding ground of animals from far and wide. The group provides the only available breeding site within hundreds of kilometres. Both the surrounding territorial sea (out to 12 nautical miles) and the wider New Zealand Exclusive Economic Zone (out to 200 nautical miles) provide essential foraging grounds for breeding and non-breeding species.

It is all these animals that make other kinds of life possible on these ocean-washed rocks. No soil has ever built up on the Bounty Islands, where the biggest storms wash right over the island tops, and only a few very small and localised plants are able to survive. However, the excrement and decaying matter of the islands' inhabitants provide an alternative to soil by way of a sludge that houses endemic insects and other invertebrates (animals without backbones) that would struggle to survive without a consistent nutrient input.

Such curious symbiotic relationships are not limited to the Bounty Islands. Nesting birds on the Antipodes and Campbell/Motu Ihupuku Islands also provide essential nutrients for plants that only exist in the vicinity of the breeding sites, while the endemic Antipodes Island Parakeet can often be seen in penguin colonies feeding on insects and waste products left over from breeding or moulting.

Connective relationships between the surrounding seas and marine and land-based species are complex and affect all forms of life. Although huge knowledge gaps still exist, one thing is certain – nothing can replace the importance of the islands and adjacent marine environments to the majority of species that have forged a tenuous existence in the New Zealand subantarctic region.

Southern Plateau Biological Marine Environment

In the seas above the southern plateau the overall volume of phytoplankton (the microscopic plants that form the main base of the marine food chain) and the primary production levels are relatively low. If phytoplankton increases then the biomass of nearly all other species also increases. Annual changes in this production can have large flow-on effects to the fish species and fisheries operating in this area. However, the overall efficiency of the southern plateau marine environment is high, supporting a highly productive marine ecosystem characterised by a huge abundance and diversity of animals at the top of the food chain, including fish, seabirds and marine mammals.

Scientists have discovered that the primary production in this region is limited not by the amount of phytoplankton nutrients such as nitrates, which are plentiful, but by the amount of iron available. Some of the reasons for this are the very low levels of dissolved iron in these waters and the effects of the availability of light and silicate.

The low primary production levels show up most clearly in the dominance of small forms amongst the phytoplankton. For example, bacteria make a large contribution to the total community biomass. The preponderance of smaller forms make the food web in this region relatively complex and long, and this implies that only a small fraction of the low phytoplankton production reaches the highest trophic levels of the large carnivores.

Although scientists expected this would mean the marine environment here would not be able to support many of the big critters at the top of the food chain, they have actually found that the system appears to be highly efficient. There are big populations of many different species of seabirds and marine mammals, and the area is a major fishing ground for commercially important species.

The 2004 NIWA report of the marine environments of the four island groups in this overall biological region (the Snares are considered to be part of a different biological region along with Stewart Island/Rakiura) found that the plant and animal life of each of the groups falls into three categories: a large group with strong links to mainland New Zealand species; a smaller group of species that occur all around the subantarctic; and a third group endemic to each of the island groups.

Generally in the shallow waters around these islands there are fewer fish overall, and fewer species, than around mainland New Zealand. It appears that the number of species declines with distance from the mainland and with island size. The most abundant fishes are notothens, which include the Maori chief and the small-scaled notothenid.

While the extensive NIWA report has provided the first comprehensive view of the marine environment in this region, it is expected that this picture will change as further information is collected. Recent sampling commissioned by the Department of Conservation will help increase our understanding of community structure and species distributions.

Seabird capital of the world

New Zealand's subantarctic islands are home to the most diverse community of seabirds in the southern ocean – more than 40 species breed here (some 10-15% of the world's seabird species) and over 120 species have been seen on or around the islands. Many of the seabirds breed nowhere else in New Zealand or the world, and no one island group supports all species.

Of the 20 species of albatross that breed in the Southern Hemisphere, New Zealand hosts 14, 11 of which breed in the wider subantarctic area.

Due to the large distances between land masses in the Southern Ocean, New Zealand's subantarctic islands are vital breeding grounds for these seabirds, and several species are found on only one of the island groups.

Campbell/Motu Ihupuku Island, with six breeding species of albatross and mollymawks, is outstanding among the world's albatross islands, second only to Crozet and Chatham Islands, which both host seven species. The most numerous is the annually breeding Campbell mollymawk *Thalassarche impavida*, previously known as the New Zealand black-browed mollymawk *Diomedea melanophrys impavida*; which is endemic to Campbell/Motu Ihupuku Island. The island also supports the main population of southern royal albatrosses *Diomedea epomophora*.

The strongholds for the Salvin's mollymawk *Thalassarche salvini* is the Bounty Islands.

Other breeding species that also nest at other islands in the southern ocean include large numbers of petrels, shearwaters, fulmars and prions utilise the islands especially the Antipodes Islands (and the Snares/Tini Heke).

The diet of 11 of the most common seabirds that breed in the region (Antipodean Diomedea antipodensis, Gibson's D. gibsoni, southern royal, Campbell, white-capped *Thalassarche steadi*, and Salvins albatrosses, sooty shearwaters *Puffinus griseus*, white-chinned *Procellaria aequinoctialis* and white-headed petrels *Pterodroma lessonii*, Antarctic prion *Pachyptila desolata banksi*, and erect-crested penguin) is thought to be composed mostly of squid, mesopelagic fish (living between 200 and 1,000 m) and macrozooplankton (krill).

Eleven species of penguin have been recorded on the islands. Three of these species are regular breeders. The Bounty Islands are the stronghold of the endemic erect-crested penguin *Eudyptes sclateri*, which breeds among the albatross. Erect-crested penguins also predominate over eastern rockhopper penguins *Eudyptes chrysocome* on the Antipodes Islands although the erect-crested penguin population on the island has undergone significant decline in recent decades, to about 50,000 nests in 1995, half the number counted in 1978.

The eastern rockhopper is the smallest of the crested penguin species and was formerly the most abundant, with millions of pairs nesting in the 1940s. This species has experienced an even greater decline in numbers, and now fewer than an estimated 60,000 pairs remain on Auckland/Motu Maha, Campbell/Motu Ihupuku and Antipodes Islands. The changes in the overall crested penguin populations may possibly be due to a decline in ocean productivity in the region as a result of rising sea temperatures.

The yellow-eyed penguin *Megadyptes antipodes* is among the world's most rare penguins, and may in fact be the rarest. It breeds on the Campbell/Motu Ihupuku and Auckland/Motu Maha Islands (as well as further north on Stewart Island/Rakiura and the South Island mainland). Campbell/Motu Ihupuku and Auckland/Motu Maha Islands are both extremely important breeding sites.

Stray king *Aptenodytes patagonicus*, royal *Eudyptes schlegeli*, gentoo *Pygoscelis papua* and chinstrap penguins regularly arrive as stragglers or to moult on the subantarctic islands but they do not breed there.

Campbell/Motu Ihupuku and Bounty Islands have endemic species of shags (*Leucocarbo campbelli* and *L. ranfurlyi*, the world's rarest cormorant).

The birds' foraging ranges from breeding areas are generally poorly known or in most cases unknown, but the foraging distribution from studies suggest that ranges are often likely to be large, and that the coastal and shelf areas are very important while they are feeding young chicks – for albatrosses, petrels and prions, shearwaters and penguins.

Many of New Zealand's subantarctic seabirds are considered under threat and are listed by the World Conservation Union (IUCN) and the Department of Conservation as such. These birds are exposed to a wide range of threats, the main ones being fisheries interactions including by-kill on long-lines and trawls and predation from introduced mammals. Long-term changes in the marine environment may have also triggered population declines in seabirds such as penguins and albatrosses. It appears that oceanic water temperatures have increased since the 1950s and that this may have altered the distribution and availability of food. Other potential threats include oil spills, increasing marine pollution, fire that destroys breeding habitats, and disease outbreaks.

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Seals and sea lions

There are four species of seal commonly found in the New Zealand subantarctic: the New Zealand fur seal, New Zealand (Hooker's) sea lion, southern elephant seal and leopard seal. The first three of these breed on the New Zealand subantarctic islands. The Antarctic and subantarctic fur seals are occasional visitors.

New Zealand fur seals *(Arctocephalus forsteri)*

New Zealand fur seals were almost completely exterminated in the subantarctics by sealers after reports by James Cook of their abundance. They were first taken in 1792, and by 1815 the boom was already over. At the peak of the sealskin trade, ships were returning with 80,000 to 100,000 skins, with the greatest slaughter taking place on the Bounty and Antipodes Islands. However, on Campbell Island 15,000 skins were taken in 1810, the year of discovery. Open hunting was closed in 1894, but licences were issued sporadically until 1946.

In 1931 only five fur seals were seen at the Bounty Islands, but this group now supports the largest breeding population of the species in the world. A survey in January 1994 estimated 21,500 animals (including pups and non-breeders but excluding temporary, non-breeding immigrants) were present. Over 50% of the islands' total surface area was used by the seals, which were found on all of the islands and islets, except for the most exposed wave-washed rocks. Compared with earlier estimates, the Bounty Islands population appears to be increasing, but at a slower rate.

The dominant prey for New Zealand fur seals varies somewhat according to locality, but is mainly squid, fish, and octopus. When the main spawning aggregations of southern blue whiting are located close to the Bounty Islands, as in 1994, fishing vessels operate within easy foraging range of the seal colony. The winter deepwater trawl fishery for southern blue whiting around the Bounty Islands has been responsible for the accidental drowning deaths of fur seals. This, and the possible restricted available breeding room, may be the reason for slowed population growth.

Since the 1950s, New Zealand fur seals have also slowly increased on the Antipodes Islands. Few, however, breed there. The rate of recovery in breeding on the Antipodes Islands (and at Macquarie Island in Australian waters) has been much slower than on other islands.

Although the Campbell/Motu Ihupuku Island coast provides ideal habitat for fur seals, no large rookeries are found on Campbell/Motu Ihupuku Island

New Zealand sea lion *(Phocarctos hookeri)*

The New Zealand sea lion is one of the rarest, most threatened and most highly localised of the five species of sea lion worldwide. They are classified as 'Vulnerable' by the IUCN and 'Threatened' under the New Zealand Marine Mammals Protection Act 1978. The sea lion, New Zealand's only endemic seal, is thought to have been hunted to extinction in the North Island shortly after Cook's arrival in the 1770s, and wiped out in the South Island soon after. By 1829, few remained anywhere. The species' present range is confined within a triangle bounded by the southern South Island, Campbell/Motu Ihupuku Island, and the Australian territory of Macquarie Island with the main population on the Auckland/Motu Maha Islands. The population is estimated to be around 11,900 animals. The New Zealand sea lion is a generalist feeding on prey from the intertidal zone over the continental shelf to waters deeper than 300 m.

