North Canterbury Marine Conservation Stocktake

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1 Introduction

1.1 Purpose & objectives

This report is to provide baseline knowledge on our local North Canterbury marine environment and its conservation needs. It presents information gathered from

- literature and online research, and
- interviewing individuals, groups and organisations involved in marine research and conservation in and around the target area,

for the purpose of identifying specific projects or general areas of marine conservation need which are deemed suitable for the Forest & Bird North Canterbury branch to engage with.

As several conversations started during this project are ongoing as well as feedback from people is still coming in at time of writing and presentation of the report and also as it includes several leads which might require further follow up, this report is pretty much a ‘living document’ and might be modified or updated as we go along learning and exploring.

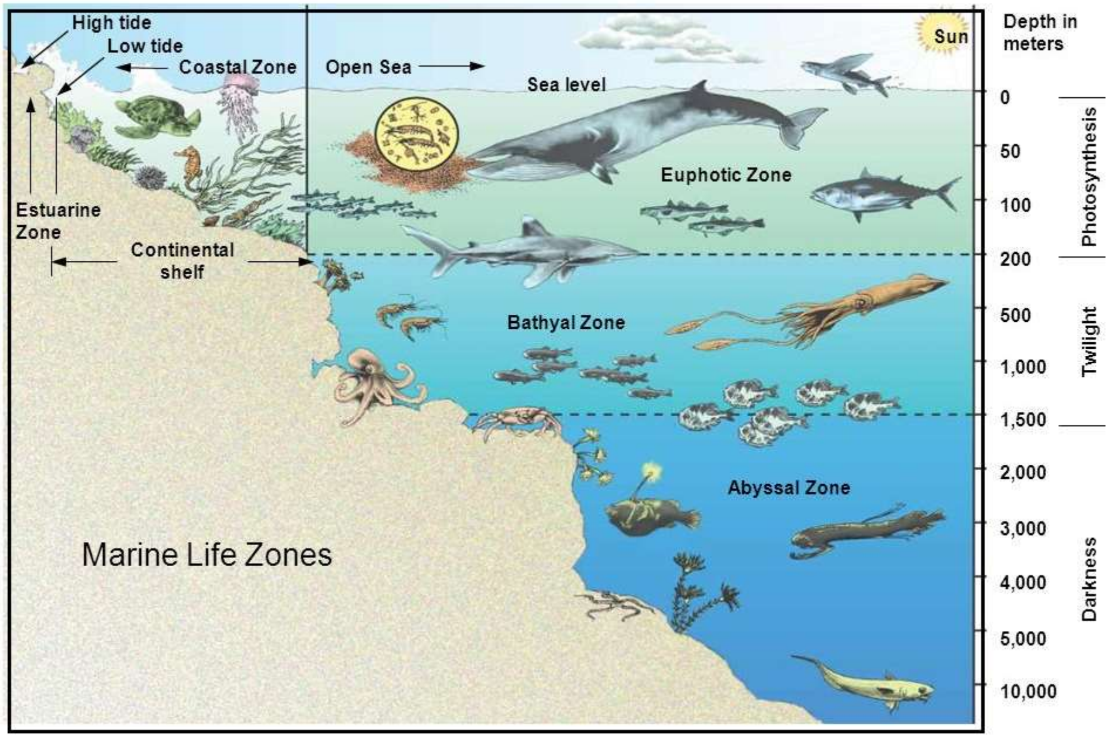
1.2 Our marine environment

The following sections are to provide background knowledge and a general overview and understanding of the system we are looking at. From there, the report will be launching into the specifics of the North Canterbury marine region, its characteristics and issues.

1.2.1 Marine ecosystems

The marine ecosystem is divided into **four distinct zones**. The deepest zone of this marine ecosystem, the **abyssal zone**, has cold, highly pressurized water with high oxygen but low nutrient levels. Ridges and vents on the ocean floor that emit hydrogen sulfide and minerals are found in this zone. Above the abyssal zone is the **benthic zone**, a nutrient-rich layer that contains seaweed, bacteria, fungi, sponges, fish and other fauna. Above this is the **pelagic zone**, essentially the open ocean, which features water with a broad temperature range, surface seaweeds and many species of fish as well as some mammals. The **intertidal zone**, where the ocean meets land, is covered by water during high tide and is terrestrial during low tide, allowing it to support unique vegetation and animal life [*https://sciencing.com/list-describe-four-aquatic-ecosystems-8180393.html*]. The intertidal zone is part of what is referred to as coastal zone, which is extending out to the edge of the continental shelf.

Marine habitats are often divided into pelagic and demersal zones. Pelagic habitats are found near the surface or in the open water column, away from the bottom of the ocean [*https://en.m.wikipedia.org/wiki/Marine_habitats*]. Demersal habitats are near or on the bottom of the ocean. Pelagic habitats are intrinsically shifting and ephemeral, and subject to ocean currents.



New Zealand's marine environment is incredibly diverse and within the broad categories described above, we find a large number of different habitats with different characteristics due to wave action or turbulence, light, temperature, salinity, dissolved gases, acidity, substrate, plant cover and nutrients [*https://www.sciencelearn.org.nz/resources/1524-habitats-food-webs-and-adaptations; https://en.m.wikipedia.org/wiki/Marine_habitats*].

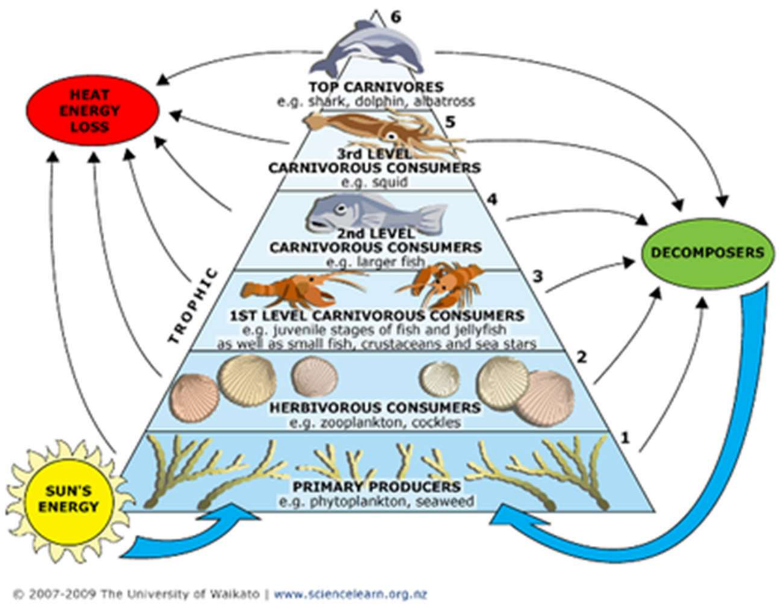
Marine habitats can also be modified by their inhabitants. Some marine organisms, like corals, kelp, mangroves and seagrasses, are ecosystem engineers which reshape the marine environment to the point where they create further habitat for other organisms [*https://en.m.wikipedia.org/wiki/Marine_habitats*].

1.2.1.1 Marine food webs

Food webs are the complex networks through which energy and materials move in an environment, from microbes all the way through to predators. They are often studied and modelled in terms of the flow of energy between different organisms. Marine food webs include all animals living in the sea, from phytoplankton, bacteria and small shrimp-like animals in the water, to animals living on the seabed like sponges and corals, to fish, squid, whales, seals and seabirds [*https://www.niwa.co.nz/coasts-and-oceans/research-projects/marine-food-webs*].

Food webs throughout the world all have the same basic trophic levels. However, the number and type of species that make up each level varies greatly between different areas and different ecosystems. Primary producers make up the base of a food web. Phytoplankton, seaweeds like kelp and seagrasses make their own food by converting energy from the sun through photosynthesis. Consumers cannot make their own food, so they need to get food from other sources. Another important but often overlooked part of the

food web is the decomposers. Bacteria and other organisms break down dead plants and animals, releasing the nutrients back into the ecosystem.
[*https://www.sciencelearn.org.nz/resources/1524-habitats-food-webs-and-adaptations*]



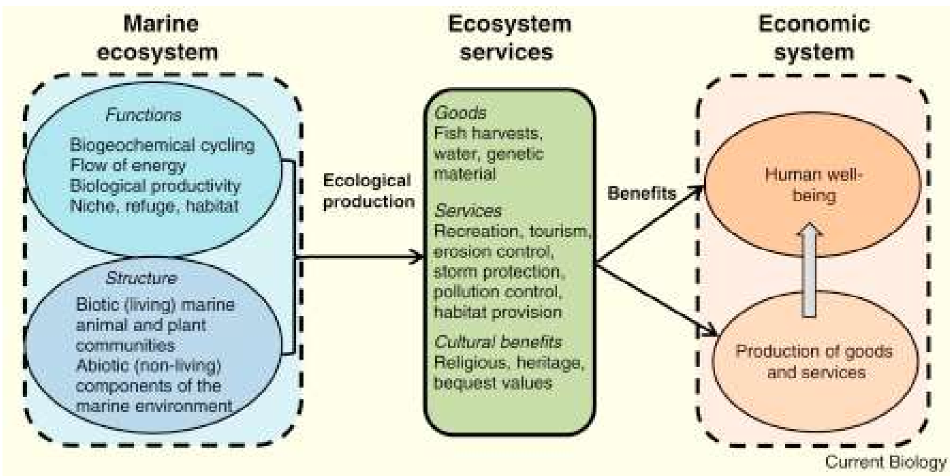
The effect of removing or reducing a species in a food web varies considerably depending on the particular species and the particular food web. In general, food webs with low biodiversity are more vulnerable to changes than food webs with high biodiversity. Some species in a food web are described as 'keystone' species. A keystone species is one that has a greater impact on a food web than one would expect in relation to their abundance. The removal of a keystone species characteristically results in a major change, in the same way that removing a keystone from an arch or bridge could cause the structure to collapse [*https://www.sciencelearn.org.nz/resources/1524-habitats-food-webs-and-adaptations*].

Information on the food web structures of our marine ecosystems is necessary in order to better understand the effects on the ecosystem of human activities such as fishing, land use, aquaculture and mining as well as understanding the potential impacts of climate variability and change on our oceans. Better understanding will enable more informed ecosystem management approaches to be developed. An ecosystem approach to understanding food webs looks at the relationships between all the species using our oceans, rather than considering species as independent. Changes affecting one species are likely to affect other species in the food web to a greater or lesser extent. For example, removing fish by fishing may free up food/energy supplies for other fish species, or could lead to a decline in associated species.

1.2.2 Why are marine ecosystems important?

The oceans are a significant source of oxygen for our planet and are instrumental in the capture and storage of carbon dioxide. Marine species provide important ecosystem services such as the provision of food, medicines, and livelihoods. They also support tourism and recreational activities around the world [*https://www.iucn.org/theme/species/our-work/marine*].

The goods produced by marine ecosystem services are the products obtained from these habitats, such as fish harvests, wild plant and animal resources, and abstracted water. Recreation, tourism and water transport are familiar services provided by many marine ecosystems. Some unique estuarine, coastal, and marine habitats are also important stores of genetic material and have educational and scientific research value as well. Marine ecosystems also provide other important services, associated with their regulatory and habitat functions, such as pollution control, storm protection, flood control, habitat for species, and shoreline stabilization. Marine ecosystems also provide other important services, associated with their regulatory and habitat functions, such as pollution control, storm protection, flood control, habitat for species, and shoreline stabilization (*Barbier 2017)*.



Healthy marine ecosystems support NZ's indigenous biodiversity and are important to Māori for customary and spiritual reasons. Fish and shellfish, seaweed, and other resources from the sea remain an important part of the Māori economy and lifestyle [*https://www.mfe.govt.nz/publications/environmental-reporting/environment-aotearoa-2015-marine/why-condition-our-marine]*. The commercial value of ecosystem services is reflected in fishing and aquaculture, which contributed $896 million (0.4 percent) to New Zealand's gross domestic product, providing over 47,000 jobs (*Ministry for the Environment & Statistics New Zealand 2016*) as well as tourism as overseas visitors enjoy recreational activities such as swimming, fishing, diving, and boating in our coastal beaches and oceans. In addition, about one-third of New Zealanders fish, dive, or harvest shellfish to feed family and friends.

1.2.3 Threats / Pressures / Human impacts

Marine ecosystems represent some of the most heavily exploited ecosystems throughout the world. For example, coastal zones make up just 4% of the earth's total land area and 11% of the world's oceans, yet they contain more than a third of the world's population and account for 90% of the catch from marine fisheries. However, human activities are now threatening many of the world's remaining marine ecosystems and the benefits they provide (*Barbier 2017).*

The list is long and includes the following [*http://www.learnz.org.nz/sustainableseas181/bg-standard-f/threats-to-marine-ecosystems; Environment Canterbury Regional Council, Ebox Series]*:

- Climate change / ocean acidification
- Fishing (recreational & commercial)
- Harvesting (recreational & commercial)
- Farming / Aquaculture
- Introduced / invasive species
- Recreational use of coastal environments
- Eutrophication
- Pollution[1]
- Stormwater[2]
- Sedimentation[3]
- Land reclamation
- Building structures
- Sand extraction

[1] **Pollutants** such as metals, oil, toxic substances, plastic and rubbish reach the sea via industrial and sewage discharges, as well as discharges from vessels, including hull scrapings, ballast water, bilge contents, tank overflows, ship waste and sewage. Also, through general runoff and stormwater and careless humans dumping their rubbish (*Environment Canterbury Regional Council, Ebox Series)*. Plastic waste, which can injure or kill marine animals, remains in the ocean for hundreds of years, and can enter the food chain (Ministry for the Environment & Statistics New Zealand 2016).

[2] When water falls onto a hard, sealed 'impermeable' surface such as roofs, roads and driveways, it cannot soak into the ground. Instead, it runs off the surface. This runoff is called **stormwater.** It flows overland via gutters and drains, into a network of pipes and open waterways. From here it flows, mostly untreated, into our streams and rivers and eventually into estuaries and the sea. Urban stormwater is a major concern for New Zealand. Because the stormwater system collects rainfall through drains, it also carries away hazardous substances such as metals off the roof of buildings, and petrol, rubber, oil, and metals left behind on our busy roads by vehicles. On its journey to the sea, stormwater can also pick up rubbish such as cigarette butts, fertiliser, plastic, leaves and animal excrement. All of these contaminate stormwater and ultimately the sea (*Environment Canterbury Regional Council, Ebox Series)*.

[3] **Sedimentation** is a natural process. However, too much sedimentation can be harmful to the coastal environment. Floods and storms can cause excess sediment to wash off the land via building sites, farms, recently harvested forestry blocks and through the stormwater network to name a few. The sediment then enters waterways and flows into the sea. Here it reduces water clarity and interferes with the vision, breathing and feeding of marine animals, covers rocks and the seabed, which smothers the plants and animals that live there and affects the growth of plants, which can disrupt the food chain (*Environment Canterbury Regional Council, Ebox Series)*.