Like the New Zealand fur seal, New Zealand sea lion are also caught accidentally in fishing operations. Over the past decade there has been incidental mortality of sea lions in the arrow squid trawl fishery which operates on the Auckland Island shelf between February and May each year. Uncertainty about impacts on the population has been heightened since 1997 due to three epidemics caused by bacterial infection.

Southern elephant seals *(Mirounga leonina)*

Southern elephant seals, once common throughout the New Zealand subantarctic, were also heavily exploited for their oil until the end of the nineteenth century. This is a circumpolar species with three separate stocks, one of which is centred on Australia's Macquarie Island and the New Zealand subantarctic islands. The largest groups occur on Macquarie, Kerguelen, and South Georgia Islands. Breeding colonies in New Zealand waters are restricted to Campbell/Motu Ihupuku and Antipodes Islands.

Breeding numbers on Campbell/Motu Ihupuku Island in the mid 1980s were down 97% on that of 1947, while the much larger Macquarie Island population, and other subantarctic stocks, have also experienced declines. The Antipodes Islands population appears, however, to be constant – the six or so breeding sites on the Antipodes producing about 100 pups per year. The southern elephant seal and New Zealand fur seal are the only native mammal breeding on the Antipodes Islands.

Outside the breeding and moulting periods, elephant seals spend their time at sea, roaming widely. Squid is probably their main food, with other foods including octopus and fish.

Leopard seals *(Hydrurga leptonyx)*

Leopard seals are regular visitors to all of New Zealand's subantarctic islands and are generally vagrants from around Antarctica. They mate at sea and do not form colonies. Leopard seals have a diverse diet ranging from krill, cephalopods and fish, penguins, fur and other seals, and juvenile elephant seals. They are the only seal to regularly eat warm-blooded prey.

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Cetaceans: toothed and baleen whales

Toothed whales in the Southern Hemisphere spend most of their summer south of 50°S and little is known of their migration patterns. Sperm whales, the largest and best known of the toothed whales, have been observed within North East Harbour and Perseverance Harbour on Campbell/Motu Ihupuku Island.

Among the baleen whales that migrate through the southern plateau waters are southern right whales, minke, blue, fin, sei, and humpback whales. These species are thought to breed in tropical, subtropical, or warm temperate waters in winter and feed in polar or cold temperate waters in summer, with spring and autumn migrations between the two regions.

Populations of southern right whale *Eubalaena australis* are now recovering from intense human exploitation in the nineteenth century and early twentieth century. They are found in the New Zealand subantarctics at the Auckland/Motu Maha and Campbell/Motu Ihupuku Islands, where they reside in shallow waters during the winter breeding and calving season. Port Ross on Auckland/Motu Maha Island is now the main Southwest Pacific breeding ground for this species. Humpback whales have also been sighted at Port Ross, and within Perseverance Harbour on Campbell/Motu Ihupuku Island.

Sources:

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Human history

Māori make the first contact

The principal iwi (Māori tribe) of Te Waipounamu (the South Island of New Zealand) and of Stewart Island/Rakiura is Kāi Tahu Whānui, known generally in New Zealand as Ngāi Tahu Whānui. Prior to the arrival of Ngāi Tahu this southern region had been occupied by several other iwi: Waitaha, Hāwea, Rapuwai and Ngāti Māmoe. Ngāi Tahu established their control of the takiwā (tribal area) by intermarriage, diplomacy and warfare with these earlier tribes, so that today Ngāi Tahu Whānui holds manawhenua in southern New Zealand.

Ngāi Tahu Whānui claims manawhenua for the southern islands including the subantarctic islands. This interest is based on the iwi's oral records, which recount fishing, hunting and other resource gathering expeditions that took place in the seas around the islands. Ngāi Tahu sealing and whaling gangs made frequent visits to Motu Maha (Auckland Islands) during the early 1800s. Ngāi Tahu Whānui has established the right of the iwi under the Treaty of Waitangi to a reasonable share of the sea fisheries for the rohe moana of the Ngāi Tahu whānui takiwā within the 200 nautical mile Exclusive Economic Zone (EEZ).

The Ngāi Tahu Claims Settlement Act 1998 acknowledges the special association of Ngāi Tahu with taonga species found in the Southern Ocean. These include hoiho (yellow-eyed penguin), titi (petrels), toroa (albatross), rimurapa (bull kelp), and marine mammals.

The Ngati Mutunga iwi and the Moriori people of the Chatham Islands claim historical links with the Auckland/Motu Maha Islands – known to these iwi as both Motu Maha and Maungahuka. This association is through an unsuccessful attempt to settle in the Port Ross area during the period 1842 to 1856.

As well as Maori accounts, there is also archaeological evidence of early human settlement in the Snares/Tini Heke and Auckland/Motu Maha Islands. Charcoal dated as at least 650 years old was found at Sandy Bay on Enderby Island, while artefacts and fish and bird bones have been taken from Enderby Island middens, and a pre-European adze has been found on the Snares/Tini Heke.

European interactions

The subantarctic islands have a European history extending over 200 years including the drawing of the first charts, sealing, whaling, scientific exploration, colonisation and settlement, farming, sailing shipwrecks, wartime coast-watching, research and meteorology. Although termed 'European', these early adventurers came from many parts of the world including America, the Australian colonies and there were Aborigines and many other ethnicities among them including Māori. All of these activities have left their mark and created evocative human stories, commonly characterised by hardship, perseverance and at times desperation and tragedy.

Most human activities in the islands have had the effect of modifying the land and/or marine ecosystems to some degree. With human presence came alien animals: rodents, rabbits, cats, pigs, sheep, goats and cattle. Settlement also involved some clearance of vegetation by fire and the sowing of introduced plants. The effects were largely limited to a few islands or parts of islands, although feral grazers and predators have extended the modification to all areas of the larger islands. Increasing commercial fishing in the surrounding ocean has been a more recent development.

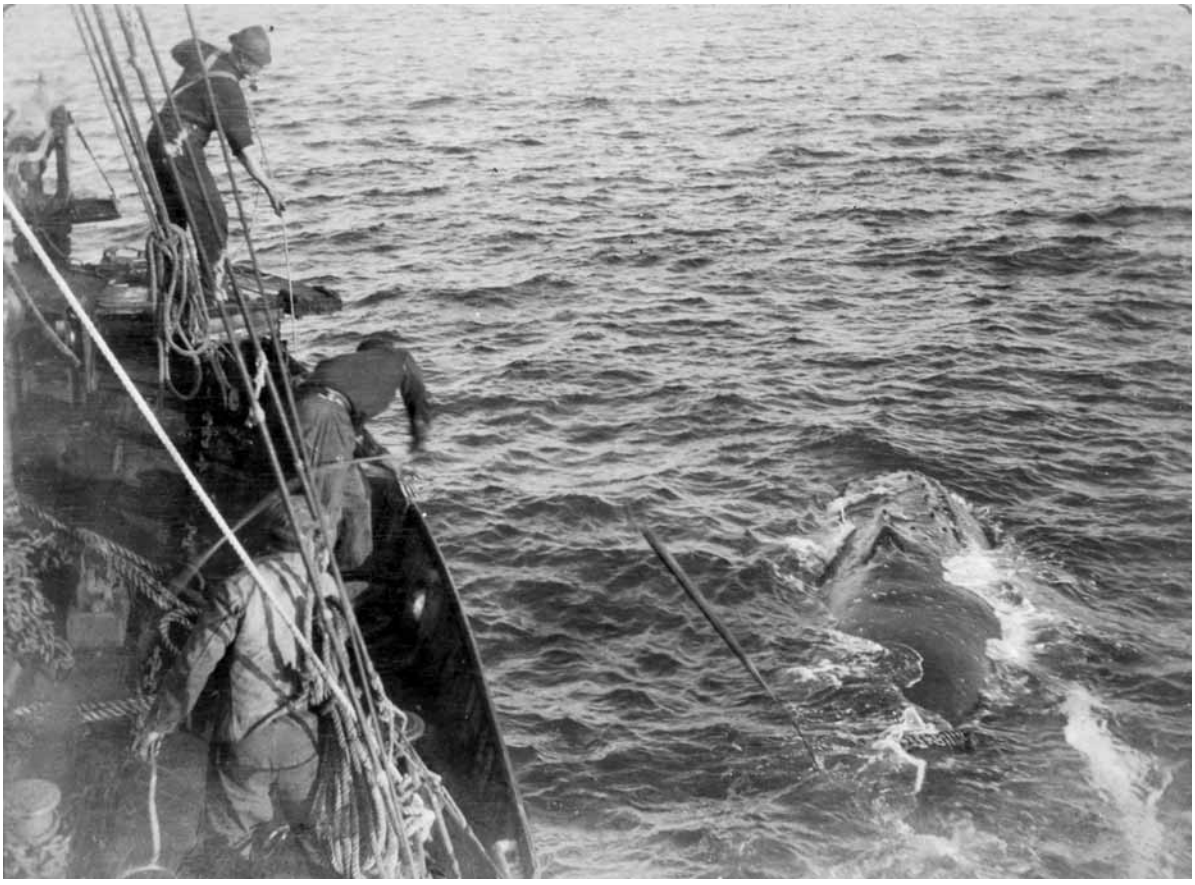
European discovery of the five island groups occurred over a period of 21 years, from 1788 to 1810. Following each discovery, there was a rush of sealers who all but exterminated the resident seal populations. Whalers followed later, with a similar impact on those species.

Shipwrecks were an unhappy feature of the sailing era. Nine known vessels were wrecked on the Auckland/Motu Maha Islands, with the loss of over 100 lives. These included the *Anjou* 1905, *Compadre* 1891, *Derry Castle* 1887, *Dundonald* 1907, *General Grant* 1866 (73 people perished), Grafton 1864, *Invercauld* 1864, *Marie Alice / Stoneleigh* 1895 and an unidentified wreck 1833. The *Perseverance* was wrecked at Campbell/Motu Ihupuku Island in 1828, and two ships (*President Felix Faure* 1908 and *Spirit of the Dawn* 1893) were lost on the Antipodes Islands. In more recent times, the *Totorore* was lost with skipper and one crewman in June 1999 – the 11 m yacht was due to pick up albatross researchers from the Antipodes Islands. How survivors eked out an existence in cold inhospitable conditions until rescued (in some cases more than two years later) are stories of remarkable human endurance, illustrated on the islands still by their relics and remains of the government-provided castaway depots. The apparently softer options of farming, shipwatching and weather recording also made for hard lives for sometime residents of these islands. Campbell/Motu Ihupuku Island, although the most southerly of all New Zealand's subantarctic islands, was the most hospitable to

farming – certainly more so than the Bounty Islands which were offered for pastoral lease at one point, regardless of their complete lack of soil. In the early twentieth century the farm near the head of Perseverance Harbour managed a wool clip of 131 bales, but eventually the isolation, climate and tenuous supply line led to its abandonment in 1931.

Perseverance Harbour was also the site of one of New Zealand's war-time coastwatching stations (the others were at Port Ross and Carnley Harbour in the Auckland/Motu Maha Islands) – staff on enemy sighting duty included a number of leading scientists, who were able to make good study of the two groups. The Tucker Cove base in Perseverance Harbour was maintained after the war as a permanently staffed weather station, until a new station was built at Beman Point. When the meteorological and other operations were automated in 1995, human occupation of the islands ended. Only moderate visits are made to the five island groups now, by Department of Conservation, tourists and researchers, and these are under strict conditions that aim to reduce human impact on the natural systems and species there.

See 'Issues' section for information about current human impacts and ways these are managed at present.



Protection and management

Land areas

The terrestrial environment of the New Zealand sub-antarctic island groups enjoys considerable protection. The Campbell/Motu Ihupuku Islands were declared a flora and fauna reserve in 1954. Similar action was taken for the Snares/Tini Heke, Antipodes and Bounty Islands during 1961. All the islands were then protected as a National Nature Reserve as defined by section 13 of the Reserves Act 1977. This is the highest level of protection possible under New Zealand law and is declared to protect values of national or international importance.

As reserves, the islands were administered by the Department of Lands and Survey, which was assisted by the Outlying Islands Reserves Committee. This committee was made up of representatives of 10 government agencies with an interest in management of the islands. It continued acting in an advisory role up until 1987 when the newly created Department of Conservation was charged with managing the islands. Management plans were prepared for each island reserve by the Department of Lands and Survey during the 1980s these have since been replaced by the Subantarctic Islands Conservation Management Strategy (1998–2008). The Department of Conservation has made many management visits to the islands for monitoring of tourist sites, research, historical surveys and pest management. A highlight was the eradication of Norway rats from Campbell Island in 2001.

The listing of the five island groups by the United Nations as a World Heritage Area in 1998 signifies recognition of the islands as having outstanding conservation and scientific significance. The listing conveys the highest possible international conservation status for these island groups, which contain some of the least modified oceanic island habitats anywhere in the world.

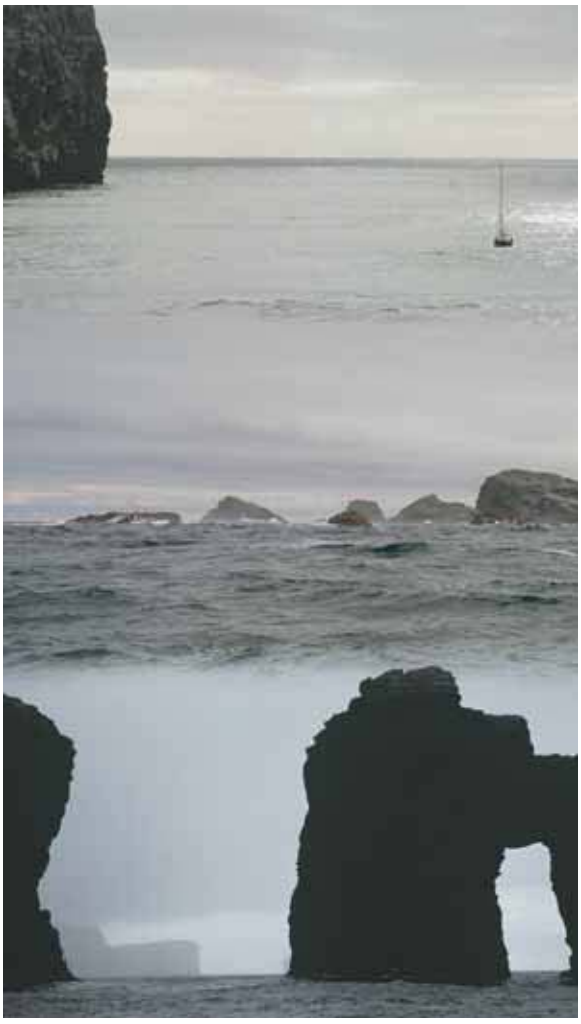
Marine areas

In January 2003 a marine reserve was created around the Auckland/Motu Maha Islands. This extends from the shore to the 12 nautical mile territorial boundary, and provides blanket protection for all life and habitats – no fish or other species can be taken by commercial or recreational fishers in the reserve area of 498,000ha. This Auckland Islands/Motu Maha Marine Reserve built on an earlier marine mammal sanctuary declared in 1993 to protect important breeding populations of the endangered endemic New Zealand sea lion and the endangered southern right whale in the inshore waters.

All marine mammals are protected by law in New Zealand waters under the Marine Mammals Protection Act 1978 and the Wildlife Act 1953, but there is also special protection for whales in the Southern Ocean. In 1994 the International Whaling Commission created the Southern Ocean Whale Sanctuary, which covers 11 million square miles south of latitude 40 degrees. There are, however, frequent breaches of the total restriction on whale harvest in this zone.

Conservation efforts also extend to seabirds, through an alliance of government, fishing industry and environmental groups, coordinated by the Department of Conservation. This programme, Southern Seabird Solutions, focuses on reducing the direct impacts of commercial fishing operations on deep sea birds. There is also research and action focused on reducing seal deaths in commercial fishing operations.

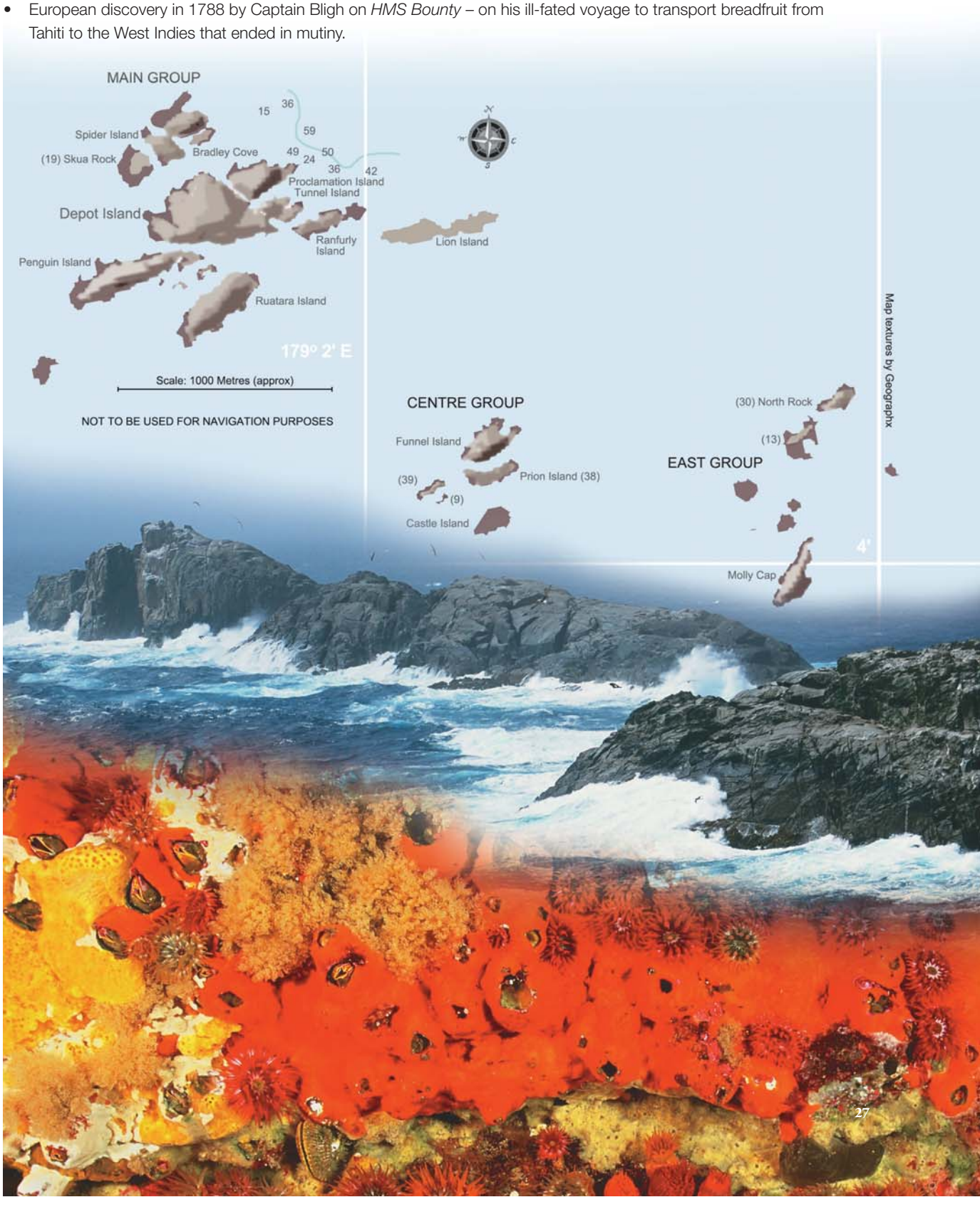
Otherwise, management and protection of the marine areas around the New Zealand subantarctic island groups is currently largely governed by fishing legislation. The purpose of the Fisheries Act 1996 is to provide for utilisation of fisheries resources whilst ensuring sustainability. The primary tool to ensure the sustainable utilisation of fish stocks is the Quota Management System (QMS) which was established in 1986. For most stocks in the QMS, a Total Allowable Catch (TAC) is set to regulate the amount of fish that can be extracted from the fishery.



Bounty Islands

IN BRIEF

- Twenty small islets and rocks, total area 135 ha, highest point 88 m above sea level.
- Bare and spray swept rocks of granitic composition, early Jurassic age. No soil, virtually no terrestrial vegetation. Entire coast exposed to ocean swell.
- Persistent westerly winds, annual rainfall 1,000 –1,500 mm.
- Latitude & longitude: 47°45'S 166°35'E.
- Distance from South Island: 700 km.
- European discovery in 1788 by Captain Bligh on *HMS Bounty* – on his ill-fated voyage to transport breadfruit from Tahiti to the West Indies that ended in mutiny.