New Zealand's Environmental Reporting Series 'Our marine environment 2016' (Ministry for the Environment & Statistics New Zealand 2016) identified **three top issues**:

1) **Global greenhouse gas emissions are causing ocean acidification and warming.**

- As the world's oceans have absorbed carbon dioxide emitted by human activities, they have increased in acidity.
- Of particular concern is the growth and reproduction of organisms with shells composed of calcium carbonate, because a more acidic ocean makes it harder for them to build their shells. This covers a diverse range of organisms, including plankton, corals, crustaceans, and molluscs such as shellfish. Plankton form the base of the food chain and are a direct or indirect source of food for almost all marine animals, so any disruption to these organisms may have widespread effects on marine ecosystems.
- Studies also show acidification changes the sensory systems and behaviour of some fish and invertebrates

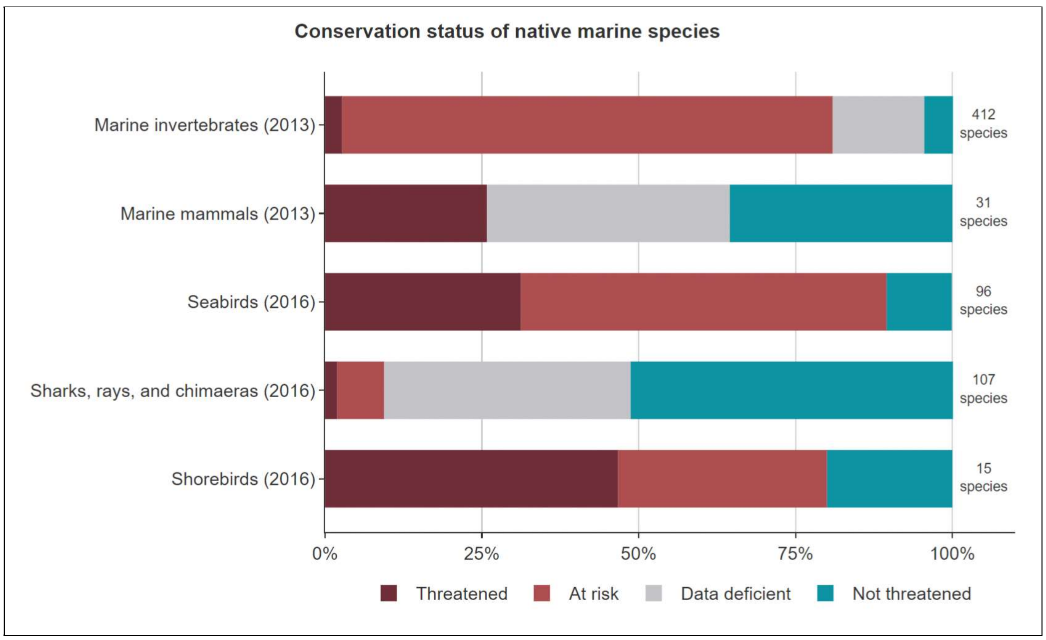
- In New Zealand, ocean acidification may affect some of the species we harvest for customary, commercial, or recreational purposes, such as pāua, mussels, and oysters.

2) **Native marine birds and mammals are threatened with extinction.** (But big gaps in our understanding of the state of non-commercial fish species, plants, algae, and other marine wildlife.)

- More than one-third of our native species and subspecies of seabirds, more than half of shorebirds, and more than one-quarter of marine mammals – including albatrosses, penguins, herons, dolphins, and whales – are threatened with extinction.

  Of species assessed, 90% of seabirds, 80% of shorebirds, and 26% of indigenous marine mammals are classified as threatened with or at risk of extinction between 2013 and 2016. 81 percent of marine invertebrates (333 of 412 species) and 9 percent of sharks, rays and chimaeras (10 of 107 species) were also classified as threatened with or at risk of extinction. There is not enough information to assess the conservation status (classified as data deficient) of 39 percent of sharks, rays, and chimaeras (42 species), and 39 percent of marine mammals (12 species).

  Also classified as data deficient were 60 species of marine invertebrates (15 percent of the identified species), but most of the existing species have not yet been described. [*https://www.stats.govt.nz/indicators/conservation-status-of-indigenous-marine-species*]



- The fragile state of some of our wildlife is in part due to historic pressures when people viewed these animals as resources, game, or pests. For marine birds, present-day pressures include the loss or modification of breeding habitats, predators, and fishing bycatch. For marine mammals, pressures include bycatch, ship strike, pollution, habitat modification, and competition for food from commercial fishing.

- There may be consequential impacts on other species and the resilience of ecosystems.
- These animals are taonga (treasures) for Māori. Their extinction would be a tangible loss for people who are inspired by, or have a spiritual connection to our marine wildlife, and their decline undermines Māori exercising of kaitiakitanga (guardianship).
- Nearly half the world's whale, dolphin, and porpoise species are found in our waters. Nearly one-quarter of the world's seabird species breed in New Zealand – and we have the highest number of endemic seabird species (found only here) in the world.

3) **Coastal marine habitats and ecosystems are degraded**.

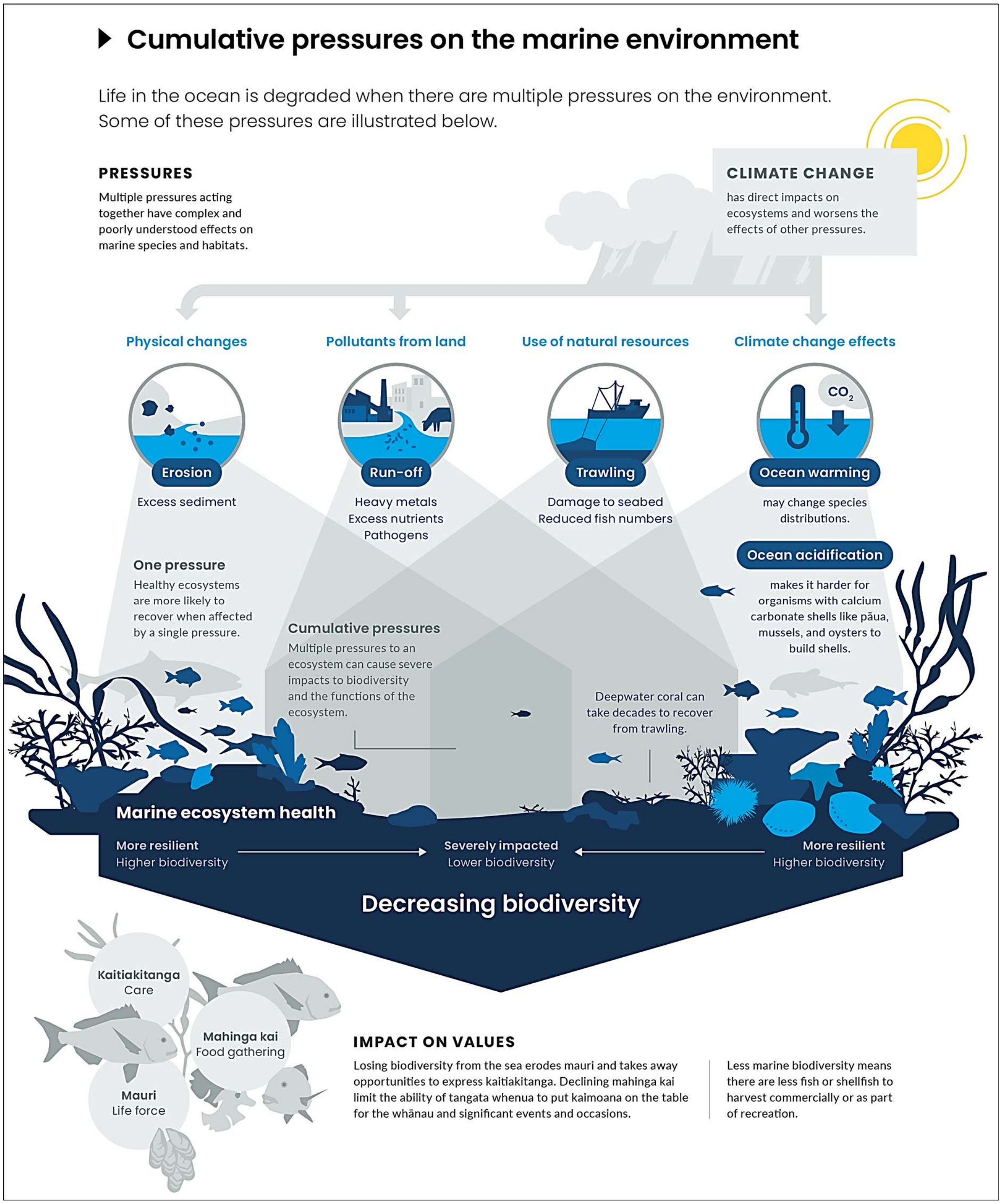
- Coastal marine habitats have critical functions in the wider ocean ecosystem – such as recycling nutrients and human wastes, trapping and stabilising sediments, producing oxygen that supports other marine life, and as nursery grounds for fish.
- A degraded coastal ecosystem has implications for aquaculture and recreational and commercial fishing. For Māori, the degradation of coastal waters has been a source of grievance since early European settlement, undermining cultural values, including harvesting of fish and shellfish.

  The most important pressures on coastal waters are impacts of climate change, excess sedimentation, seabed trawling, marine pests[4] and excess nutrients. Other pressures include other commercial and recreational fishing methods, dumping of dredge spoils, infilling of estuaries and harbours for building coastal infrastructure (reclamation), and other sources of pollution.

However, in many marine threat rankings the impact of **fishing** on the marine environment comes first. Seabed trawling and dredging are the most destructive fishing methods, causing major damage to seabed habitats and species. Most fishing methods result in the accidental death of non-target species, including fish, sharks, rays, seabirds, fur seals, sea lions, and dolphins. Fishing can disrupt the natural balance of species within the wider marine ecosystem. New Zealand's commercial fisheries are managed by a quota management system (QMS) that sets levels of allowable commercial catch for the purpose of ensuring the continued viability of fish stocks over time. Recreational fishing is a pressure on coastal waters, particularly near our most populated urban centres. In 2015, 17 percent of the New Zealand fish stocks were overfished – meaning they were depleted and needed active management or had collapsed and needed to be closed. [Ministry for the Environment & Statistics New Zealand 2016].

What often seems to slip out of focus, as each threat to the marine environment is already rather complex in itself, is the perspective of looking at cumulative pressures. However, this is what poses the biggest risk to tip an ecosystem over the edge.

[4]The number of non-indigenous marine species in New Zealand's coastal waters has risen 10 percent since 2010. Non-indigenous marine species most likely enter our waters on the hulls of boats and ships, or in ballast water. Some of these species become marine pests.



(Ministry for the Environment & Statistics New Zealand 2016)

2 The North Canterbury marine environment

The marine areas predominantly focused on in this report (and referred to as North Canterbury marine environment) are the waters off Banks Peninsula and Pegasus Bay.

2.1 Physical characteristics

2.1.1 Banks Peninsula

Banks Peninsula is a highly distinctive extant volcanic landmass featuring the water-filled craters of two extinct volcanoes with steep valleys and a rugged and indented coastline, mainly composed of basaltic reefs, extending from the mouth of the estuary of the Heathcote and Avon Rivers / Ihutai to the eastern end of the Kaitorete Spit (*Reynolds-Fleming & Fleming 2005; Environment Canterbury Regional Council, Ebox Series*).

The coastline is made up of numerous long, deeply indented embayments, almost radial in orientation and separated by high rocky headlands. The seaward sides of the Peninsula's two craters have collapsed and the resulting two natural harbours, Lyttelton / Whakaraupō and Akaroa, are some 15 km long. Other long, narrow embayments include Port Levy, Pigeon Bay, Little Akaloa, Otanerito, Peraki and Te Oka Bay, each with different orientations to prevailing seas and winds. Typically, the shores of these bays change to seaward from gently sloping beaches at their inland extremities, through rocky shores that increase in steepness, to rugged shores and high cliffs. Between each bay, headland cliffs rise directly from the gently sloping seabed (sometimes 12-15 m deep), to more than 100 m above sea level (*Graham et al. 2003*).

Subtidal habitats below headland cliffs are equally rugged. Large boulders and dissected unbroken bedrock form the steep bottom to depths of ca. 15 m. Here the rocky bottom gives way to an almost level muddy bottom, with few rocky outcrops. This level muddy bottom extends for several kilometres to seaward.

The **main oceanic current** which may influence peninsular circulation is the Southland Current/Front, which is believed to have its origin in the subtropical convergence west of New Zealand. It flows along the continental shelf through Foveaux Strait, around the south-east tip of New Zealand and along the continental shelf break of the east side of the South Island, eventually forking into two directions just after Banks Peninsula. (*Reynolds-Fleming & Fleming 2005).*

Currents close to shore along Banks Peninsula's open northern coast are predominantly tidal, ranging from about 2.0-2.5 m. Surface water movement due to wave action is considerable in all seasons. Turbidity is a striking feature of the Banks Peninsula marine environment. A combination of deforested hills and periods of substantial run-off at the ends of long embayments result in a continual supply of very fine sediment to the near-shore environment from Banks Peninsula soils. Sediment is transported from south to north around the Peninsula, especially when the northerly-flowing coastal current, flood tidal streams and south-easterly swells coincide (*Graham et al. 2003*).

2.1.2 Pegasus Bay

Pegasus Bay is a gently curved stretch of coastline, some 50 km long and running essentially south-north from Banks Peninsula to Motunau. Banks Peninsula and the cliffs and rocky shores of the Teviotdale Hills in the north create the embayment, providing some shelter for the Bay's sand and mixed sand-gravel beaches. Sandy beaches south of Leithfield beach are backed by extensive sand dune systems. The bay is interspersed with estuaries, lagoons and hāpua. The two larger rivers flowing into the bay (Waimakariri and Ashley rivers) supply considerable quantities of greywacke sediments to the near-shore environment (*Graham et al. 2003; Environment Canterbury Regional Council, Ebox Series*).

Pegasus Bay shores are rocky in the north but consist of finer sediments (fine gravels to fine sands) south of the Waipara River. Steep cliffs of limestone, silt/mudstone and sandstone characterise the shores between the Waipara River and Motunau. Wave-cut platforms and boulder beaches are variously developed at the foot of these cliffs, presenting a rugged and exposed shore (*Graham et al. 2003*).

The seabed at depths of 9-15 m off the rugged northern Pegasus Bay shores comprises four types: rocky reefs of bedrock, areas of low-lying boulders, cobbles and compacted pebbles, low lying outcrops of mudstone, and rippled sand. Southern parts of the inshore seabed comprise predominantly fine sands from 3 to 14 m depth and change to predominantly silt and parts clay by 18 m depth. Offshore sediments of the Pegasus Bay are quite similar across the entire area, comprising moderately well sorted muds (*Graham et al. 2003*).

The hydrodynamics of Pegasus Bay are complex, being influenced by winds, tides and other large-scale oceanographic processes, such as the Southland current. Inflows from rivers, notably the Rakaia and Waimakariri, add to the complexity of the region's hydrodynamics, especially during flood flows when large volumes of silt-laden freshwater enter the near-

shore zone. As the Southland current sweeps around Banks Peninsula, it appears to drive a counter clockwise eddy or gyre within Pegasus Bay on occasions, but at other times northward flow predominates.

Despite gentle offshore gradients, the near-shore environment is one of high energy. Waves in southern Pegasus Bay are predominantly from the north-east and east in summer and from the south-east in winter. Longshore currents and rips, along with tidal streams, create a turbulent near-shore environment with considerable water mixing and sediment movement. This means that the seabed itself is highly mobile at shallower depths. Water movement due to wave action is considerable in all seasons (*Graham et al. 2003*).

Turbidity is a striking feature of seawater along the Canterbury coast, especially near Banks Peninsula. The combination of large braided alluvial rivers with high sediment loads when in flood, proximity to Banks Peninsula with its high loess inputs to the coastal system, the gently sloping bottom of the Pegasus Bay and seasonal weather patterns of protracted periods of relative calm seas results in a continual supply, deposition and re-suspension of very fine sediment within the near-shore environment. The frequent wind and wave-induced moderate water movement continually re-suspends this material both off Banks Peninsula and within Pegasus Bay (*Graham et al. 2003*).

2.2 Habitats & species compositions

2.2.1 Banks Peninsula / Pegasus Bay

While the **Pegasus Bay** coastal environment is characterised by open, sand and gravel shores and gently sloping sediment bottoms reaching 25-30 m depth some 10 km from shore, the coastal environment of **Banks Peninsula** varies widely from exposed rocky headlands to sheltered, shallow muddy inlets. Although there is scant information available on the ecologies of the area, three broad **coastal environments** are apparent based on exposure to currents and wave action (*Graham et al. 2003*):

1. **Harbour or semi-sheltered bay environments** hold diverse soft bottom benthic communities that vary from location to location, depending on hydrodynamic conditions and sediment particle size composition. Hard bottom communities are equally variable and diverse, also changing in response to hydrodynamic conditions. A small number of fish species is known from these habitats. Dolphins are uncommon, except in some eastern and southern bays, and in Akaroa Harbour. Seals are generally rare. At least three at risk or endangered bird species inhabit semi-sheltered shores, especially in Akaroa Harbour.
2. **Exposed coastal environments near headlands** experience high wave exposure. These shores are usually steep, plunging to 10-16 m depth where they intercept a gently sloping sand or mud bottom. The fauna inhabiting these muddy bottoms is broadly similar to and intergrades with that inhabiting more sheltered mud bottoms in harbours and bays. Rock bottom biota tends to be dominated by large brown seaweeds, and have dense animal communities dominated by mussels, ascidians, sponges, bryozoans and hydroids. The abundant reef fishes comprise species that are relatively common around much of the South Island coast. Hector's dolphins frequent these waters, especially off the eastern headlands. Several species of birds

feed along these exposed shores and some oceanic species venture into these waters.

3. **Offshore environments are characterised** by muddy bottoms supporting abundant and diverse benthic communities, which provide nursery areas to commercially important crabs and fishes. Worms, crustaceans and molluscs dominate this community. The diverse pelagic fish fauna includes several species important for commercial and recreational activities. Penguins, terns, shags and oceanic birds all forage in these offshore waters, along with Hector's dolphins.

2.2.2 Motunau Island

A small, 3 ha island lying 1.2 km offshore at the northern end Pegasus Bay south of the mouth of the Motunau River. It has steep sides rising to a distinctive flat top about 25 m above sea level. Geologically, it consists of Tertiary rocks, capped with loess and gravels, and surrounded by eroding cliffs and wave-cut reefs.
[*https://en.wikipedia.org/wiki/Motunau_Island*]

Motunau Island is Nature Reserve administered by the Department of Conservation (DoC) and access is by permit only. It is the only island with a significant population of breeding seabirds off the Canterbury coast, and has been described as supporting in excess of 23,000 birds. Species which are otherwise rare within the region, like White-faced Storm Petrel, Fairy Prion and Sooty Shearwater breed here. It also supports a substantial proportion of the region's White-flippered / Little penguin population. Black-backed Gulls, Variable Oystercatchers, Red-billed Gulls, and White-fronted Terns were also found to breed here. Fur seals were regularly recorded in small numbers, but also sightings of elephant seal and NZ sealion are reported (*Beach et al. 1997*).

An ecological survey of Motunau Island was carried out between 1958 and 1962; birds, lizards and vegetation were resurveyed in 1996/97. While burrowing seabird numbers appeared stable, vegetation change was affecting the ability of the small petrels to utilise certain areas of the island resulting in distributional changes of their breeding sites on the island. Concerns at the time were boxthorn covering large parts of the island, impacting breeding seabirds by either killing them (Carcasses of 17 dead Fairy Prions were recorded entangled in boxthorn) or overgrowing nesting areas, and the effect the introduced grass sward may have on the ability of the small petrels to burrows (*Beach et al. 1997*).

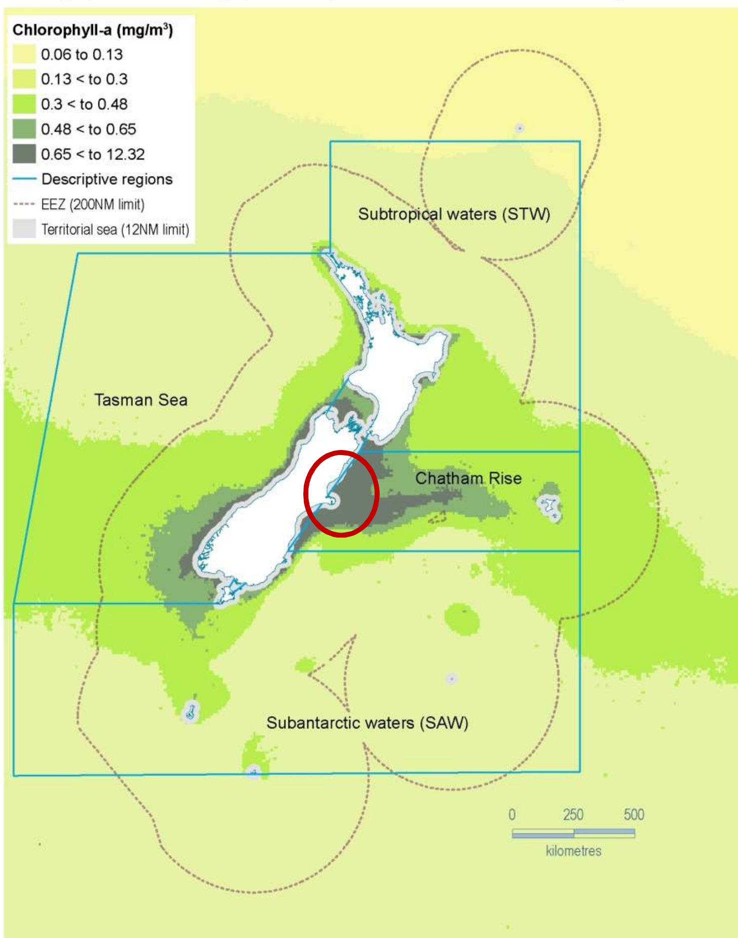
The island has since been cleared of boxthorn and is monitored annually (?) by DoC to prevent re-seeding. However, it appears that no comprehensive survey of the island's seabird populations has been carried out since.

2.3 North Canterbury marine suite of species

2.3.1 Algae / phytoplankton

Phytoplankton, microscopic organisms at the base of the food chain, use a pigment called chlorophyll-a to capture energy and grow via photosynthesis. These phytoplankton then become food for other marine organisms. As the marine environment's primary producers, phytoplankton are critical for the productivity and abundance of other marine life, and the overall health of the marine ecosystem. They also influence other important aspects such as carbon dioxide uptake by the ocean. Primary productivity is the synthesis of new organic material from nutrients and sunlight by phytoplankton and can be measured by satellite observations of concentrations of chlorophyll-a. Primary productivity is often high along coastlines and in underwater continental shelf areas (Ministry for the Environment & Statistics New Zealand 2016*)*.

Primary productivity (chlorophyll-a concentrations), 1997–2016



Source: NIWA; Land Information New Zealand

The map shows North Canterbury waters to be part of a highly productive area.

Algae (e.g. bull kelp) often function as foundation species in marine benthic systems. *Thomsen & South* (*2019*) found that Durvillaea spp., Cystophora spp. and U. pinnatifida can be co-occurring foundation species on wave-exposed intertidal rocky shores in New Zealand. In addition, Cystophora spp. and U. pinnatifida can benefit from stressors and disturbance that reduce the cover of Durvillaea spp. However, Durvillaea spp., Cystophora spp. and U. pinnatifida can be considered foundation species for different reasons. Durvillaea spp. controlled the abundances of other species and local biodiversity networks whereas Cystophora spp. became abundant in the absence of Durvillaea spp. but played a central role as a host to many epiphytes. By contrast, U. pinnatifida was mainly important due to its high abundance, with less effect on attachment networks, suggesting that it is less important in controlling biodiversity.

2.3.1.1 Species of conservation concern

Bull kelp (Durvillaea spp) has recently suffered substantial die-offs along Canterbury coastlines in the wake of the 2017/2018 marine heatwave. The medium to long term effects of this are currently unknown.

2.3.2 Benthic communities

Graham et al. (2003) distinguish between soft and hard bottom benthic communities:

A few benthic species like mud crab (Macrophthalamus hirtipes) and mud shrimp (Pontophilus australis) as well as olychaete worms occur abundantly and consistently in sheltered, **soft-bottom habitats** around **Banks Peninsula** (e.g., Lyttelton and Akaroa harbours and some other semi-sheltered bay environments). Four different soft bottom benthic communities have been identified in Lyttelton Harbour:

Chione stuchburyi community: Cockles (Austrovenus stutchburyi) dominated locally in shallow, sheltered waters, where it attained biomasses of up to 9 kg/sqm. Associated species included the shrimp Pontophilis australis, an anemone (Anthopleura aureoradiata), another bivalve (Myadora striata) and three amphipods.

Macrophthalamus-Virgularia community: More widespread on sheltered, sandy mud bottoms was an assemblage dominated by the mud crab Macrophthalamus hirtipes and sea pen Virgularia gracillima, with gastropods (Xymene plebeius, Micrelenchus huttoni), an ophiuroid (Ophiomyxa brevirima), a polychaete worm (Platynereis australis) and the ubiquitous shrimp, Pontophilis australis.

Zeacolpus-Pectinaria community: A third community occurred widely on sandy harbour bottoms. A gastropod (Zeacolpus vittatus) and a tube-worm (Pectinaria australis) co-dominated. Other characteristic taxa included gastropods (Trochus tiaratus, Zegalerus tenuis), bivalves (Myadora striata, Nucula hartvigiana, Spisulaaequilateralis), a small cuttlefish (Sepioloidea pacifica), the seastar Patiriella regularis, and a tube-worm (Owenia fusiformis).

Ostrea-Sigapatella community: Small, dispersed patches of the oysters (Ostrea heffordi) and associated slipper limpet (Sigapatella novaezealandiae) were present wherever there were hard surfaces for settlement. This assemblage was more restricted than the others, its only other member being the small crab Halicarcinus whitei.

Changes from mud to sand are not well explored with regards to community changes. Information on more exposed soft bottom biotas around northern Banks Peninsula is also scant. Towards the lower limits of hard substrates, fine sediment covers rock surfaces and some larger deposit feeders characteristic of more sheltered waters (e.g., the sea cucumber Stichopus mollis, cushion stars Patiriella regularis) occur here. There is a transitional zone between rock and sediment substrates. Dead mussel and rock oyster shell accumulate in this zone, and fauna characteristic of both hard and soft bottoms, co-exist. Cushion stars, sea cucumbers and occasional horse mussels congregate in this zone, along with abundant scavenging whelks, cancer crabs (Cancer novaezelandiae), hermit crabs and blue cod. The true soft bottom biota appears on the gently sloping muddy sand to sandy bottoms beyond the rocky slopes, usually at about 12-15 m, but shallower off boulder shores.

Hard bottoms are often dominated by brown algae up to 6m depth, forming kelp beds. The shallower rocky bottoms support several typical rocky shore invertebrates. More than 45 species have been identified. Notable amongst these are large herbivorous gastropods (Cookia sulcata, Haliotis iris) and echinoderms; green-lipped mussels and the sea tulip (Pyura sp.) dominate the fauna of the shallow, brown algae zone. Boulders at the deeper margin of the rocky bottoms also support abundant sponges, sea squirts, Perna canaliculis and the topshell; red algae, notably Lenormandia chauvinii, replace brown algae on rocky bottoms below about 6-8 m depth.

Within the exposed coastal environments of Banks Peninsula, the biota on exposed unbroken bedrock shores is quite strongly zoned, at least in the immediate upper sublittoral. Green-lipped mussels (Perna canaliculis) form a dense covering over rock surfaces dominating the sublittoral fringe on these shores but are interspersed with bull kelps (Durvillaea spp) in extremely exposed situations. Sea tulips (Pyura pachydermatina) are abundant in this zone also. Another large brown seaweed, Ecklonia radiata, grows ubiquitously at 2-5 m depth, and bladder kelp (Macrocystis pyrifera) occurs at about this depth wherever the shore is slightly sheltered from full exposure. Clumps of large green-lipped mussels are common at 7-11 m depth, interspersed with rock oysters, tunicates and sponges. Mussels appear to persist beyond this zone on most exposed shores but are absent by 12-14 m depth. Accumulations of dead mussel and oyster shell lie at the transition between rocky and sediment substrates and the associated fauna is described above.

The fauna inhabiting the almost level, mud bottoms **more distant from shore** in **Pegasus Bay** is quite diverse. Living in or on the sediment surface are more than 68 taxa, apparently distributed in patches. Many of these taxa were polychaete worms living within the layer of fine brown silt overlying the more compacted mud, and more properly regarded as members of the infauna. Crustaceans dominated the epibenthos, with four molluscs also widespread. Most widespread and conspicuous among the molluscs are the large scavenging whelk Austrofusus glans. Other molluscs include the small bivalve Mactra ordinaria, its likely predator Philine auriformis, and the circular slipper limpet Zegalerus tenuis. Crab larvae recently settled from their planktonic development occur widely on these bottoms, along with mysid shrimps, the small predatory shrimp Pontophilus sp. and several epibenthic amphipods (Photis nigrocula, Oedicerotidae, Meridiolembos sp.) and cumaceans (Diastylopsis sp. 1, Diastylis sp.). Scavenging, epibenthic hermit crabs (Diacanthus spinulimanus) are abundant in patches, presumably wherever there is food. The species composition here differs from the benthos found within Banks Peninsula bays, principally in the absence of mud crabs and the increased importance of smaller crustaceans, notably amphipods and cumaceans.