The Bounty Islands are located 700 km to the east-southeast of mainland New Zealand; they are the most northerly New Zealand subantarctic islands.

The Bounty group is made up of 20 small islands in three distinct clusters (Main, Centre and East), with a total area of 135 ha. The largest, Depot Island, is 800 m long and reaches a maximum altitude of 88 m.

These specks of land are the only visible part of the underlying Bounty Platform. They are formed of the seabed rock, coarse granite thought to be of early Jurassic age, around 177–188 million years old.

The topography of the Bounty Islands ranges from smooth wave-battered platforms to high columnar jointed cliff faces and angular summit outcrops. There is no soil on the islands and plant life is limited to algae and lichens, and a couple of very small clumps of Cook's scurvy grass *Lepidium aff. oleraceum* which was discovered in 2005. The group is subjected to persistent westerly winds, which generate sizeable waves that in the most intense storms can cover the highest rocks with sea spray.

Living on these tiny islands are a number of interesting terrestrial invertebrates eking out their life in the harsh conditions including an endemic weta *Ischryoplectron isolatum*, a flightless beetle *Bountya insularis*, two spiders including *Pacificanna cockayni* which is endemic to the islands, and two endemic flightless moths *Reductoderces* sp and *Proterodesma turbotti*, both also found on the Antipodes Islands.

Seven seabird species breed on the islands. These islands are the strong hold for the Salvins mollymawk *Thalassarche salvini* with an estimate from the latest survey in 1997 of 30,750 pairs breeding on islets, and erect-crested penguins *Eudyptes sclateri* with about 28,000 pairs. There are an estimated 29,000 pairs of fulmar prion *Pachyptila crassirostris crassirostris* compared to an estimated 76,000 pairs in 1978 and an estimated 500-600 pairs of the endemic Bounty Island shag *Leucocarbo ranfurlyi* utilising these small islands. Also breeding on the islands are Snares Cape petrel *Daption capense australe*, Antarctic terns *Sterna vittata bethunei* and the southern black-backed gull *Larus dominicanus dominicanus*. Many bird species are only present on the islands during the summer breeding season.

In summer a generous layer of guano is formed from the many seabirds breeding here, but most of this is washed off during winter rains – hollows in the rocks then become filled with a nutrient-rich sludge of decaying organic matter from the breeding colonies and seaweed washed up by the often turbulent ocean. The higher rocks are coated in a polished pale layer of residual guano, enamelled to the surface.

Climate information is limited for the Bounty Islands and no consistent records exist; the mean annual temperature is estimated at 10°C. The weather is more often than not cloudy and bleak. Sea fog is common during the months of November and during autumn – this may be the result of cooling caused by cold subsurface water up-welling at the edge of the Bounty Platform.

The islands provide no safe anchorage and pose such difficulty landing that very few people have visited, let alone set foot on the islands. Safe access to the islands occurs one in every four days, making research opportunities difficult.

The Bounty Islands are free of introduced mammals.

Nowhere else on earth could one find islands more totally influenced by the surrounding sea than the Bounty Island… There is not a trace of vegetation, apart from the occasional green tinge of algae, on these barren worn outcrops in the ocean, no colours other than the grey of rock and sea and sky, the grey and white of circling and nesting mollymawks, the slate blue-grey of fulmar prions, the black and white of crested penguins and the dark brown of fur seals. Pungent smells of guano and sea and a cacophony of sound assault the senses: the plaintive staccato chorus of mollymawks, the abrupt screeching of penguins, and the incessant cooing and bickering of prions mingle with the rumbling and crash of the surf.
—Conon Fraser, *Beyond the Roaring Forties: New Zealand's Subantarctic Islands*. GP Publishing,

Marine description

The defining underwater features of the Bounty Island group are large, steep walls, boulders and highly pinnacled areas. The surrounding ocean is an extremely high energy marine environment: no sheltered areas exist around the group and every islet and rock is exposed to very heavy seas on a regular basis. Wave-based erosion is evident in the presence of platforms and stacks. The Bounty Islands have a narrow fringe of water less than 100 m deep, the remainder of the Territorial Sea is around 200 - 250 m deep.

While we have very limited knowledge of the biological marine environment around the Bounty Islands, a few expeditions over the last 30 years and recent marine expeditions to the group have given us a glimpse into the colourful world below the waves. We are beginning to build an underwater picture that is a dramatic contrast to the rather colourless features of the terrestrial environment, and which is populated by a remarkably diverse range of species. The water around the Bounty Islands is extremely clear and pristine; there is no permanent land-based runoff. Diving visibility has been measured upwards of 40 m.

A mosaic of plants and animals clings to the steep walls, while the niche habitats of cracks and small caves, where the constant surge of the ocean is unable to reach, are bursting with fragile forms of life that would not survive on the majority of available surfaces.

The animal life is a mixture of sessile (stationary) and motile (mobile) invertebrates. Sessile invertebrates such as barnacles, sponges and anemones coat the rock walls and boulders, with no space being completely devoid of life. There are large areas of barnacles in the intertidal and subtidal zones (from the high-tide line down to 12 m below the surface of the waves). Growing on and interspersed between these barnacles is a huge variety of animals, including sponges, ascidians, bryozoans, hydrozoans, and anemones. Mobile invertebrates are also common, with chitons, gastropods (including the subantarctic endemic species of whitefoot or virgin paua, *Haliotis virginea huttoni)*, starfish and crabs crawling over the rock surfaces.

At least 33 species of seaweeds have been described from the Bounty Islands; six (18%) of those are endemic to this island group. Due to limited sampling, it is likely this figure is an underestimate. The shoreline is covered in a thick forest of bull kelp *Durvillaea antarctica* that provides some protection from large predators for the playful New Zealand fur seal pups.

Sponge gardens appear in highly bouldered areas between the islands to depths of 60 m. The surrounding ocean is rich in plankton with swarms of euphausiids (krill) being most abundant during the night. The water column is festooned with jellyfish and salps.

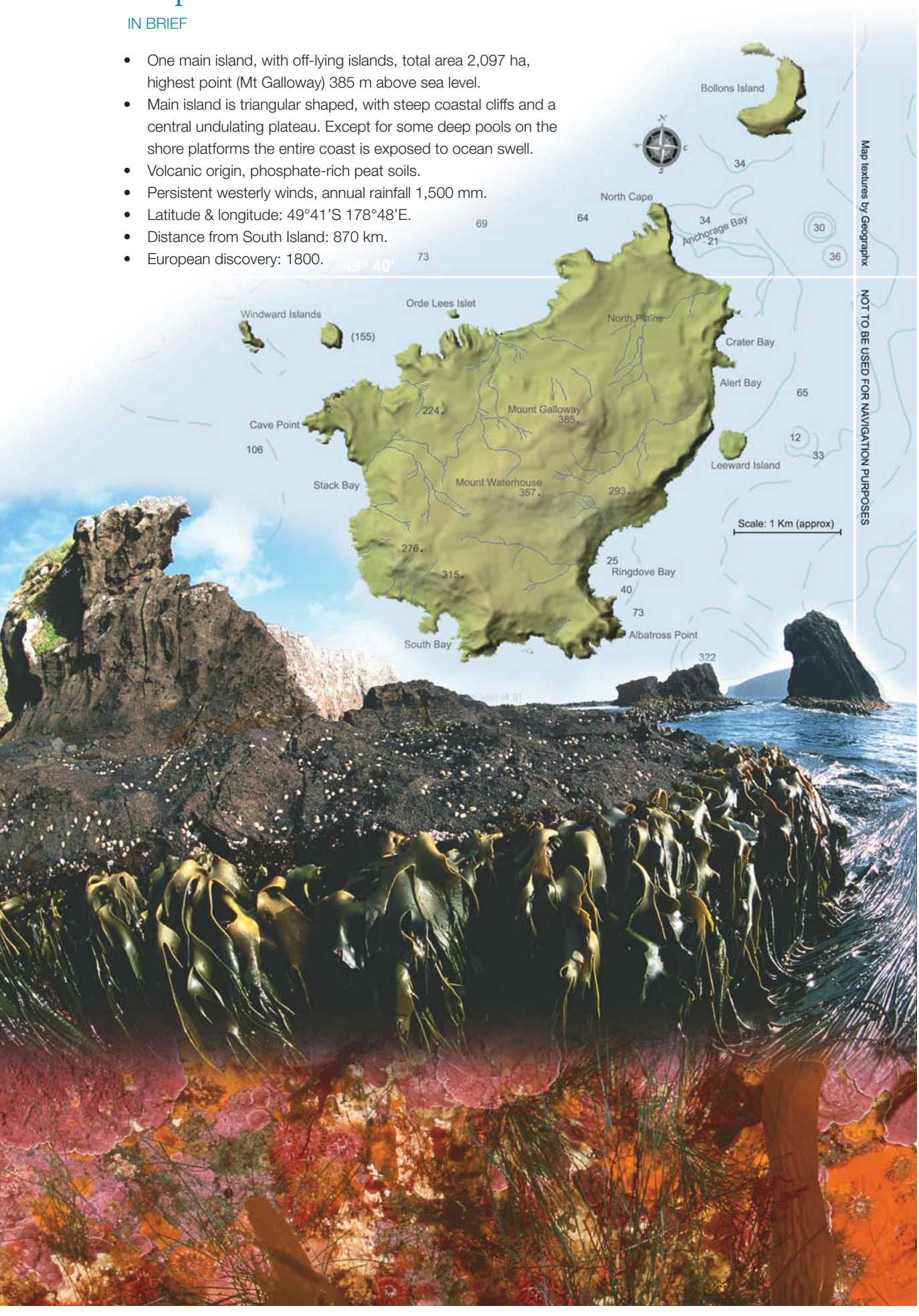
All life on the Bounty Islands group is directly or indirectly dependent on the surrounding ocean for survival.

In the absence of terrestrial plants, the Bounty Island shag uses an endemic brown seaweed to construct its nests. This is *Marginariella parsonsii* sp. nov. which grows down to a depths of 15 m. The land-based invertebrates survive on the sludge created by excrement, decaying animals and rotting seaweed in much the same way as others elsewhere would use soil.