Pegasus Bay's sandy beaches have an abundance of Tuatua (Paphies subtriangulata), except adjacent to the mouth of the Waimakariri and Ashley Rivers. This species has relatively high ecological significance for these beaches. Tuatua are an important prey species for many individuals in the ecosystem, being commonly preyed on by fish, birds and crustaceans. They also filter large quantities of water which lowers turbidity. This filtration also facilitates other benthic macrofaunal species (*Taylor 2013*).

2.3.2.1 Species of conservation concern

Knowledge of NZ's benthic environment is still regarded as limited. While more than 17,000 species have been identified, experts estimate that between 17,000 and 65,000 species are yet to be identified. At the same time, many marine invertebrates are at risk of extinction. However, only limited information is available about the conservation status of marine invertebrates such as rock lobster, pāua, pipi, sponges, and corals. Of an estimated 12,000 species, 415 were assessed [*Gordon et al, 2010; Freeman et al, 2014*]. Of the assessed species, 11 (2.7 %) were classified as threatened with extinction. A further 324 species (78 %) were considered to be at risk of extinction, principally because they are naturally uncommon, i.e., they are naturally restricted to certain habitats. [*https://www.mfe.govt.nz/publications/environmental-reporting/environment-aotearoa-2015-marine/state-our-marine-environment*]

Tuatua are under pressure due to heavy recreational activities along beaches like 4WD and horse riding which compacts their habitat and causes mortality from trampling. Suggested mitigation measures are to reduce the permitted area for vehicle and horse users in Pegasus Bay, put limits on the frequency and types of users permitted, and require users to follow predefined tracks (*Taylor 2013).*

2.3.3 Fish

2.3.3.1 Species in relation to different habitat types

As reported in *Graham et al. (2003*), 21 fish species have been recorded from **Akaroa Harbour**, with the more common ones being triplefins, opalfish, spotties, banded and scarlet wrasse. Some of these are important to recreational fisheries. As for **exposed near-shore habitats**, out of the 23 species occurring here, the most commercially important ones are blue moki, blue cod, and greenbone / butterfish, all of which occur close to **rocky reefs.** However, blue cod are more widespread and abundant in **deeper water**, whereas blue moki and greenbone are more restricted to **rocky reefs near shore** where they are more vulnerable to fishing pressure. **Rocky bottoms** also have a diverse fish fauna, with as many as 19 species recorded at any one location. These include several widespread reef fishes like spotties, banded wrasse, leather jackets, as well as blue cod, blue moki, butterfish and terakihi. The fish community within **offshore environments** is with 34 species the most diverse**.** Abundant species include barracouta, red cod, sand flounder, spiny dogfish, and two-saddled rattail. Common species include elephant fish, hapuku, New Zealand sole, red gurnard, rig, rough skate, and school shark.

Banks Peninsula has been found to provide nursery grounds for rough skate, while Pegasus Bay holds both spawning and nursery grounds for Elephant fish, nursery grounds for barracouta, blue and silver warehou, red gurnard, school shark, sea perch and tarakihi, and spawning grounds for rig and red cod (*Morris et al. 2014*).

River mouths and estuaries are also important spawning and nursery areas for species like flounders and whitebait.

Whitebait is a term used to collectively describe the juvenile form of 5 native fish species of the family Galaxiidae: Inanga (*Galaxias maculatus*), Kōaro (*Galaxias brevipinnis*), Giant kōkopu (*Galaxias argenteus*), Shortjaw kōkopu (*Galaxias postvectis*) and Banded kōkopu (*Galaxias fasciatus*). The adults mainly live in rivers and streams and often prefer native forest surrounds. Most of the galaxiids lay their eggs in freshwater, and after hatching, the larvae are swept down to the ocean where they grow. The young then move back up into freshwater in large shoals known as runs [*sciencelearn.org.nz*].

The most common species of whitebait is inanga. Unlike the other members of the whitebait family, inanga cannot climb. Instead they overcome small barriers by burst swimming. These fish are considered to be a lowland species due to their lack of climbing ability. Here, the adults spawn in estuaries amongst riparian vegetation near the upper limit of the saltwater wedge at high tides. Juveniles spend about 6 months at sea, where they float as part of the ocean's plankton mass before returning to the rivers and grow into adults

[*https://www.sciencelearn.org.nz/resources/442-whitebait; https://niwa.co.nz/our-science/freshwater/tools/kaitiaki_tools/species/inanga*].

2.3.3.2 Species of conservation concern

Whitebait / Inanga

Whitebait runs are smaller than they used to be due to a range of factors. The main problem is a decline in the quantity and quality of habitat. This is caused by barriers for fish migrating into tributaries and lakes (such as floodgates, culverts and weirs), draining of wetlands and other changes in land use. Degradation and loss of their spawning grounds is also a problem. Livestock trampling and lack of shade over riparian (streamside) spawning areas kills whitebait eggs. Declining water quality associated with land use change and intensification has also probably affected whitebait numbers. The value of these habitats is now being recognised, leading to protection and restoration initiatives[5] [*https://niwa.co.nz/our-science/freshwater/tools/kaitiaki_tools/species/inanga*].

Basking sharks

New Zealand appears to be the species' centre of abundance in the southern hemisphere, with historical reports of aggregations containing hundreds of these giant filter-feeders from the waters off Kaikoura and Bank's Peninsula. Basking sharks are pelagic filter-feeders. They are generally encountered on the surface inshore during the spring and summer, when they readily enter shallow water close to the surf zone and may even enter brackish coastal lagoons such as Lake Ellesmere/Waihora. Coastal regions favoured by basking sharks are generally those that exhibit high planktonic productivity. At other times of the year basking sharks are found offshore in deep water over the upper continental slope and oceanic banks. Satellite tagging suggests they may have a preference for water temperatures between 15 and 17·5 C. Reported sightings of basking sharks around New Zealand have been infrequent since the mid-1990s and few large aggregations have been seen over the same period. A summer aerial survey conducted around Banks Peninsula in 2009/10 and 2010/11 failed to find any basking sharks, whereas a similar survey conducted from 1990 to 1997 never went two years in a row without sighting basking sharks [*https://www.doc.govt.nz/nature/native-animals/marine-fish-and-reptiles/sharks-mango/basking-shark/*].

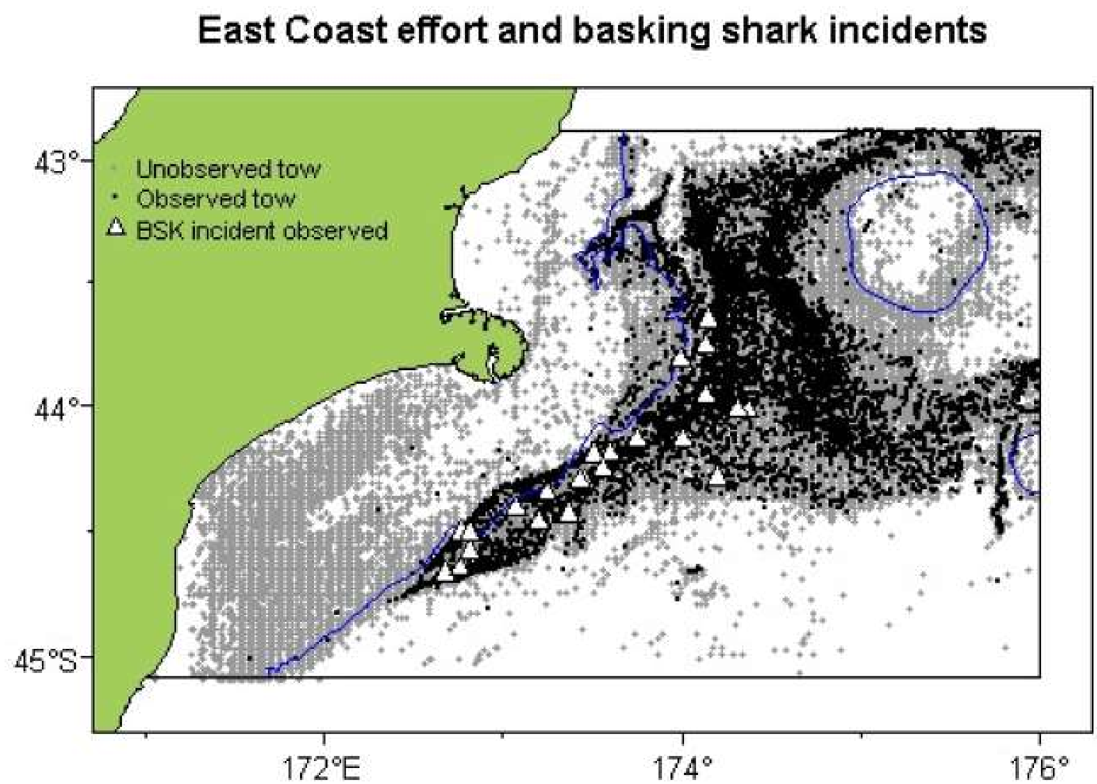
Incidental mortality of basking sharks occurs in gill net fisheries for rig and school shark, and in middle-depth and deepwater trawl fisheries for barracouta, squid and hoki. All directed

[5] Many school/iwi/community groups doing planting/rehabilitation/surveys. Some one-offs (e.g., Whaka Inaka), and some ongoing (e.g., Whitebait Connection). [*Mike Hickford, UC, pers. comm. 2019*]

basking shark fisheries have shown a similar pattern of high initial catches followed by depletion of the stock and long-term closure. Most depleted populations have exhibited very long recovery times (several decades) or no discernible recovery.

The low estimated effective population size of basking sharks potentially makes them susceptible to the fixation of deleterious genes and loss of adaptive genetic variation (evolutionary potential), two factors that could negatively affect the species' long-term survival. The potential effects of global climate change on the distribution and abundance of basking sharks are unknown. Discard plastics, nylon fishing line and other types of rubbish at sea can be accidentally ingested and individuals can also suffer from entanglement in marine debris.

Basking sharks are classified as Vulnerable globally and Endangered in the Northeast Atlantic and North Pacific by the IUCN Red List of Threatened Species. They are protected under the Wildlife Act 1953. This means it is illegal to hunt, kill or harm basking sharks within New Zealand's Territorial Sea and Exclusive Economic Zone (200 nm limit around New Zealand). Any offence under this Act is liable to a fine of up to $250,000 and six months imprisonment. Basking sharks are also protected from fishing by New Zealand vessels operating on the High Seas under the Fisheries Act 1996. It is not illegal to accidentally catch a basking shark but it must be released alive and unharmed.

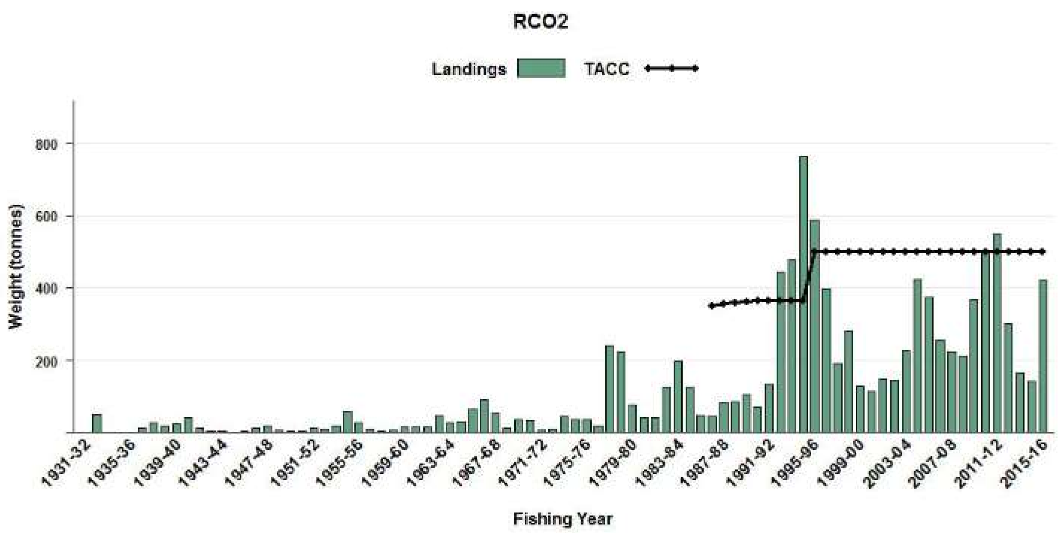


The map shows positions of all unobserved tows, observed tows, and observed basking shark incidents for the EC fishery area. The 250 m depth contour is shown.

Red Cod

Red cod are a fast-growing, short-lived species with few fish in the commercial fishery older than six years. They are targeted primarily by domestic trawlers in the depth range between 30 and 200 m and are also a bycatch of deepwater fisheries off the southeast and southwest coasts of the South Island. The domestic red cod fishery is seasonal, usually beginning in November and continuing to May or June, with peak catches around January and May. During spring and summer, red cod are caught inshore before the fishery moves into deeper water during winter. The red cod fishery is characterised by large variations in catches between years. Research indicates that this interannual variation in catch is due to varied recruitment causing biomass fluctuations rather than a change in catchability. [*Fisheries Assessment Plenary May 2017: Stock Assessments and Stock Status; https://fs.fish.govt.nz/Doc/24442/71_RCO_2017.pdf.ashx*].

The bulk of reported commercial landings within the RCO 3 has been sourced from Canterbury Bight and Banks Peninsula waters and has about halved since the early 2000's.



2.3.4 Seabirds

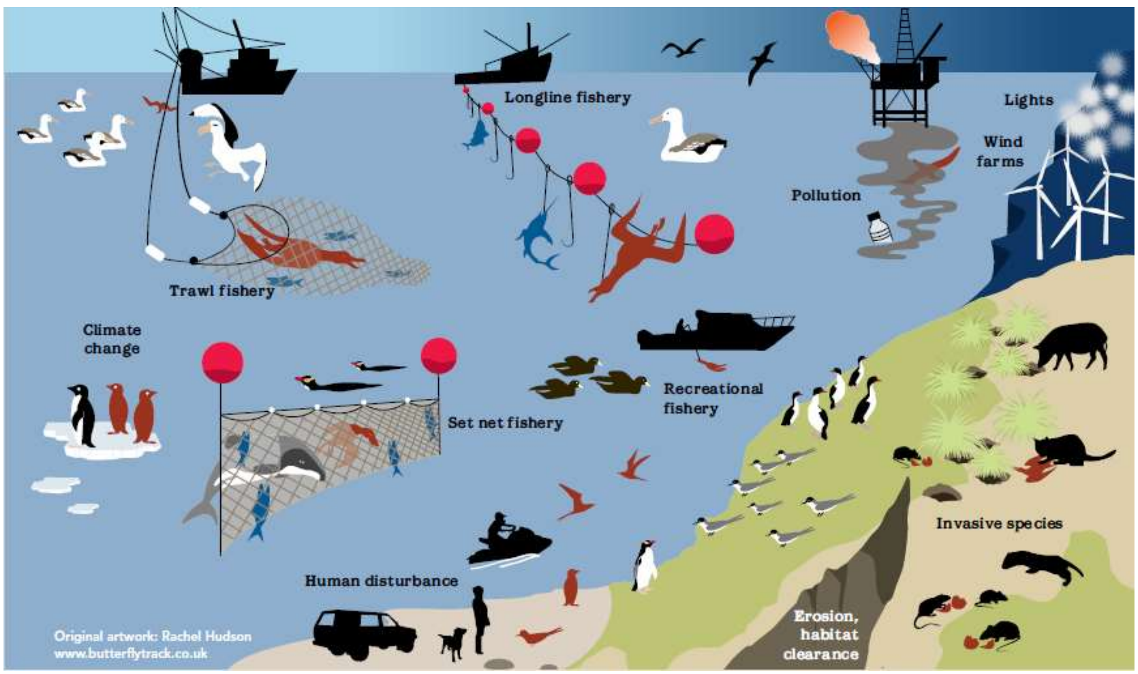
Seabirds (also known as marine birds) are birds that are adapted to life within the marine environment. While seabirds vary greatly in lifestyle, behaviour and physiology, they often exhibit striking convergent evolution, as the same environmental problems and feeding niches have resulted in similar adaptations. In general, seabirds live longer, breed later and have fewer young than other birds do, but they invest a great deal of time in their young. Most species nest in colonies, which can vary in size from a few dozen birds to millions. They feed both at the ocean's surface and below it. Seabirds can be highly pelagic, coastal, or in some cases spend a part of the year away from the sea entirely [*https://en.wikipedia.org/wiki/Seabird*].

2.3.4.1 The importance of seabirds

As predators at the top of the food chain, seabirds are crucial components of marine ecosystems and possess attributes that make them useful as indicators of change in the marine environment. Given that there is an increasing demand for relevant indicators for the marine environment, seabird populations represent a viable and cost effective 'canary in the cage' for the long-term assessment of marine ecosystems across broad spatial scales (*Forest & Bird 2014*).

Fluctuations of seabird populations can have important implications for the ecology of their terrestrial ecosystems in which they are situated. Seabirds play a major role in shaping the ecology of terrestrial communities by acting as links between the land and sea, importing sources of marine-derived nutrients (*Forest & Bird 2014*).

Seabirds are ranked by the IUCN as the world's most threatened bird grouping. Threats to seabirds here in New Zealand include: introduced predators, which represent the most significant onshore threat to seabird populations worldwide; modification of seabird breeding habitats and rapid increase in coastal subdivisions; marine pollutants that enter the marine environment (ie. effluent, chemical contaminants, plastics and oil and petroleum products); by-catch of seabirds by commercial fishing boats. The impact from recreational fishing, while likely to be considerable, is poorly understood (*Forest & Bird 2014*).



2.3.4.2 Seabird species in the North Canterbury region

The latest local seabird list (as compiled by A. Crossland from CCC in 2014) comprises a total of 68 species, of which 43 occur regular, and 13 are resident breeders.

The region's rocky coastline and headlands (Banks Peninsula and Motunau Island) provide a home to White-flippered / Little Blue as well as Yellow-eyed penguins, Sooty shearwater, Fairy prion, Spotted shag as well as Black shag, Red-billed gull and Black-backed gull. Along coastal wetlands and beaches we find Pied, Little and Little black shag as well as White-fronted terns breed in trees or on sandspits (*Graham et al. 2003*).

The region's breeding birds are predominantly found to frequent inshore waters, as do visitors like Black-billed gulls or Caspian terns. Further offshore (e.g. >3nm out) we find increasingly more pelagic bird species like Wandering Albatross, Grey-headed Albatross, Salvin's Albatross, NZ Black-browed Albatross, NZ White-capped Albatross, Southern Buller's Albatross, Northern Giant Petrel, Cape Petrel, Buller's shearwaters, fluttering shearwaters and Hutton's shearwaters, either foraging or passing through, as recorded during observed fisheries interactions conducted between 30-400m depth contours or aerial surveys (*Graham et al. 2003*). All of them are recurring visitors, and Hutton's shearwaters have been shown to use these waters during breeding when rearing their chicks (*Bennett et al. 2019)*.

2.3.4.3 Species of regional importance / conservation concern

For the following species, the North Canterbury coastal and offshore areas represent a stronghold for breeding populations, provide important foraging areas and/or support populations in decline.

<u>White-flippered / Little penguin (WFP)</u>

Although considered a subspecies to the Little (or blue) penguin by some, the White-flippered penguin is not listed as such officially due to insufficient genetic diversity [*http://nzbirdsonline.org.nz/species/little-penguin*]. It can be, however, acknowledged as a regional variety, found only on Banks Peninsula and Motunau Island.

The New Zealand threat status for White-flippered / Little penguin is 'nationally vulnerable' [*https://www.mfe.govt.nz/publications/marine-environmental-reporting/our-marine-environment-2016/appendix-2-conservation*]. White-flippered penguins (WFP) have suffered serious decline in the past due to predation but populations are in recovery and breeding areas expanding since local landowners took conservation action, supported by DoC, regional councils (CCC, ECAN) and local conservation groups (e.g., BPCT) and rehabilitation centres.

Gaining information on the WFP population size and trend to date appeared tricky due to the patchy nature of individual colony management and data recording regimes and responsibilities. The last comprehensive full population count has been carried out in 2000/2001 (published in *Challies & Burleigh 2004*), resulting in an estimate of 10,460 birds, breeding across 68 colonies of which the 51 contained < 20 nests and only 5 contained > 50 nests. Nearly half of the population was found to breed on Motunau Island. However, nearly 20 years on, the results of this study can be considered outdated. After high predation pressure on Banks Peninsula during the 1980's and 1990's, the population was possibly at its low point and just at the start of recovery at the time of survey [*C. Challies, pers. comm. 2019]*. Indications are that the population has at least doubled since, and birds were reported to be expanding back into areas where they previously nested about 30 years ago [*The Wildside Newsletter August 2017]*.

The earthquakes within the Christchurch region during 2010/2011, which caused rockfall in some of the WFP colonies on Banks Peninsula, appeared to have had only minimal effects on the local populations and did not result in major population decline or reversing trends [*C. Challies in Southern Birds June 2012*].

Bräger and Stanley (1999) studied the distribution of white-flippered penguins in the waters of southern Banks Peninsula between November 1993 and March 1997. The birds were not evenly distributed but appeared to concentrate in several bays. In Akaroa Harbour, the relative abundance of white-flippered penguins varied considerably at different times of the year with monthly averages ranging from 0.8 to 11.0 individuals; peak numbers occurred in April and November, with relatively few sightings from December to March and from August to September. Within Akaroa Harbour, white-flippered penguins almost exclusively used only the southern (outer) half of the bay. Indications are that areas further offshore are less frequented by WFP but little information is available (*Graham et al. 2003*).

There are no studies on the diet of WFP. From Little penguins it is known that they forage diurnally, predominantly within 5m of the surface (Heather and Robertson 1996), feeding on a diet consisting of arrow squid and small fish, the latter predominantly small, schooling species such as sprat and Graham's gudgeon (*Graham et al. 2003; Agnew 2014)* found that Little penguins from Oamaru adjusted their foraging in response to changing prey abundance and distribution across the season.

Conservation / management happening to date:

Flea Bay

- The Flea Bay colony (managed by the Helps family who owns the land) is the largest on Banks peninsula, supposedly holding 70% of the WFP population [*The Wildside Newsletter May 2015; T. Stracke pers. comm. 2019]*. (NB: At this stage not clear whether this is 70% of Banks Peninsula population or including Motunau).
- Numbers of breeding birds grew from 2000 (717 breeding pairs) to 2004 (888 breeding pairs) to 2008 (1063 breeding pairs) to 2012 (1304 breeding pairs). There was a slight decline in 2016 due to severe weather events (El Nino, 2 years in a row) as well as areal predators (Giant Petrel) invading the area [*T. Stracke pers. comm. 2019]*. The Helps family does extensive predator control and population counts (supported by DoC and volunteers) and the colony is part of a well-established Eco-tour destination (Pohatu).

Harris Bay

- The main study colony in Harris Bay is holding around 30 breeding pairs and there are another 30 pairs in adjacent bays within the wider embayment [*C. Challies pers. comm. 2019*].
- Harris bay has a predator-proof fence built by CCC, and DoC does some trapping above in the hills and maintain the track. Chris Challies does the trapping and counting inside [*T. Stracke, pers. comm. 2019].*

Penguin rescue & rehab facility Christchurch

- Run by Kristina Schuett and Thomas Stracke, in collaboration with South Island Wildlife Hospital and DoC. They are members of WReNNZ (Wildlife Rehabilitators Network of NZ) and holding a 10-year DoC permit.
- Self-funded through donations.
- Organising field trips (for/with F&B?) to WFP colony in Harris Bay, in collaboration with colony manager Chris Challies (F&B member).
- Rehabilitation numbers show increasing trend over time; improving success rate likely due to increasing experience of rehabilitators [*T. Stracke, pers. comm. 2019]*.

Year	Birds rehabilitated	Average no. of days spent at facility
2010	7	9.9
2011	21	17.7
2012	6	23.0
2013	23	17.8
2014	16	23.4
2015	14	11.5
2016	13	20.9
2017	22	17.6
2018	24	29.9
2019	35	14.7

White-flippered Penguin Trust

- Established in 2001 but had lapsed after the earthquakes (2011).
- Currently in the process of being re-established.
- Mission statement: to preserve, protect and foster the White-flippered Penguin as it is not only an endangered species but is also the only endemic species to Canterbury.
- It is the intention of WFPT to establish an eco-tourist facility at Boulder Bay on Godley Head to fund the ongoing preservation of the species. Here, the public will be able to view the Penguins as they arrive on shore at dusk before moving inland to their nesting boxes. A viewing platform, a visitor-centre, lighting and other facilities based on the successful eco-tourism ventures at Oamaru and Phillip Island (Australia) are part of the Trust's vision.

<u>Yellow-eyed penguin (YEP) / Hoiho</u>

Hoiho are classified globally as *endangered* and in New Zealand were recently (2016) reclassified as *nationally endangered*. Hoiho, in at least part of their range, are undergoing a serious continued decline in abundance [*https://www.yellow-eyedpenguin.org.nz/penguins/*]. Multiple pressures[6] appear to affect YEP population numbers (including starvation, disease, bycatch, predation, land-use changes and other human threats) and as the population declines it is likely to become less resilient to future impacts. Indications are that marine impacts are a major cause for decline, likely driven by global warming [*https://www.yellow-eyedpenguin.org.nz/penguins/*]. A recent study found sea surface temperature (SST) to be the dominating factor influencing survival of both adult birds and fledglings (*Mattern et al. 2017)*.

In 2016, the 'Yellow-eyed penguin stocktake report – He pūrongo mō te hoiho' reported on progress against the objectives and actions in the former 'Hoiho recovery plan 2000–2025' and recommended a new strategy to be developed. In February 2018, 'The pathway ahead for hoiho – Te ara whakamua' was completed by Conservation Science Advisor Trudi

[6] Detailed description thereof on YEP Trust website (https://www.yellow-eyedpenguin.org.nz/penguins/threats/)

Webster on behalf of the Yellow-eyed Penguin Trust. The report further assessed the array of threats hoiho face in the terrestrial and marine environments throughout their range. It summarised the current thinking about the threats and the research and management responses necessary to advance hoiho recovery. The hoiho recovery programme needs to be guided by a new strategy because the current hoiho recovery plan is no longer fit for purpose, although many of its objectives and actions are still relevant [*https://www.doc.govt.nz/nature/native-animals/birds/birds-a-z/penguins/yellow-eyed-penguin-hoiho/hoiho-threat-management-and-recovery-plan/*].

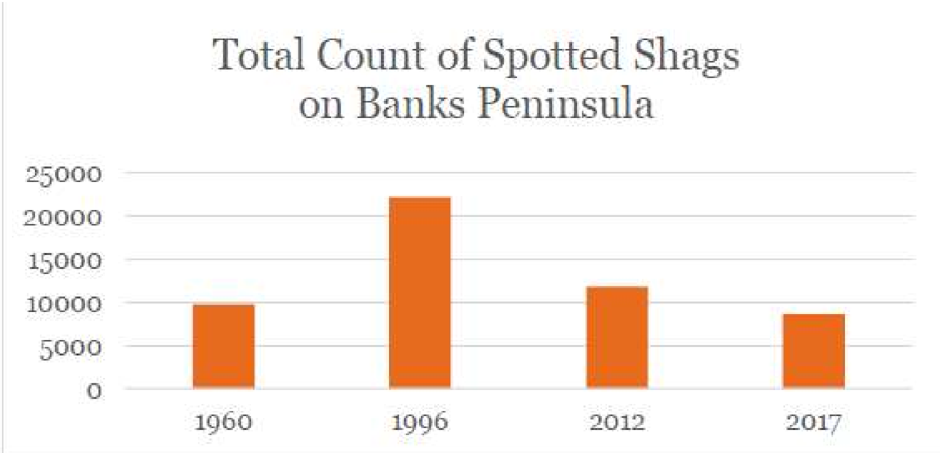
Hoiho breed along the south-east South Island, Stewart Island/Rakiura and its outliers, Codfish Island/Whenua Hou, the Auckland Islands and Campbell Island, but are also found on Banks Peninsula which marks the northern end of their breeding range. The colony is located in Flea Bay where it is monitored by the landowners in collaboration with BPCT and DoC. Since 2013 chicks get microchipped for easier identification upon return [The Wildside Newsletters, assorted]. Numbers have always been small and nesting success has fluctuated (1-9 chicks per year) since records began in 1988. And while average fledging numbers had shown a downward trend by 2000, this was reversed after intensified monitoring and predator control and unlike in other South Island locations, birds have been breeding successfully free from predation, starvation or disease and on average 5 chicks fledging per year until 2015. However, from 2016 onwards, less and less chicks were surviving, and some only due to care at Christchurch's rescue facility. Disease like avian malaria had found its way to Banks Peninsula Hoiho too. 2018 saw one chick surviving and 2019 none. On the more positive end of things, a juvenile bird, previously fledged from Banks Peninsula was re-sighted off the coast in 2017, and a two-year-old Banks Peninsula born penguin was found back moulting ashore in 2018 [*The Wildside Newsletters, assorted*].