Antipodes Islands

IN BRIEF

- One main island, with off-lying islands, total area 2,097 ha, highest point (Mt Galloway) 385 m above sea level.
- Main island is triangular shaped, with steep coastal cliffs and a central undulating plateau. Except for some deep pools on the shore platforms the entire coast is exposed to ocean swell.
- Volcanic origin, phosphate-rich peat soils.
- Persistent westerly winds, annual rainfall 1,500 mm.
- Latitude & longitude: 49°41'S 178°48'E.
- Distance from South Island: 870 km.
- European discovery: 1800.



The Antipodes Islands are situated 870 km southeast of the South Island; they are the most remote of all the New Zealand subantarctic islands.

The Antipodes group lies on the eastern margin of the Bounty Platform. They are the remains of a Pleistocene volcano – the rocks formed are the youngest of all in the New Zealand subantarctic region with some areas being less than a million years old. The main island is dominated by a central cone built on older layers of volcanic ash and breccia. Basalt boulders and columns are common around the island.

Within the 12 nautical mile radius of the island group there are numerous pinnacles of small remnant volcanic cones forming significant seamount structures southwest of the island.

Persistent westerly winds, often gale force in strength, sweep over the islands on a regular basis. Overcast conditions, drizzle and fog are common. Annual rainfall is 1,000–1,500 mm. The annual mean air temperature is estimated at around 8°C.

The coastal island flora is dominated by dense tussock grasslands of *Poa litorosa*, up to 1.5 m high. There is no forest cover.

The islands are the main breeding grounds for the endemic Antipodean albatross *Diomedea antipodensis* (about 5,000 breeding pairs). There are large colonies of eastern rockhopper and erect-crested penguins. Comparisons of photographs taken in 1978 and 1995 at Antipodes Island show a contraction in erect-crested penguin colony areas at some sites. These indicate that the erect-crested penguin population has declined substantially in the past 20 years. Sea temperature warming may be a factor in the decline. Other breeding seabirds include black-browed mollymawk *Thalassarche melanophrys,* light-mantled sooty albatross *Phoebetria palpebrata*, and white-capped mollymawk *Thalassarche steadi*, grey petrel *Procellaria cinerea,* white-chinned petrel *Procellaria aequinoctialis aequinoctialis,* soft-plumaged petrel *Pterodroma mollis mollis* (the species breeds only on Antipodes Island in the New Zealand region), and white-headed petrel *Pterodroma lessonii*, subantarctic little shearwater *Puffinus assimilis elegans*, subantarctic diving petrel *Pelecanoides urinatrix exsul* and black-bellied storm petrel *Fregetta tropica tropica*. This group is also home to two endemic species of parakeet (Antipodes Island parakeet *Cyanoramphus unicolor* and Reischek's parakeet *Cyanoramphus novaezelandeae hochstetteri).*

The main island has dark volcanic cliffs rising to an open, exposed plateau of tussock and fern, dotted with the isolated nests of wandering albatrosses. The second-largest island, Bollons, and adjacent Archway Island, make up two thirds of the rim of a once perfect volcano, now partially destroyed by the sea. The Windward Islands have their bases pierced by high, narrow caves, so that they seem rooted to the sea floor by powerful splayed fingers of rock. Night falls, with the lonely cry of the sooty albatross and the mocking laughter of parakeets giving way to the moaning, mewing, and crooning of vast numbers of petrels and prions returning to their burrows from the ocean.
—Conon Fraser, *Beyond the Roaring Forties: New Zealand's Subantarctic Islands.* GP Publishing,

Marine description

The coastline of the Antipodes group is made up of steep-sided islands and stacks. Boulder beaches are found in some areas, and there are a number of large caves scattered around the island. Sheer cliffs rise up to 150 m from the ocean floor and tower above the surface with wave platforms cut out of the rock in a few areas. The island is battered by ocean swells on a regular basis – no areas are safe from the ravages of the sea.

The crystal clear oceanic water has an average temperature of between 7–11°C, and surface salinity of 34.5 parts per thousand. To the south of the group the ocean floor drops away abruptly to around 3,000 m deep – this is within the 12 nautical mile territorial boundary. These attributes create a varied and diverse range of habitats for marine flora and flora.

Although very limited scientific work has been carried out around the islands, due to their remoteness and arduous working conditions, it appears that the waters around this group support a high level of species diversity. Recent subtidal surveys indicate that species diversity in some areas around the islands may be the richest of all the New Zealand subantarctic islands. Further analysis of the research undertaken will provide a better picture of diversity and abundance patterns.

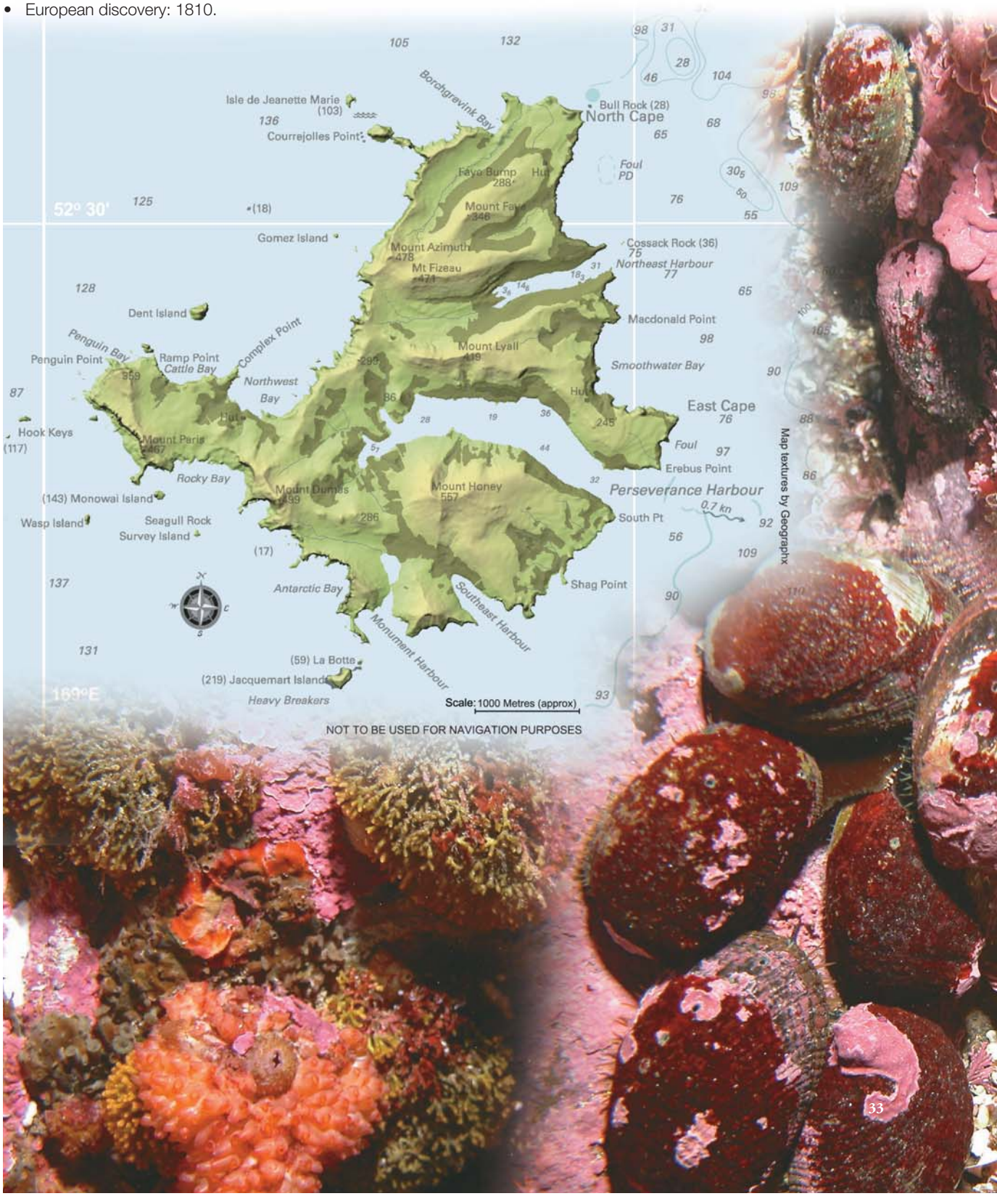
The marine environment of the Antipodes Islands supports a diverse range of sessile marine invertebrates: ascidians, sponges, anemones, bryozoans, octocorals, and hydrozoans all compete for space on crowded rock walls. Virgin paua (*Haliotis virginea huttoni)* are present in large numbers, as well as many different gastropods and bivalves. Crabs cling to the rocks or hide in the cracks of the rock walls.

Of the 116 described seaweeds collected from the Antipodes group, 15 (13%) are endemic, including *Marginariella parsonsii* sp. nov. Algal species are most likely under-represented in these counts, and endemism at each island could well be understated due to limited collecting. A new endemic species of bull kelp *Durvillaea* sp. which has massive stipes and blades, grows at depths of 20 m, far beyond the range of the bull kelp that grows around the intertidal fringe of mainland New Zealand. The bladder kelp *Macrocystis pyrifera* grows in dense stands on rocks in the sheltered areas round the island. Many forms of coralline algae grow over submerged rocks in platters of pink – although these algae are found also on mainland New Zealand coasts, this large fragile plate-like form occurs only in the subantarctic islands.

Campbell/Motu Ihupuku Island

IN BRIEF

- One main island with several off-lying islets, total area 11,331 ha, highest point (Mt Honey) 557 m above sea level.
- Main island features steep cliffs, large inlets, hilly terrain, numerous streams. About 20% of the coastline is semi-sheltered.
- Remnant of dissected shield volcano, peaty soils.
- Persistent westerly winds, annual rainfall 1,500 mm.
- Latitude & longitude: 52°33'S 169°09'E.
- Distance from South Island: 660 km.
- European discovery: 1810.



Campbell/Motu Ihupuku Island is located 660 km south of the New Zealand mainland. The island is the southernmost of the New Zealand subantarctic islands, and is situated on the southern portion of the Campbell Plateau.

The island is the eroded remains of a shield volcano embedded on continental crust. It is around 6–11 million years old. Four fiord-like valleys are scattered around the eastern side of the island. There are large cliffs of basalt columns, and majestic cliffs featuring a sequence of sandstone, mudstone, conglomerate and limestone tower above Northwest Bay.

Campbell/Motu Ihupuku Island is surrounded by a narrow band of water less than 100 m deep while out to the Territorial Sea limit the shelf reaches depths of 200 m.