North Canterbury waters apparently get frequented by birds from the Otago breeding population even though it is not yet clear whether it is for feeding or rather commute. Mel Young, a PhD researcher with Otago University is currently writing up her results about the at-sea distribution of juvenile YEP. Funding had been acquired to track YEP fledglings from Banks Peninsula as well but the study is on hold due to minimal to no breeding success over the last two seasons.

Adult YEP typically forage up to 25 km offshore during the breeding season. When birds do not have to return regularly to feed hungry chicks they can travel much further, up to 60 km or more from shore [*https://www.yellow-eyedpenguin.org.nz/penguins/*].

Spotted shag (SpSh)

Spotted shags breed in caves and on headlands of Banks Peninsula (*Graham et al. 2003*). The species is currently listed as 'not threatened'. Banks Peninsula supports up to 70% of the global population of this species which make up major parts of the large feeding congregations of cormorants in waters off Banks Peninsula. Spotted shags breeding colonies wax and wane in size and seem to move location fairly regularly. The 2010- 2012 earthquake sequence caused cliff collapse, resulting in partial loss and further redistribution of breeding colonies [*The Wildside Newsletters, assorted*]. The latest population survey has been carried out by CCC, supported by DoC, in Nov 2017.



It is unclear why the 1996 count was more than double of other counts, and whether we are seeing a downward trend or simply natural fluctuations. It is hoped that continuation of surveys will give a better understanding [*The Wildside Newsletters, assorted*].

However, numbers are at their lowest since the beginning of recording, and while earthquake effects cannot clearly be determined, it has been observed that Spotted shag colonies are now mostly found in habitats where predators cannot get them [*A. Crossland, pers. comm. 2019*]. Concerns are that loss / limitation of suitable breeding habitat in combination with predation pressure might have caused population decline and that the current situation might warrant a change in conservation status to 'threatened'. Little is known about the actual predation pressure on the breeding population on Banks Peninsula.

Spotted shags exhibit seasonal change in foraging habitat. They usually forage communally out to 15 km for most of the year, but, during summer, most feed closer inshore. During aerial surveys of flying seabirds up to 18.3 km off Banks Peninsula in February and July-August 1996, Hawke (1998) recorded about 50% of the 299 spotted shags that he observed within 1 nautical mile of shore. He attributed this to them feeding close to their breeding colonies (*Graham et al. 2003*). The main post-breeding aggregations in recent years have been observed at Ashburton River Mouth [*A. Crossland, pers. comm. 2019*].

The diet of spotted shags is primarily small (<150mm long) fish and marine invertebrates (primarily arrow squid); the main fish species taken are ahuru, red cod, gudgeon, cockabullies and sprats (*Graham et al. 2003*).

<u>White-fronted tern (WFT)</u>

The New Zealand population has declined markedly over the last 40 years and is currently regarded as At Risk/Declining. In 1998, the total population was estimated at 12,000-15,000 pairs (*Mills 2013*). No information seems to be available on more recent population numbers.

White-fronted terns often breed in ephemeral sites such as riverbeds, estuaries or river mouths that are subjected to frequent flooding**.** They nest in dense colonies which provide little protection against predation by introduced mammalian predators such as stoats, ferrets, cats, and rats. White-fronted terns often nest adjacent to red-billed gull colonies and some gulls, especially males, specialise in preying on the eggs and chicks of terns. Colonies of nesting terns are also vulnerable to disturbance by people and their dogs (*Mills 2013*). Breeding usually occurs in large dense colonies on shingle riverbeds, sand dunes, stacks and cliffs. Sometimes a site will be used in successive seasons, but usually the birds change sites in successive years even if they were successful at a specific site the previous season (*Mills 2013*). In North Canterbury they are found breeding around the coastline of Banks Peninsula and on Motunau island. A report on recent population counts is in preparation by A. Crossland (CCC).

White-fronted terns feed on small surface-shoaling and larval fish at sea, in lagoons or up rivers (*Mills 2013*). Around Banks Peninsula they occur primarily within 1 nautical mile offshore (*Graham et al. 2003*).

Red-billed gull (RBG)

The red-billed gull, *Larus novaehollandiae scopulinus*, is classed as Nationally Vulnerable in New Zealand because of an apparent decline in numbers nationally, especially at some of the largest colonies as revealed by the nationwide (*Frost & Taylor 2016*). The population thus far had been estimated at about 40,000 breeding pairs based on information collated in 1965. The 2014-16 survey resulted in 27,831 pairs of red-billed gulls breeding in New Zealand, of which 14,713 pairs were found at 122 South Island sites. The largest mainland concentrations on the South Island are at Kaikoura (3210 bp) and Taiaroa Head (2145 bp).

The red-billed gull is a long-lived, slow-reproducing species in which individual adults do not necessarily breed every year, so any long-term population change is more likely to be revealed by surveys carried out over many years. Nationwide surveys, such as the 2014-16 study, however, are too costly and complex to be done sufficiently regularly to provide accurate and timely information on major population changes. Instead, Birds New Zealand, in conjunction with others, aims to identify several representative colonies around the country, that are reasonably accessible and for which teams of volunteers are willing and able to survey several times a season over many years, using comparable and consistent methods (*Frost & Taylor 2016*).

In North Canterbury, RBG are breeding predominantly on Banks Peninsula in 9 distinct colonies (4 with 100-500bp, 3 with 10-100bp and 2 with <10bp). In Pegasus Bay RBG are only found breeding on Motunau Island with <100bp. While small in comparison to the main South Island colonies, this is the largest aggregation of RBG breeding colonies in all of Canterbury and of conservation concern seeing that the whole population is currently in decline.

Among the many factors potentially adversely influencing the red-billed gull population, predation and disturbance at breeding colonies, although prevalent, may be less important than changes in food availability offshore during the breeding season (*Frost & Taylor 2016*). Off the North Canterbury coast RBG are found feeding on surface-dwelling prey like invertebrates and fish over a wide area of the continental shelf. During the breeding season RBG are often found feeding inshore on krill (*Graham et al. 2003*).

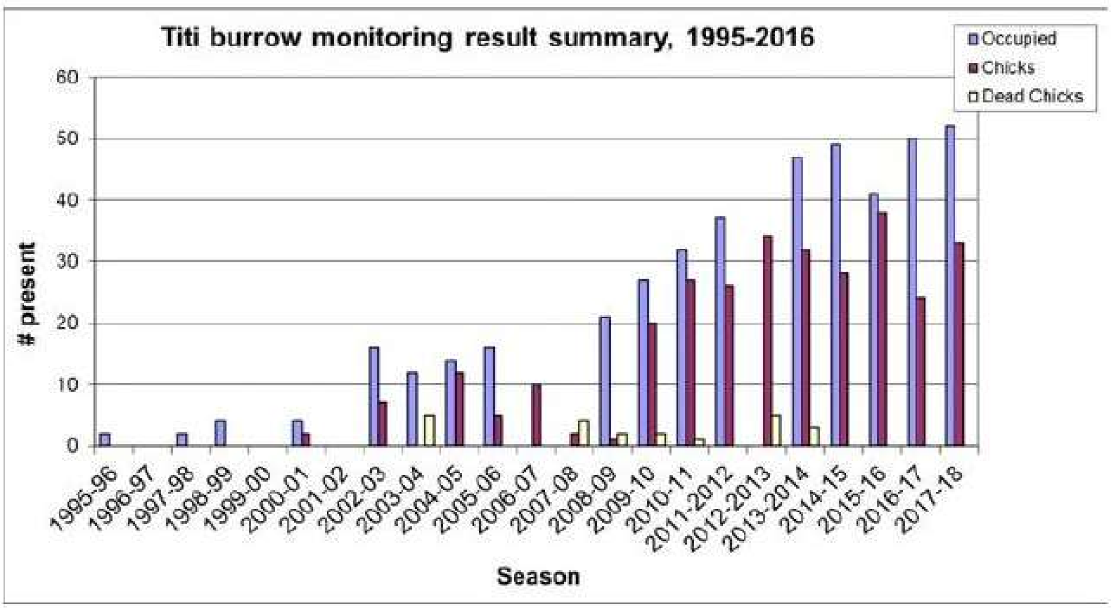
Sooty shearwater

Another previously common species listed as ‘At Risk / declining’.

Introduced mammals, particularly feral cats, rats, mustelids, feral pigs and dogs have extirpated most mainland sooty shearwater breeding colonies. Large breeding populations are now restricted to predator-free offshore islands. The sooty shearwater is one of the seabird species most frequently observed killed in the New Zealand fisheries during 1996-

2004, with demersal longliners and trawling operations responsible for the majority of mortalities. Sooty shearwaters migrate to the North Pacific Ocean, where they may be at greater risk from pollutants and gill net fisheries (*Sagar 2013*).

Sooty shearwaters breed on numerous islands around New Zealand, from the Three Kings in the north and south to islands around Stewart Island, as well as The Snares, Auckland, Campbell, Antipodes and Chatham Islands. All the large colonies are around Stewart Island or on The Snares. A few small colonies persist on headlands of mainland South Island (*Sagar 2013*). For North Canterbury this refers to the colony at Stoney Bay, looked after by the Armstrong family. The colony is enclosed by a predator proof fence since (*when?*), which was damaged in the 2010/2011 EQ's but full repairs were completed in 2014. The colony shows continuous growth since about 2009 and currently counts about 52 breeding pairs fledging around 30 chicks per year [*The Wildside Newsletter, assorted*].



A considerably larger colony of Sooty shearwater is reported from Motunau Island, where a survey carried out in 1997 estimated 230 burrows. In comparison to the previous survey from 1962 which found about 80 burrows, these numbers also indicate population growth for Sooty shearwater breeding in the North Canterbury region. However, it appears that no further comprehensive population counts have happened since.

Sooty shearwater eat fish, squid, krill, and offal from fishing vessels taken from the surface and by diving. Birds frequently plunge or dive for food to depths averaging 16 m, and have been recorded swimming to depths of over 60 m.

Hutton's shearwater (HS)

Even though not a breeding bird in the North Canterbury region, HS are regularly observed both off Banks Peninsula and Pegasus Bay [*A. Crossland pers comm 2019*]. Bennet et a. (2019) found that foraging adults frequented North Canterbury waters extensively during chick-rearing (Dec-Feb), indicating the importance of this area in supporting and endangered seabird species.

HS breeds exclusively in the Kaikoura ranges with one large and one small colony remaining in the wild as well as in a man-made translocation colony on the Kaikoura peninsula. The species is listed as Threatened / Nationally vulnerable but has since suffered substantial losses due to the Kaikoura earthquakes in 2016. Post-EQ population estimates have been carried out and are currently under review.

Fairy prion

The fairy prion is an abundant and familiar petrel of exposed coastal waters around New Zealand, especially from Cook Strait southwards. It often feeds in large flocks over tide rips near offshore rocks and islands. The species breeds on the Poor Knights Islands, islands in the outer Marlborough Sounds (especially Stephens Island, Trio Islands and The Brothers), rock stacks and islets off the West Coast (including the Open Bay Islands), Motunau Island, rock stacks off Banks Peninsula, cliff ledges on Otago Peninsula and nearby Green Island, many islands in Foveaux Strait and around Stewart Island, Mangere Island and at least six smaller islands in the Chatham Islands, the Snares Islands, Antipodes Island and Macquarie Island. Fairy prions are likely to have bred on many coastal headlands before human arrival in New Zealand. Apart from on a few inaccessible cliff ledges on Otago Peninsula, fairy prions have since been extirpated from the mainland by introduced predators. Their main natural predators at their island breeding sites are subantarctic skuas and swamp harriers. Introductions of feral cats, weka or rats decimated or extirpated fairy prion populations on many muttonbird islands around Stewart Island. (*Miskelly 2013 / 2019*).

On Motunau Island, the fairy prion is the most abundant breeding species. Their burrows occur all over the island but are concentrated on the slopes and plateau edge in approximately 14,000 burrows. If the North-East and West slopes are no longer being used because of their boxthorn cover, and total prion numbers are stable, then the birds must have redistributed themselves around the island (*Beach et al. 1997*).

The species is listed in NZ as ‘At Risk / Relict’. Few actions specifically targeted at conservation of fairy prions have been undertaken. These included translocation of 240 near fully-grown chicks from Stephens Island to Mana Island during 2002-04 in an attempt to establish a new population, and installation of nest boxes at a cliff-ledge colony on Otago Peninsula. Other more generic island restoration projects (especially pest mammal and weka eradications) have and will benefit fairy prion populations, including on Stephens Island, Mangere Island and on several muttonbird islands near Stewart Island (*Miskelly 2013 / 2019*).

Fairy prions mainly eat small pelagic crustaceans, along with small fish and squid. The small krill species *Nyctiphanes australis* is by far the predominant species eaten in New Zealand, followed by pelagic amphipods and copepods.

White-faced storm petrel (WFSP)

The species is listed as ‘At Risk / Relict’. Birds breed in colonies on small islands scattered irregularly around the New Zealand coast, returning for parental duties at night. Their small size makes them extremely vulnerable on land and they are only able to breed on islands that are totally free of exotic predators. The largest colony, on Rangatira Island (Chatham Islands) was estimated at 840,000 pairs.

On Motunau Island, WFSP seem to be restricted to the central and western parts of the plateau. A total of 425 burrows was estimated in 1958-62, but only 134 in 1996. The 1996 figure could be an under-estimate due to Storm Petrels using larger burrows which were attributed to Fairy Prions (*Beach et al. 1997*).

They are only found in the seas around New Zealand for the duration of the breeding season (August to April), migrating to the tropical eastern Pacific for the off season. WFSP are pelagic and usually found near the edge of the continental shelf and over upwellings in the very deep water beyond. In New Zealand they are tied to their breeding colonies and often seen much closer to shore.

White-faced storm petrels mainly eat planktonic crustaceans and some small fish, picked up from the surface of the water (*Southey 2013*).

2.3.5 Marine mammals

North Canterbury waters are home to two year-round resident marine mammal species, the South Island Hector's dolphin and the New Zealand fur seal. Yet, waters are frequented by another 6 species like the seasonal migrants Southern right whale and Humpback whale, and seasonal to infrequent visitors Dusky dolphin, Common dolphin, Orca and Bottlenose dolphin (*Cawthron Institute 2010*). In addition, Minke, Sperm, Sei, Pilot, Pigmy right and beaked whale as well as Leopard and Elephant seals are sighted on occasion (*Graham et al. 2003*).