Campbell/Motu Ihupuku Island has the most consistent weather data of the entire subantarctic islands due to the meteorological station at the head of Perseverance Harbour – this was permanently staffed from the end of the second world war to 1995, and now is automated. The day-to-day weather on Campbell/Motu Ihupuku Island is most often cloudy and windy. Winds are at times hurricane strength with gusts over 50 knots (96 kph) on at least 100 days per year. When the wind blows with strength from the west it brings rain, hail and snow at any time of year. This is the coldest of the subantarctic islands, with an annual mean air temperature of around 7°C. Rain falls on 325 days of the year, and the average annual sunshine is only 650 hours.

The Campbell/Motu Ihupuku Island group has no true trees except for a single sitka spruce planted as a memorial in the early 1900s. The main vegetation is comprised of tussock grasslands associated with mega herbs, scrub or dwarf heath-like forests in areas with sufficient shelter (dominated by *Dracophyllum longifolium* and *Myrsine divaricata*), maritime cushion and turf communities, swamps, bogs and rushlands, and cushion fellfields.

The island hosts the only breeding colony of the endemic-breeding Campbell mollymawk *Thalassarche impavida* (estimated at 25,000 pairs in 1995–97, this species has recently been separated taxonomically from the very similar black-browed mollymawk *Thalassarche melanophrys*). During the breeding season (August to April) breeding birds forage mostly over the Campbell Plateau and along shelf areas off the east and west coast of the South Island. Campbell mollymawk declined rapidly during the 1970s to early 1980s, coinciding with a period of intensive long-line fishing for tuna in the region and high numbers of this species getting caught on lines. The population began to recover in the 1990s. Also breeding on the island group are southern royal albatross *Diomedea epomophora* (estimated to be around 8,000 pairs representing the bulk of world breeding population).

Campbell Island… is an island of pale, tussock-covered hills and craggy, rounded mountains; of often inaccessible penguin colonies at the base of steep volcanic cliffs, and of harbours and bays where huge elephant seals lie dozing in foul mud wallows in the tussock. Rare right whales gather in winter to mate in Northwest Bay, and Campbell is the world's major breeding ground of the majestic southern royal albatross. Like the wandering albatross, the royal nests in solitary state, and from a distance the white mushrooms of individual birds thinly dot the wide, rolling landscape.
—Conon Fraser, *Beyond the Roaring Forties: New Zealand's Subantarctic Islands.* GP Publishing, *Wellington, 1986.*

The only New Zealand breeding population of the grey-headed mollymawk *Thalassarche chrysostoma* (12,000 pairs) is at Campbell Island/Motu Ihupuku. This species has declined by 82–88% since the 1940s. The endemic Campbell Island shag *Leucocarbo campbelli* (estimated to have less than 1000 breeding pairs) disperse over adjacent seas generally within 10 km of the main island.

Breeding penguins include, eastern rockhopper *Eudyptes chrysocome filholi* and yellow-eyed penguins *Megadyptes antipodes*. Of note is the fact that the once massive eastern rockhopper penguin colony has declined by 94% since the 1940s, which has been attributed to a lack of food as a result of a southward shift of the nutrient-rich convergence zone or a decrease in primary productivity. Elephant seal and some of the other albatross population declines on the island have also been attributed to changes in food availability as a result of ocean warming.

New Zealand fur seal *Arctocephalus forsteri*, New Zealand sea lion *Phocarctos hookeri* and the southern elephant seal *Mirounga leonina* all breed on the islands although they their breeding populations are relatively small. Southern right whale *Eubalaena australis* frequent Campbell's inshore waters especially in winter.

Cattle, sheep and rats have been eradicated from Campbell/Motu Ihupuku Island, and cats apparently died out in the 1980s.

Marine description

Campbell/Motu Ihupuku Island appears to have the least diverse, but nevertheless still distinctive, coastal marine environments of all the subantarctic islands. Again there are large gaps in our knowledge of the area, due to the limited scientific work possible here, so this view may change with further research.

Campbell/Motu Ihupuku Island's coastal environment is made up of boulder beaches, a few sandy bays, steep rock walls, large jumbled rocks and high stacks dropping away beyond the tides. Shallow areas to the east of the island have a seabed of medium-grained sand. The heads of the harbours have intertidal mud flats.

A recent survey mission discovered, but could not examine in detail, a zone of basalt columns reaching to about 20 m below the surface; this was separate from the main island, about one kilometre off the north-eastern coast. This area possibly provides a ecological habitat with significant difference to the main island coast, given the variation in water currents. Annual water temperatures and salinity around Campbell/Motu Ihupuku Island are similar to the other New Zealand subantarctic island groups.

The different habitat types in this island's marine surroundings provide a wide range of surfaces for a number of invertebrates to exist. On the rock walls barnacles cling at the subtidal fringe and in deeper areas of the subtidal zone rock walls are coated with colourful sponges, ascidians, hydrozoans and bryozoans. Gastropods and crabs occur in large numbers in, on and under ledges and rocks. The crab *Jacquinotia edwardsi* is the largest crustacean – it has a carapace over 150 mm wide and is abundant around Campbell/Motu Ihupuku Islands from the deep water up to the intertidal zone. Mussels (such as blue mussel *Mytilus galloprovincialis* and the ribbed mussel *Aulacomya ater maoriana*) and a wide variety of other molluscs (including the subantarctic whelk genus *Pareuthria*) are scattered around the island. Virgin paua *Haliotis virginea huttoni* is the most conspicuous shellfish, with large congregations grazing on the abundant coralline algae – some of this pinkcoloured algae is growing in the spectacular unique plate-like forms.

To date, 93 species of seaweeds have been described in the Campbell/Motu Ihupuku Island environment. Eleven (12%) of these are endemic. Impressive forests of bladder kelp *Macrocystis pyrifera* and an undescribed *Lessonia brevifolia* dominate the subtidal zone along the shoreline in the more sheltered inlets – here the thick stands of bladder kelp grow to a depth of 20 m or more. The brown strapweed *Xiphophora* sp grows abundantly in the harbours. On the open coastline, where the shore is pounded by swells, bull kelp *Durvillaea antarctica* holds on in defiance.

Issues

Growing knowledge base

Although there is a large body of literature about the subantarctic region, the limited nature of our understanding and knowledge of New Zealand's biological marine environment is nowhere more marked than for the subantarctic. Because of its remoteness, vast and diverse nature, tempestuous weather and frequently great water depths, relatively few marine studies have taken place around these island groups. Species present are not well known, let alone the ecology and interactions of these species.

There has been consistent effort in scientific research in the New Zealand subantarctic, despite the difficulties set by the distance and climate. However, most of this work has been carried out above the tideline.

To move below the water surface increases the challenge of the work considerably: the distance from the mainland, the cold, the size of the consistent oceanic swell, the persistence of strong winds, and the sea's own inhabitants all set limits on what can even be attempted.

However, despite all the difficulties, serious attention is being paid to the New Zealand subantarctic marine environment, with marine ecosystem functioning and ocean mapping projects being undertaken by NIWA and nearshore underwater surveys being conducted in recent years, supported by the Department of Conservation. As this and future research is analysed, our picture of these extraordinary areas will become clearer, and can better inform our management decisions.

Managing human impacts

New Zealand's subantarctic region is one of the least modified areas of the world. But still there are human impacts here, some historic, some ongoing, and some possible in the future.

The land environments on the small islands themselves have been changed by the people that have been shipwrecked, visited and lived there (see 'Human history' section). This is now being reduced through careful management – pest populations are being eradicated, there are now no permanent settlements on the islands, and any short-term human visits are strictly controlled to reduce their impact and the risks of new pests being carried ashore.

At sea, the greatest impacts come from the economic activity of commercial fishing in the Southern Ocean. Other potential impacts include the introduction of new organisms and pollutants through boat movement in the area. There is also the background effect of sea temperature rise, the result of natural variation and human activity around the whole planet causing climate change.

The current management regime in the subantarctics aims to minimise current and future impacts of human activity, so the natural communities there, on land and in the sea, can continue to flourish. There are two main aspects to this: the Department of Conservation's management of the islands themselves and the limited aspects of the marine environment within its current ambit (marine mammals, and the marine reserve around the Auckland/Motu Maha Islands), and the Ministry of Fisheries management of the commercial fishery.

Potential risks or pressures

There are a number of real or potential risks and pressures - through human usage or natural processes – faced in the New Zealand subantarctic region. A selection of these are summarised in the following list, and a number are then outlined in more detail.

- impacts associated with extraction methods (eg mining and dredging)
- risks associated with petroleum and mineral exploration and development – future development of oil rigs, service vessels and other infrastructure would raise the potential for pollution including oil spills
- risks associated with seismic surveys
- impacts associated with fishing methods (eg bottom trawling, long-lining)
- development of new fisheries in subantarctic waters – sustainability and potential threats to the islands and marine environment would need to be assessed
- changes in genetic composition through targeted exploitation of the fisheries
- marine mammal by-catch
- seabird by-catch
- reduction of biodiversity through over-exploitation of the fisheries
- risk of damage to the islands or their surrounds through unauthorised landings, near-shore visits or shipwrecks
- alien species invasions or diseases
- further development of tourism ventures (eg introduction of limited tourism entry on to the Bounty and Antipodes Islands)
- visitor impacts to island biota and associated vessel risks
- disturbance to wildlife from aircraft operations over or near to the subantarctic Islands
- risks associated with shipping – fuel, oil spills and litter pollution
- light pollution from the use of deck lights
- scientific activities
- climate change
- cumulative impacts on ecosystems

Commercial fishing

There are several important established commercial fisheries around the subantarctic islands including trawling (particularly for southern blue whiting, hoki, squid and scampi) and long-lining (particularly for ling). These are largely conducted outside the 12 nautical mile limit of the Territorial Sea, however, there is potential for development of new fisheries such as spider crab in this area.

Two main types of long-lining take place in the New Zealand subantarctic, but one, ling long-lining, is by far the most important. Although a lot of tuna long-line fishing takes place in southern New Zealand waters, little occurs over the southern plateau itself, and virtually none close to the subantarctic islands.

Fishing can, and does, impact on individual components of, and eventually the whole, marine ecosystem of the region. The most evident impact is the other animals caught in the fishing gear: non-target commercial and non-commercial fish, seabirds and sea mammals – albatross and petrels take the baits strung behind fishing boats and drown, seals too get caught in long-lining (though rarely in ling operations), and birds, seals and sea lions can get trapped in trawling gear. Less obvious is the potential impact on food webs and structural damage to the seabed.

The Ministry of Fisheries has a legislative obligation under the Fisheries Act to provide for utilisation of fisheries resources whilst ensuring sustainability.