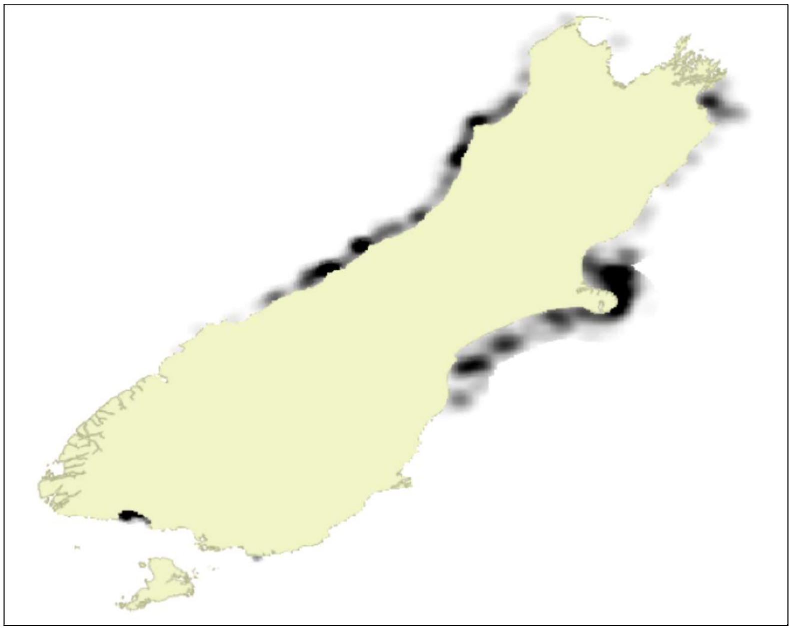
2.3.5.1 Species of regional importance / conservation concern

The following sections provide further information on those species to whom NC waters are of known importance.

<u>Hector's dolphin</u>

One of the smallest dolphin species worldwide, the Hector's dolphin is split within two sub-species in New Zealand: the Māui dolphin which is found off the west coast of the North Island and the South Island Hector's dolphin which is found around the South Island (commonly referred to as simply "Hector's dolphin"). Māui dolphins are listed as 'Threatened / Nationally Critical', while Hector's are listed as 'Threatened / Nationally vulnerable' [*https://www.doc.govt.nz/nature/native-animals/marine-mammals/dolphins/hectors-dolphin/*].

Hector's dolphins are found around the coast of the South Island but distribution is patchy. Populations are concentrated between Haast and Farewell Spit in the west, around Banks Peninsula in the east, and Te Waewae Bay and Porpoise Bay/Te Whanaga Aihe in the south [*https://www.doc.govt.nz/nature/native-animals/marine-mammals/dolphins/hectors-dolphin/*].



Kernel density plot of Hector's dolphin distribution around the South Island, using sightings from the two most recent line transect surveys (*Slooten et al. 2019*).

The South Island population of Hector's dolphin is estimated at 14,849 individuals [*https://www.doc.govt.nz/nature/native-animals/marine-mammals/dolphins/hectors-dolphin/*]. A small, separate sub-population of these dolphins is reported for the Pegasus Bay-Motunau area (*Clement et al. 2001*).

The Banks Peninsula animals are considered to be part of a semi-residential and fairly isolated community that are not thought to intermix with other regional communities to the north or south.

During the warmer summer and autumn months, dolphins move close to the shore and spread into the Peninsula's bays and harbours. It is over this time period that most Hector's dolphin calves are born (October to March). While calves have been regularly sighted within particular areas of Akaroa and Lyttelton Harbours and some southern bays, no distinct calving and/or nursery areas have been clearly identified. Over the colder months animals generally move further offshore and mainly out of the bays and inner harbour regions, with only a few animals continuing to remain in mid-harbour and entrance waters (*Cawthron Institute 2010*). A study identifying major hotspot locations (based on over 9000 sightings over the course of 29 years) found highest densities of Hector's dolphins east of Birdling's Flat, the outer Akaroa Harbour, Flea Bay, and around Okain's Bay [*Brough et al. 2019*]. These were predominantly based on summer distribution patterns, when the dolphins concentrate closer to the coast. Notable declines in the use of the Akaroa Harbour and the Okain's Bay hotspots were evident outside summer, and the distribution of sightings during winter months was not consistent with the hotspot patterns seen during other seasons (*Brough et al. 2019*). Recurring low density areas were also identified between Lyttelton Harbour and Menzies Bay, inner Akaroa Harbour, and around Long Bay.

Females reach sexual maturity between seven to nine years of age. They produce just one calf every two to three years, making population increase a very slow process. Most females only have four or five calves in a lifetime. Calving usually occurs between November and mid-February, and calves stay with their mothers for up to two years [*https://www.doc.govt.nz/nature/native-animals/marine-mammals/dolphins/hectors-dolphin/*].

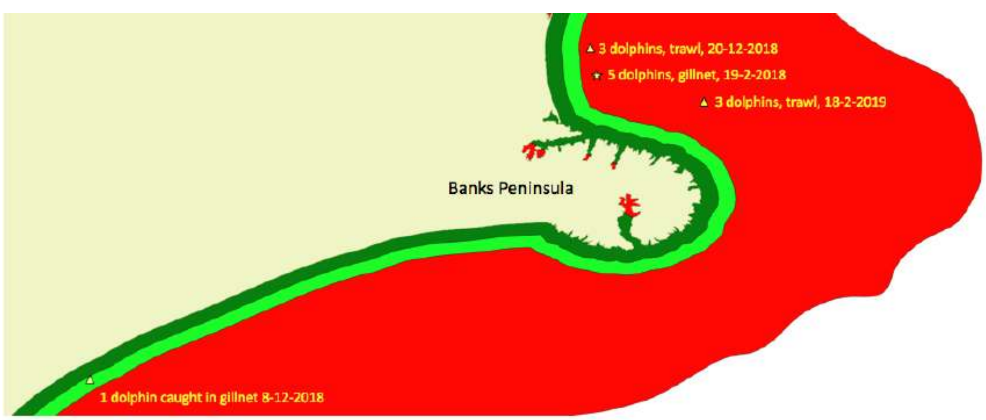
Like other dolphins, Hector's use echolocation to find their food. They send out high frequency 'clicks' that bounce off surrounding objects and fish, giving the dolphins a detailed picture of their surroundings. This sonar is not used all the time, which may be one of the reasons why the dolphins get caught in nets. Set net fishing poses a major threat to Hector's dolphins, as entanglement leads to death through suffocation. [*https://www.doc.govt.nz/nature/native-animals/marine-mammals/dolphins/hectors-dolphin/*]

Furthermore, the diet of Hector's dolphins includes flatfish and red cod (*Slooten & Dawson 1994; E. Hutchison pers. comm.*) and therefore overlaps to some degree with the target species of the inshore trawl fishery (*Rayment & Webster 2009*).

A behaviour called 'trawler foraging' (*W. Rayment & T. Webster pers. obs.*) it seems particularly prevalent on the north side of Banks Peninsula, where a region of relatively high Hector's dolphin abundance overlaps with high inshore trawl fishing effort and dolphins are possibly feeding on the fish being stirred up. And although the bycatch rate of Hector's dolphins in trawl fisheries is low compared with that in gillnet fisheries (*Department of Conservation & Ministry of Fisheries 2007*), the consequence of any bycatch is significant.

Aggregations of dolphins, typically involved in what is assumed to be foraging behaviour, were observed following small inshore trawlers year-round. Group size of aggregations of dolphins following trawlers was larger than for non-trawler groups and dolphins behind trawlers were typically in a more "excited" state, frequently exhibiting aerial and sexual behaviours. It is thought that trawlers increase the availability of prey for Hector's dolphins and hence foraging behind trawlers is an energetically favourable activity. However, following trawlers probably also increases the risk of being caught in trawl nets, compounding the threats faced by this endangered species.

To monitor as well as mitigate bycatch, observers and in some cases video camera monitoring was established on commercial fishing vessels. However, observer coverage was highest in 1997-98 and has been very poor since then. Only about 1-3% observers on gillnetting boats. A bit better on trawling. There has been no gillnet observer coverage at Banks Peninsula since 2002. in the last 18 months, three cases of trawl bycatch have been reported. Two events of 3 dolphins each and one event with 1 dolphin. In addition of 5 dolphins caught in one gillnet off Banks Peninsula. [*Liz Slooten, pers. comm. 2019*]



Recent bycatch events around Banks Peninsula, reported by fishermen [*https://www.doc.govt.nz/our-work/hectors-and-maui-dolphin-incident-database/*].

Over the last two decades the IUCN status of Hector’s has changed from ‘Vulnerable’ to ‘Endangered’. According to the IUCN, sixty per cent of all dead Hector’s dolphins, for which the cause of death could be determined, had died as a result of gillnet entanglement. [*EIA*]

As Hector’s dolphins predominantly occur in inshore waters, often even in bays and harbours, they are also at risk of being injured by boats. Newborn dolphins are particularly vulnerable as they swim relatively slowly, close to the surface. Some have been killed by boat propellers when unwary boaties have run them over [*https://www.doc.govt.nz/nature/native-animals/marine-mammals/dolphins/hectors-dolphin/*].

The Banks Peninsula marine mammal sanctuary in Canterbury was established in 1988 primarily to reduce set-net deaths of Hector’s dolphins in the area. The Marine Mammals Protection Regulations were introduced in 1992 to control marine mammal tourism activities. Set-net controls were introduced to Canterbury in 2002 and in west coast North Island in 2003. DOC, in a joint initiative with the Ministry of Fisheries developed a Draft Threat Management Plan (TMP) released in 2007. This is currently under review with the aim to reassess the way threats to these dolphins are managed. This is based on updated information on the Hector's and Māui dolphin populations and new information on the threats they are exposed to (such as fishing, disease and noise), and how serious those threats are. The consultation process is to begin in June/July 2019 and plan to be finalised in October 2019.

Make your submission:

https://www.mpi.govt.nz/news-and-resources/consultations/hectors-and-maui-dolphins-threat-management-plan-review/?fbclid=IwAR3dvaJkhvhM3BTsWgYaqWDbmNQJN5aO2dR9rv8eYP4MI6RJ1U8jB07Rst4

Right and Humpback whales

Regular sightings of southern right whales occur off Banks Peninsula, in particular the northern bays and Lyttelton Harbour coastline, each year as whales migrate back to their traditional wintering grounds around New Zealand. The majority of whales are sighted along New Zealand’s eastern coastal shores, and Banks Peninsula is considered one of their preferred habitats. It is not unusual for these whales or humpback to enter shallow, enclosed harbours such as Otago, Akaroa or Lyttelton Harbours, and remain for several hours or the course of a day. However, based on historical whaling data and a review of sightings, Banks Peninsula does not appear to be a final destination point for right whales. At the current sighting rate, at least one, and more likely two, right whales are expected to appear near or within Lyttelton Harbour entrance waters each winter where they will remain for a few days and up to a week. These whales are fairly solitary animals that usually travel alone or in small groups of 2-3 individuals.

Due to their low numbers around mainland New Zealand (less than 50 animals), southern right whales are listed as *nationally endangered*. While researchers believe whales around mainland New Zealand are potentially increasing, as of 2002 there has been no increase in the number of cow/calf pairs sighted in the last 25 years. Instead, the recent increase in sighting numbers is attributed to the increase in public awareness. Right whales’ tendency to remain within coastal surface waters while feeding and migrating, and their natural curiosity places them at greater risk of interactions with human activities *(Cawthron Institute 2010).*

Seals

New Zealand fur seals are increasing in abundance and distribution around Banks Peninsula (PBAL 2001) but appear to be rare visitors to harbours and embayments along the eastern and northern coasts. They are becoming common at isolated, exposed promontories, especially along the peninsula's southern coast, but are infrequent on the peninsula's north-eastern coast. A few NZ fur seals are found along the northern coast of Pegasus Bay, where they haul out in rocky promontories in the vicinity of Motunau (*Graham et al. 2003*).

Two distinct breeding colonies are found in southern Peninsula bays. Seals tend to be more densely clumped within breeding colonies from late spring to summer, and pups generally leave colonies around late winter/spring months. This species is considered non-migratory and generally thought to return to the same breeding colony once they are sexually mature. However, fur seals are known to travel long distances to find food. Some adults will travel out to open waters over winter while younger animals remain in shelf waters. Fur seals are the most common pinniped species observed within New Zealand waters today. Due to their general abundance and sustained growth, New Zealand fur seals are considered *not threatened* by the New Zealand Threat Classification System. Current threats at sea include entanglement in trawl fisheries and pollution such as oil spills. On land, fur seals are susceptible to disturbance from humans and domestic animals, such as dogs *(Cawthron Institute 2010).*

2.4 Marine protected areas

Marine Protected Areas - Policy and Implementation Plan (2005) [*https://www.doc.govt.nz/about-us/science-publications/conservation-publications/marine-and-coastal/marine-protected-areas/marine-protected-areas-policy-and-implementation-plan/*]:

New Zealand Commitment to Marine Biodiversity

1) Marine biodiversity is among the great taonga (treasures) of Aotearoa/New Zealand. The geological isolation, range and complexity of habitats, and number of major ocean currents that influence New Zealand have created diverse marine communities. The Government, recognising both the environmental importance of marine biodiversity and the value that it provides to all New Zealanders, has made an explicit commitment to ensure its protection.
2) The New Zealand Biodiversity Strategy (NZBS) reflects the commitment by the Government, through its ratification of the international Convention on Biological Diversity, to help stem the loss of biodiversity worldwide.
3) The NZBS establishes the strategic framework for action, to conserve and sustainably use and manage New Zealand's biodiversity. The strategy provides statements of desired outcomes and objectives for different aspects of biodiversity management. The strategy also lists a number of actions that, when combined with existing management measures, will achieve the objectives and outcomes.
4) The following are the **desired outcomes for Coastal and Marine Biodiversity in 2020**:
    a. *New Zealand's natural marine habitats and ecosystems are maintained in a healthy functioning state. Degraded marine habitats are recovering. A full range of marine*

habitats and ecosystems representative of New Zealand's marine biodiversity is protected.

b. *No human-induced extinctions of marine species within New Zealand's marine environment have occurred. Rare or threatened marine species are adequately protected from harvesting and other human threats, enabling them to recover.*

c. *Marine biodiversity is appreciated, and any harvesting or marine development is done in an informed, controlled and ecologically sustainable manner.*

d. *No new undesirable introduced species are established, and threats to indigenous biodiversity from established exotic organisms are being reduced and controlled.*

5) There are seven objectives under the Coastal and Marine Biodiversity theme, and of direct significance to the Marine Protected Areas (MPA) Policy is Objective 3.6, which is to:

   Protect a full range of natural marine habitats and ecosystems to effectively conserve marine biodiversity, using a range of appropriate mechanisms, including legal protection.