Most of New Zealand's major fisheries, approximately 600 stocks, are managed under the Quota Management System (QMS). The QMS is New Zealand's primary fisheries management tool and creates property rights that aim to promote efficiency of harvest, reduce fishing effort and incentives to overfish. The QMS also provides incentives for rights holders to ensure that fish stocks are managed sustainably. In addition, for most stocks within the QMS there is an obligation to set a Total Allowable Catch (TAC) that aims to maintain stocks at or above a level that can produce the maximum sustainable yield, having regard to the independence of stocks.

No trawling by vessels greater than 46 m can take place within the New Zealand 12 nautical mile Territorial Sea, although typically there are industrial sized vessels within this length restriction. In addition no foreign-flagged vessels can fish within New Zealand 12 nautical mile territorial sea.

The Fisheries Act 1996 allows for a Conservation Services Levy (CSL) to be charged to the fishing industry, to recover the costs of research related to the impact of commercial fishing operations. Levies are primarily used to boost observer coverage in selected fisheries, to monitor the status of protected species known to be incidentally taken in fishing operations (protected species by-catch), and to develop ways of mitigating the bycatch of species protected under the New Zealand Marine Mammals Protection Act 1978 and the Wildlife Act 1953. In addition, there is a limit set for the number of sea lions that can be killed in the squid fishery in this region in any one season – if the limit is reached, this fishery may be closed by the Minister of Fisheries.

Human visitors

Direct human contact is most likely these days through scientific expeditions, ecotourism, illegal landings and any shipping accidents. The largest potential effect of these is likely to be on the islands' land-based animals. These activities may also have potential impacts on the near-shore communities through the introduction of unwanted marine pests.

The number of applications to conduct research (mostly land-based) in the New Zealand subantarctic islands has risen considerably since 1995. Between 1987 and 1995, the number of research permits issued totalled about 60, while in 2002/03 alone 50 were issued.

The first tourist ship to visit the island groups in modern times was in 1968 – this was en route to the Ross Sea. Later the islands became a destination in themselves. Tourist vessels currently make up to 16 visits a season to the region, and sometimes a tour going to the Auckland and Campbell groups will also take in Macquarie Island. A few private motor yachts also bring visitors.

Strict rules apply to all types of visitors. Rules on where tourists can go, and how many are allowed at any one site on each island are based on the Conservation Management Strategy's assessment of vulnerability and other factors. All parties must have a permit, and be accompanied by a Department of Conservation representative. A limit of 600 visitors per season applies to three main sites, with no more than 150 visitors per day. Vulnerable small sites have been identified at the Auckland/Motu Maha and Campbell/Motu Ihupuku Islands, and these sites receive no more than 150 visitors per season and no more than 50 per day.

Landing without a permit (tourist or otherwise) is not permitted at the Bounty or Antipodes Islands, but inflatables from tour ships visit close to shore.

Because there is no continuous human presence at any of the New Zealand subantarctic islands, completely controlling, or even knowing about all illegal landings is almost impossible.

Exploration for new energy and mineral sources

The Campbell Plateau contains a number of potentially commercial sedimentary basins, the largest of which is the Great South Basin. This basin measures 450x250 km and extends as far south as 50°S. The Great South Basin lies beyond the modern shelf area in water depths greater than 500 m, with much of it beyond the shelter of the South Island and Stewart Island/Rakiura. Recent reinterpretation of the seismic and well data indicate that the Great South Basin still ranks favourably for further petroleum exploration prospects.

Hydrocarbon exploitation brings potential hazards to any marine environment. The petroleum exploration and production industry is recognised as maintaining a good environmental record and is strictly regulated. Current and proposed environmental controls include the Marine Protection Rules Part 200, the seismic activity code of practice, and an environmental accord between the industry and all government agencies that would apply to the entire Exclusive Economic Zone (EEZ).

While the environmental risk posed by petroleum and mineral exploration and development is low, the effects of a non-routine incident on the marine environment are potentially significant. Potential risks include accidental leakage and spillage, increased turbidity due to disturbance of bottom sediment during rig and/or pipeline positioning and decommissioning, disposal of drill cuttings and fluids, and discharge of liquid and solid waste. Noise from seismic surveys in particular has the potential to disturb marine animals. Acoustic disturbance to marine mammals is a key concern. The frequency range of hearing sensitivity varies significantly with marine mammal species. Particular concern is afforded to baleen whales during seismic surveys as the frequencies over which they communicate overlap directly with acoustic profiles of the surveys. Sperm whales and beaked whales may also be vulnerable to high energy seismic pulses as they are deep divers and are already physiologically compensating for predictable pressure changes at these depths. Seal species are thought to be relatively tolerant of, or able to habituate to, seismic disturbance; however, research is scant in this area.

Mining for minerals has impacts on the marine environment, which include plumes of lost material as the sediments are mined, destruction of habitat of many sessile species in the path of the collector and as a result of the resettling of the sediment plume, and the potential release of heavy metals. The main tools used are dredges, free-fall grabs and wirebound samplers. Although mining would have significant impacts, the economic viability of any such venture is still largely uncertain. It is also unclear if any would occur within

the 12 nautical mile territorial limit of the islands. Thus commercial mining may be a long way off from the New Zealand subantarctic islands immediate surrounds.

Bio-invasion

The subantarctic islands are considered a pristine high value marine area, and any introduction of marine pests there is a very real concern. At the present time no known pest species have been introduced to the islands' surrounds but it is clear that their establishment there is definitely possible. However, very little survey work has been undertaken to establish certainty.

The islands are subject to visits by a wide range of vessel types that have originated from international or national ports. Little is known about what these vessels are carrying on their hulls, or in inner pipes or ballast water. When combined with recent changes in climate and the growing number of vessel movements the likelihood of alien species establishing in the subantarctic region is increasing.

Given the islands' delicate ecosystems and distance from the mainland, control or eradication of any invasive species would be very difficult and may be almost impossible. Marine pest introductions could have severe and permanent impacts on the subantarctic coastal marine environment.

Marine pests

Exotic organisms are most likely to arrive in the New Zealand marine environment through hull fouling, sea-chests and discharge of ballast water. New Zealand receives over 2,500 international ship visits each year at more than 20 ports; the annual foreign ballast water discharge in New Zealand is estimated at 6 million tonnes. Other possible vectors for introductions include flotsam, fishing equipment, aquarium material, animals such as turtles, and deliberate introductions.

The potential donor region for New Zealand covers a large geographic area and therefore contains numerous marine species. Over 600 species have been identified as potential bioinvaders to New Zealand.

To date, an estimated 148 organisms have been introduced accidentally into New Zealand waters – 70% probably arriving as hull fouling. Such species can displace native species and change habitats and ecosystems, with flow-on effects to recreational and commercial activities. They are most likely to arrive in busy ports and marinas and are easily spread to nearby communities.

See the 'Who is involved' section for more information about Biosecurity New Zealand – the lead government agency managing potential risks from exotic organisms introduced to the New Zealand environment.

Bio-invasion case study: *Undaria seaweed*

A major threat to the inshore marine ecosystems in the subantarctic is the introduction of foreign marine species such as the invasive large brown seaweed *Undaria pinnatifida*. This laminarian kelp, a native of the north-west Pacific, was introduced to New Zealand during the 1980's and has spread from Stewart Island/Rakiura to Auckland/Motu Maha since its discovery in Wellington. Undaria was probably transported to New Zealand in ballast water originating from Australia or Japan. Undaria can occur in dense stands, shading everything living underneath. It can occupy shores of varying exposure, with a wide vertical distribution from low tide level to up to 18m deep. If Undaria establishes in the subantarctic islands it will most likely have a devastating effect and will be very difficult to eradicate.

The Cawthron Institute and the National Institute of Water and Atmospheric Research (NIWA) have been involved in research on Undaria, and the Department of Conservation and Biosecurity New Zealand are trying to prevent the spread of Undaria to Fiordland and the subantarctic islands by the inspection of vessel hulls.

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See also: Biosecurity New Zealand website: www.biosecurity.govt.nz and Maritime New Zealand website: www.maritimenz.govt.nz

Shipping

The main potential threats posed by shipping traffic are various forms of pollution and disturbance of marine mammals and seabirds. The types of pollution that may originate from shipping include physical (flotsam and jetsam), light, sound, and chemical (fuel spills or bilge discharge). Floating debris is a major hazard for marine mammals and seabirds that may be attracted to it and become entangled. While foraging or migrating in open waters, marine mammals and seabirds are susceptible to disturbance from the sound and light of vessels, and are at risk of colliding with vessels, particularly where the vessel sound and light attracts the animals. Oil spills may cause widespread deaths in marine animals, and damage critical habitats on a large scale. The negative impacts of large-scale oil spills on the marine environment can be extensive, long term, and sometimes irreversible. The remoteness of the subantarctic means that there is limited capacity to combat pollution of the sea by oil and other noxious and hazardous substances.

Oil directly affects seabirds by coating the plumage and reducing water-proofing properties of the feathers. Also, as birds preen the oiled plumage, residues are ingested and these affect metabolism. Oil is discharged at sea in a number of ways but waste engine oil is a regular contributor. The worst impacts from oil spillage result from shipwrecks, particularly of oil-carrying tankers. There are many different types of oil that are both transported by sea and used onboard vessels. Those most likely to be spilled in New Zealand are heavy fuel oil, light fuel oil, marine diesel, petrol, and crude oil. Albatrosses also ingest plastics.

What now?

Who is involved?

Many different groups have a stake in New Zealand's coastal and marine environment, including local communities, indigenous groups, the general New Zealand public, various industries (particularly fishing, shipping, tourism, and mineral extraction industries), government agencies, environmental and non-governmental agencies, and national and international scientific and conservation bodies.

Responsibilities for the management of our coastal and marine environment are shared between a range of central and local government agencies. Some significant agencies and responsibilities are outlined here.

Department of Conservation

Responsible for managing protected areas and species, under the Wildlife Act 1953, Marine Reserves Act 1971, Reserves Act 1977, Marine Mammal Protection Act 1978, and Conservation Act 1987.

The Department of Conservation also manages coastal resources (excluding fishing and many significant fishing impacts) under the Resource Management Act 1991 (RMA). The subantarctic islands are a special case where the Resource Management Act 1991 gives the Minister of Conservation the powers, functions and duties of both Regional and District Councils under the RMA, as they pertain to the subantarctic islands (s31A RMA).The RMA can provide a means of achieving protection, within the principles of sustainable management. For this to happen a coastal plan would need to be in place in particular to manage surface water activities. At present no coastal plan exists for the coastal marine area surrounding the five subantarctic islands. The Minister of Conservation is also responsible for both the RMA consent process and the access arrangement for minerals activities under s61 of the Crown Minerals Act 1991 in both the islands themselves, and the coastal marine areas of the Kermadec, Snares/Tini Heke, Bounty, Antipodes, Auckland/Motu Maha and Campbell/Motu Ihupuku Islands, and the islands adjacent to Campbell/Motu Ihupuku Island.

Ministry of Fisheries

Responsible for managing fishing and fishing impacts, and fisheries resources under the Fisheries Acts, whose jurisdiction extends out to 200 nautical miles – the edge of our Exclusive Economic Zone (EEZ).

Biosecurity New Zealand, part of the Ministry of Agriculture and Forestry

Responsible for minimising the risks posed by vessels accidentally transporting exotic, marine life into or around New Zealand waters. This is achieved under the Biosecurity Act 1993.

Maritime New Zealand

Maritime New Zealand has overall responsibility for responding to major marine oil spill incidents, maintaining a nationwide level of oil spill preparedness, and for dealing with cost recovery and prosecution.

Potential protection tools – a coordinated approach

Different tools used for the protection of marine biodiversity are governed by different legislative criteria and processes and are administered by different agencies. There is considerable scope for using a combination of management tools to achieve biodiversity outcomes. Tools that could be used in the territorial seas surrounding the subantarctic islands include:

- Fisheries Act 1996.
- Marine Mammal Protection Act 1978.
- Marine Reserves Act 1971.
- Resource Management Act 1991.
- Special Legislation.
- Wildlife Act 1953.

Table 1: Table of the various tools and the protection they may afford

Purpose	Full protection	Targeted protection and management		Variable protection
	←			→
Primary uses	Non-extractive activities, such as ecotourism and research	Specific activities, limited for biodiversity protection	Mixture of protection of particular uses and particular qualities	Mixture of uses, extractive and commercial
Purpose	Full protection of primarily natural areas because of particular features or habitat and biodiversity characteristics	Protection of particular species and components of biodiversity	Safeguarding multiple interests in the use and protection of a particular area	Managing resource use and managing nonextractive use
Tools	• Marine reserves • Special legislation	• Marine mammal sanctuaries • Restrictions on Wildlife refuges and sanctuaries • Special legislation	• Marine Parks • Regional Coastal Plans • Restrictions on fishing	• Regional Coastal Plans • Controls on: transport, pollution, mineral and hydrocarbon extraction, fishing (TACs and TACCs), mineral extraction

What next

The Department of Conservation and the Ministry of Fisheries are committed to consulting in a way that is fair and open to all stakeholders and members of the community.

The Department of Conservation and Ministry of Fisheries consider it is important to maintain stakeholder and expert engagement in both the development and implementation of marine protection for this region. Collaboration across various boundaries of agency jurisdiction will also be essential. This ongoing input will help to ensure that protection reflects up-to-date knowledge and the changing needs of those with a stake in the region.

A summary of this planning process will be made available through the department's website (www.doc.govt.nz). The website will also contain updates on how people can input into the process as it further develops.

At all stages of the process you can find out more by contacting the Department of Conservation or Ministry of Fisheries. Staff will be available for consultation, advice and to answer questions.

The next steps of consultation

ONE: Following the release of this document a Subantarctic Islands Marine Protected Area Planning Forum will be established to identify sites and potential tools for area based protection of biodiversity. The stakeholders represented on the forum will include tangata whenua, fishing industry interests, tourism interests and environmental NGOs. Technical expertise will also be critical to the development of marine protection proposals for these subantarctic islands. At the conclusion of the Forum process the Forum will provide a report of recommended marine protected area proposals to the Ministers of Conservation and Fisheries for their consideration.

TWO: After the Ministers have considered the report, a decision will be made whether or not to progress marine protection proposals for the New Zealand subantarctic islands. If it is decided to progress marine protection proposals, there will be opportunities for the wider community to have their say during the statutory processes for each marine protected area.

Further information

www.biodiversity.govt.nz *Biodiversity New Zealand*
Information on marine biodiversity and the Government's approach to maintaining and recovering our marine biodiversity.

www.doc.govt.nz *Department of Conservation*
Information about the subantarctic islands, the Marine Protected Areas policy and other aspects of marine protection.

www.fish.govt.nz *Ministry of Fisheries*
Information on conserving, using, enhancing and developing New Zealand's fisheries resources.

www.maritimenz.govt.nz *Maritime New Zealand*
Information about maritime safety and environmental protection standards, prevention and response to marine oil pollution incidents in New Zealand waters.

www.mfe.govt.nz *Ministry for the Environment*
Information on local authority initiatives in water quality and land use practices, and information on the development of a New Zealand Oceans Policy.

www.biosecurity.govt.nz *Biosecurity New Zealand*
Information on minimising the risks posed by vessels accidentally transporting exotic, marine life into or around New Zealand waters.

Videos and films:

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Beyond the Roaring Forties (45 min) National Film Unit, Wellington, 1986.

Island of strange noises (30 min) Television New Zealand, Natural History Unit, Dunedin, 1984.

No Place for People (45 min) South Coast Video, Riverton, 1996.

Sea Lion Summer (24 min) Television New Zealand Natural History Unit, Dunedin, 1981.

The Lost Whales (50 min) Television New Zealand Natural History Unit, Dunedin, 1997.

Wild South. Islands in the storm (53 min) Television New Zealand Natural History Unit, Dunedin, 1995.

Wild South. Whale out my window (52 min) Television New Zealand Natural History Unit, Dunedin, 1996.

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Glossary

Albatross: Albatrosses are the world's largest seabirds. The smaller Thalassarche albatrosses are referred to throughout this report as mollymawks.

Ascidians: A group of animals that includes sea squirts. Their name alludes to their sac-like body (from the Greek for wine flask).

Benthic: Dwelling on or associated with the seabed. Benthic organisms live on or in the seabed.

Biogeographic region: An area that is defined according to patterns of ecological and physical characteristics in the seascape. Biogeographic regions will form the basis of marine protected area nearshore planning.

Biological diversity (biodiversity): The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Convention on Biological Diversity).

Biomass: The amount of a group of organisms present in the system at any one time, expressed as the weight of carbon per unit area of water column or as weight per unit volume of water.

Bryozoans: Colonial invertebrates that resemble moss clumps, small corals and small seaweeds.

Coralline algae: calcareous, stony or coral-like red algae typically appearing pink in colour.

Demersal: occurring near the seabed. Demersal organisms live near, but not on, the seabed, and usually feed on benthic organisms.

Ecological (ecosystem) diversity: The variety of ecosystem types (for example, forests, deserts, grasslands, streams, lakes, wetlands and oceans) and their biological communities that interact with one another and their non-living environments.

Ecosystem: An interacting system of living and non-living parts such as sunlight, air, water, minerals and nutrients. Ecosystems can be small and short-lived, such as water-filled tree holes or rotting logs on a forest floor, or large and long-lived, such as forests or lakes.

Exclusive economic zone (EEZ): The EEZ includes the area lying between 12 and 200 nautical miles from New Zealand's coast.

Euphausiids: Shrimp like crustaceans / krill - see zooplankton.

Gastropods: A large class of molluscs that includes snails, slugs, limpets and paua. Most of the living forms have a shell with a simple valve, which is often coiled, though this is reduced or lost in some groups (eg nudibranchs).

Genetic diversity: The variability in the genetic make up among individuals within a single species. In more technical terms, it is the genetic differences among populations of a single species and those among individuals within a population.

Guano: The accumulated droppings / excrement of sea birds. It is rich in phosphates and ammonia.

Habitat: The place or type of area in which an organism naturally occurs.

Holdfast: The organ that attaches algae to a reef. Holdfasts vary from single cells to large complex structures in kelps, and to large discs in bull kelp.

Hydrozoans: Are simple and compound polyps and jellyfishes including stinging corals and Portuguese man of war.

Invertebrates: An animal lacking a backbone (eg sponges, corals, worms, insects, snails and starfish).

Macrozooplankton: Larger planktonic forms such as krill or shrimps krill – see zooplankton.

Management tools: Management tools are mechanisms that, directly or incidentally, establish a protected site and/or manage threats to the maintenance and or recovery of the site's biodiversity at the habitat or ecosystem level. Direct management tools can therefore include marine reserves, fisheries restrictions, and mechanisms to reduce adverse impacts of land-based activities or shipping. Incidental management tools could include cable protection zones or marine mammal sanctuaries.

Mesopelagic: Associated with open water between 200 and 1,000m in depth – see pelagic.

Mollymawk: Term used to refer to the smaller Thalassarche albatrosses.

Octocorals: Related to sea anemones and jellyfish these are animals that always have eight tentacles. Although they are commonly called "soft corals" they are not close relatives of the "true corals". They include the sea pens, sea fans and gorgonians.

Pelagic: Associated with open water. Pelagic organisms live in the open sea, away from the seabed.

Phytoplankton: The microscopic plants and organisms that float and drift at different levels in the ocean forming the main base of the marine food chain.

Primary production: Primary production is the production of organic compounds from inorganic materials principally through the process of photosynthesis (though chemosynthesis also plays a role). The organisms responsible for primary production are known as primary producers, and form the base of the food chain.

Salps: Transparent primitive ancestors of vertebrates, that may be barrel-shaped individuals or tubular colonies composed of many separate animals.

Sedentary: Animals that live attached to the substratum but are capable of limited movement, eg sea anemones.

Sessile: Fixed, not mobile. Sessile animals include barnacles and coral.

Species diversity: The variety of species – whether wild or domesticated – within a particular geographical area. A species is a group of organisms, which have evolved distinct inheritable features and occupy a unique geographic area. Species are usually unable to interbreed naturally with other species due to such factors as genetic divergence, different behaviour and biological needs, and separate geographic location.

Stipe: The stalk that keeps the fronds of large brown algae off the reef, particularly noticeable in common kelp and bull kelp.

Subantarctic Water: Waters south of the Subtropical Front, which are cooler and have a lower salinity than Subtropical Waters to the north.

Zooplankton: Small animals that drift in the ocean. They range in size from a fraction of a millimetre to large jellyfish that can be metres in length.

— many of these definitions taken from The Living Reef: The Ecology of New Zealand's Rocky Reefs, (eds) N. Andrew and M. Francis, Craig Potton Publishing, Nelson, 2003.