Contribution of other Marine Management Initiatives to Marine Biodiversity Protection

6) The Marine Protected Areas (MPA) Policy is intended to guide the development of a comprehensive and representative network of MPAs using a number of marine management tools. The network will significantly contribute to meeting Objective 3.6 and the NZBS outcome that natural marine habitats and ecosystems are maintained in a healthy functioning state. However, it is just one of a wide range of management initiatives designed to protect marine biodiversity. The other initiatives include effects-based management of the coastal and marine area under the Resource Management Act 1991 (RMA), management for sustainable utilisation of fisheries under the Fisheries Act 1996, protection of marine mammals and threatened species under conservation legislation, and management of marine incursions under the Biosecurity Act 1993.

7) Three other major initiatives relating to marine management and their relationship to the MPA Policy are outlined below.

8) A New Zealand Oceans Policy will provide the overarching framework for all decisions made about the marine environment to ensure they are both coherent and consistent with stated priorities. The need for a comprehensive marine biodiversity management regime was identified in the NZBS (Objective 3.2, Action (a)). The Oceans Policy may influence the approach taken to matters such as the protection of marine biodiversity, including the MPA Policy. Such influences will be considered once the Oceans Policy is completed.

9) The Ministry of Fisheries is also implementing the Strategy for Managing the Environmental Effects of Fishing (SMEEF)1. The SMEEF is being implemented to deliver on the general obligation to avoid, remedy or mitigate the adverse effect of fishing on the aquatic environment. Under the SMEEF, the Ministry will identify habitats or species at risk from fishing, and establish environmental performance standards, which will inform the delivery of management interventions. Where fishing affects the maintenance of marine biodiversity, the MPA network will assist in addressing Fisheries Act obligations. Conversely, any sites protected in the course of implementing the SMEEF will be considered for contribution to the MPA network on the basis that they are

representative of a particular habitat or ecosystem and they meet the protection standard.

10) The New Zealand Coastal Policy Statement (NZCPS) – a mandatory national policy statement under the RMA – is currently under review. The primary role of the NZCPS is to provide national guidance to local government on day-to-day coastal planning matters. Local authorities are required to give effect to the NZCPS when preparing policy statements and plans and assessing resource consent applications. In relation to marine protection, the NZCPS could provide more specific policy guidance on managing effects such as sedimentation, discharging, and dumping on sites that form part of the MPA network, and on the types of values at the national, regional and local level that would merit some form of marine protection.

2.4.1 Marine reserves

New Zealand's coastal marine area is more than 15 times larger than its terrestrial area, and our Exclusive Economic Zone[7] is the fourth largest in the world. However, only a small percentage of this environment is currently protected (*Environment Canterbury Regional Council, Ebox Series*).

Marine reserves currently provide the highest level of marine protection in New Zealand, and generally prohibit harvesting or human intervention. There are over 44 marine reserves in New Zealand's territorial waters, and these are managed by DoC. The main aim of a marine reserve is to create an area largely free of human impacts for the purpose of scientific study. Marine reserves may be established in areas that contain underwater scenery, natural features, or marine life of such distinctive quality, or so typical, beautiful or unique, that their continued preservation is in the national interest. The Marine Reserve Act was passed in 1971, and in 1975 the first marine reserve was created. They have been found to provide safe areas for marine life to "breed and seed", ultimately spilling over marine reserve boundaries to replenish the surrounding marine ecosystem (*Rose et al. 2014*).

One of the primary functions of most marine reserves in New Zealand is protecting spatially delimited areas from the effects of fishing. Their success is generally measured by the recovery of exploited species within their boundaries, which is reliant on consistently conducted monitoring time series (*Willis 2013*).

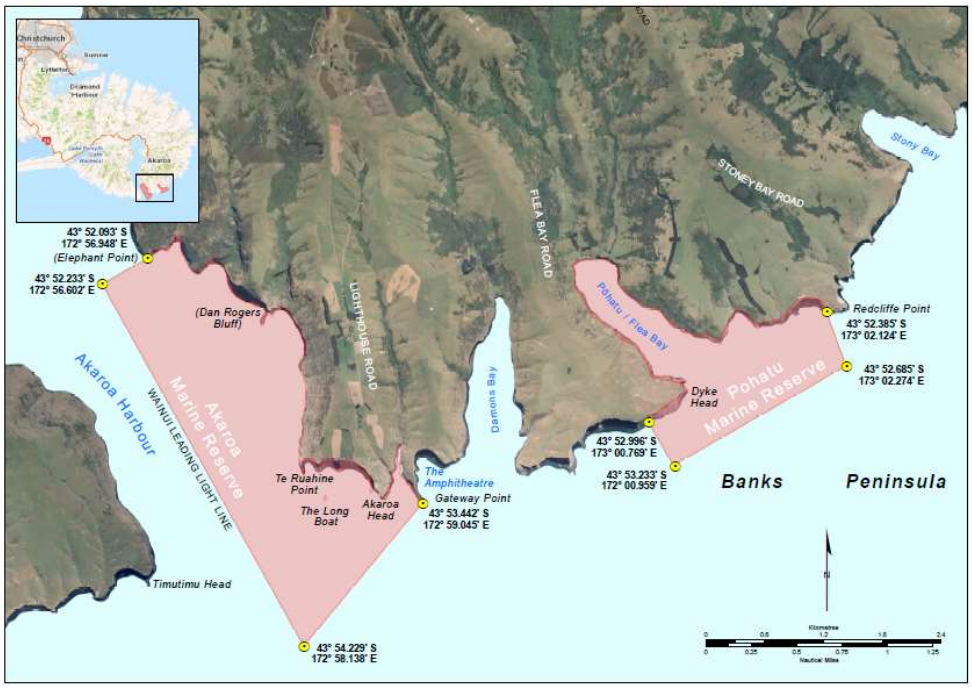
However, intended as a conservation tool rather than a fisheries management tool, marine reserves protect all components of a marine ecosystem, helping to conserve biodiversity and allowing ecosystems to return to a more natural state. Marine reserves are widely recognised as a successful conservation tool with many direct and indirect benefits. Research surveys have shown increases in species diversity, abundance and size of many marine species in marine reserves around New Zealand. Snapper, blue cod, rock lobster and paua have all shown increases in abundance and size in reserve sites, compared to non-reserves sites in many marine reserves. Surveys have also shown changes to benthic (seafloor) communities. Furthermore, marine reserves can benefit whole communities by uniting people through education and management, connecting people to their 'big blue backyard' and by creating unique attractions that boost the local economy. Marine reserves are a huge attraction in New Zealand to local, domestic and international visitors.

[7] The exclusive economic zone is where a country has special rights over the exploration and use of marine resources including energy production from wind, water and oil. It stretches from the shoreline out to 200 nautical miles from the coast.

[*https://www.doc.govt.nz/nature/habitats/marine/type-1-marine-protected-areas-marine-reserves/purpose-and-benefits/*]

2.4.1.1 Marine reserves in the North Canterbury region

Two marine reserves have been established within the North Canterbury region (in fact, apart from the Hikurangi marine reserve south of Kaikoura, these are the only marine reserves along New Zealand's East coast): Akaroa and Pohatu marine reserve, both located on the south side of Banks Peninsula.



[*Source: https://www.doc.govt.nz/globalassets/documents/parks-and-recreation/places-to-visit/canterbury/mahaanui/akaroa-and-pohatu-marine-reserves.pdf*]

2.4.1.2 Akaroa marine reserve

The Akaroa Marine Reserve, an area of 475 hectares (1,170 acres) at the entrance to the Akaroa Harbour, was approved in 2013 after a lengthy campaign and has been gazetted and legally come into effect on June 8, 2014.

Forest and Bird carried out exploratory dives in the Akaroa Harbour in 1990 and a formal proposal for the establishment of a 560ha marine reserve was made in 1996 by the Akaroa Harbour Marine Protection Society. The Conservation Minister Kate Wilkinson declined the application for the reserve in 2010 on the grounds that it would adversely affect recreational fishing. The decision was challenged in the High Court and was squashed in a 2012 ruling. Overall, the two separate consultation processes for the application had attracted more support than opposition. In April 2013 the Minister of Conservation Nick Smith announced the approval of the reserve but at the reduced size of 475 ha, which constitutes approximately ten per cent of the total harbour area. The size was reduced to take into account the concerns about customary and recreational fishing [*https://en.wikipedia.org/wiki/Akaroa_Marine_Reserve*].

Most of the remaining harbour is managed under a Taiapure[8] established in 2006. A follow up step will be integrating the local management of the Akaroa Taiapure and Akaroa Marine Reserve so the two mechanisms work together.
[*http://www.stuff.co.nz/the-press/news/10133273/NZs-newest-marine-reserve-opens-at-Akaroa?rm=m*]

Reserve characteristics:

[*https://www.doc.govt.nz/parks-and-recreation/places-to-go/canterbury/places/banks-peninsula-area/akaroa-marine-reserve/*]

Sheer cliffs dotted with caves form the backdrop of the reserve, and huge room-sized boulders lie in the water at their base. There are also numerous small reefs. Giant beds of bull kelp and red algae surround these landforms, which are encrusted with communities of sponges, anemones, sea stars and sea tulips. The reef around Gateway Point is of particular scientific interest as it supports an extremely rich and diverse fauna and flora - at least 10% of the benthic species found in this area are 'undescribed'. The sea floor is mostly gently sloping between 18-30 metres deep, rising steeply to the rocky platform which fringes the shore. The usual array of burrowing animals inhabit the sandy bottom, mostly various tubeworms, molluscs and bivalves.

Akaroa is visited by many marine mammals including the world’s smallest dolphin, the Hector’s dolphin. Smaller whale species often visit the reserve, and occasionally larger whales such as humpback, southern right and blue. Hector's dolphins can usually be seen throughout Akaroa Harbour in the summer months. Common and dusky dolphins are occasional visitors. Seals haul out along the rock platforms edging the reserve, which are also inhabited by white-flippered penguins. Albatrosses, petrels and many other seabirds visit or live in the harbour.

The township has built a substantial tourism industry around the marine life in its harbour. The reserve runs alongside the Dan Rogers Bluff and Cathedral Cave, which are spectacular scenic features and wildlife habitats visited on most marine tourism cruises. The relevance of the reserve to marine tourism is that it includes the main area that most marine tourism operators visit, both because of the scenery and bird nesting habitats (*Rose et al. 2014*).

Marine reserve rules:

[*https://www.doc.govt.nz/parks-and-recreation/places-to-go/canterbury/places/banks-peninsula-area/akaroa-marine-reserve/*]

You are not permitted to take any animal or natural form from the reserve, including fish, shellfish, shells, seaweed, rocks or driftwood.

[8] ‘Taiapure’ means ‘local fishery’ and identifies an area that has customarily been of special significance to an iwi or hapu as a source of food or for spiritual or cultural reasons. Taiapure are legally recognised under the Maori Fisheries Act 1989.

- No fishing of any kind.
- Don't take or kill marine life.
- Don't remove or disturb any marine life or materials.
- Don't feed fish - it disturbs their natural behaviour.
- Take care when anchoring to avoid damaging the sea floor.

2.4.1.3 Pōhatu marine reserve

Pōhatu Marine Reserve is centered on Flea Bay and was formally notified in 1999 [*https://en.wikipedia.org/wiki/Pohatu_Marine_Reserve*]. Its rock pools contain dense communities of the smaller sea creatures, and beneath the waves it has a wide range of water depths and seabed types. About 2,600 korora (white flippered penguins) and some yellow-eyed penguins breed at Pohatu – the largest little penguin colony on the mainland. They can be seen clustered in the undergrowth of the surrounding hills, up to 700 m from the shore. They also swim out in the bay in large coordinated groups. There is a seal colony in the outer reserve, Hector's dolphins often visit, and orcas are a common sight, making the water really quite crowded on a good day. Albatrosses cruise these waters and are most likely to be seen from the headlands. The rocky shore platform around the edge of Flea Bay is abundant in small animals and plants. Visitors who enjoy rockpooling will see many kinds of crabs, shellfish, anemones and seaweed *[https://www.doc.govt.nz/parks-and-recreation/places-to-go/canterbury/places/banks-peninsula-area/pohatu-marine-reserve/*].

Recreational visits and use are encouraged in the Pōhatu Marine Reserve. This includes recreational activities such as: kayaking, boating, snorkelling, rock pooling in low tide, swimming and hiking. Rock lobster (crayfish) tagging is conducted by DoC to monitor change in population and distribution over time and to help measure the impact of the Reserve (*Rose et al. 2014*).

<u>Marine reserve rules:</u>

[*https://www.doc.govt.nz/parks-and-recreation/places-to-go/canterbury/places/banks-peninsula-area/pohatu-marine-reserve/*]

It is not permitted to take any animal or natural form from the reserve, including fish, shellfish, shells, seaweed, rocks or driftwood. Carefully replace rocks and stones if you lift them to observe marine life.

- Dogs are not permitted in the reserve, as they disturb wildlife.
- Stay on the main beach. The beach is surrounded by private land and the penguins nest there.
- Remove all rubbish.

2.4.1.4 Monitoring marine reserves

The two main objectives for establishing marine reserves are **rehabilitation** and **preservation**. Rehabilitation involves reinstating a former condition that has been modified by humans, whereas preservation focuses on maintaining existing habitats and conditions (*Cole 2003*).

When the primary objective of a monitoring programme is to observe the long-term effects of an area-based manipulation (e.g., the cessation of fishing in a delimited area), achieving that objective depends on whether observed changes in space or time are actually due to the manipulation. An ideal design has been referred to as a 'beyond-BACI' design, where BACI stands for 'Before After Control Impact'. Sampling should be conducted in both impact and control sites, before and after the impact occurs. A beyond-BACI design suggests that temporal variability be accounted for by replicated sampling episodes in time before the 'impact' (here, reserve establishment). Thus far, it has been difficult to implement a monitoring programme in New Zealand that samples more than once (if at all) before reserve establishment. Areas are usually surveyed only once and, unfortunately therefore, the surveys are often referred to as 'baselines'. However, factors other than fishing combine to cause considerable temporal variability. The call is out for a commitment to pre-reserve biological monitoring that is replicated in time (*Willis 2013*).[9]

Biological monitoring of marine protected areas (MPAs) is important to assess their effects and to determine whether they are meeting their objectives. Brough et al. 2018 found baited underwater video (BUV) an effective tool for monitoring fish populations and investigating species-habitat relationships at Banks Peninsula (in Pōhatu and Akaroa Marine Reserves). They recorded 28 fish species, which included the commonly fished species blue cod, blue moki and terakihi. The relative abundance of legal-sized blue cod (> 300 mm) was 3.6 and 2.1 times greater in Pōhatu and Akaroa Marine Reserves, respectively, than in the control areas, and was positively related to coarse sediment, cobble habitat and depth, and negatively related to the distance from reef structure. The relative abundance of legal-sized blue moki (> 400 mm) was 10 and 8 times greater at Pōhatu and Akaroa Marine Reserves, respectively, than in the control areas, and was strongly associated with canopy-forming algae and depth.

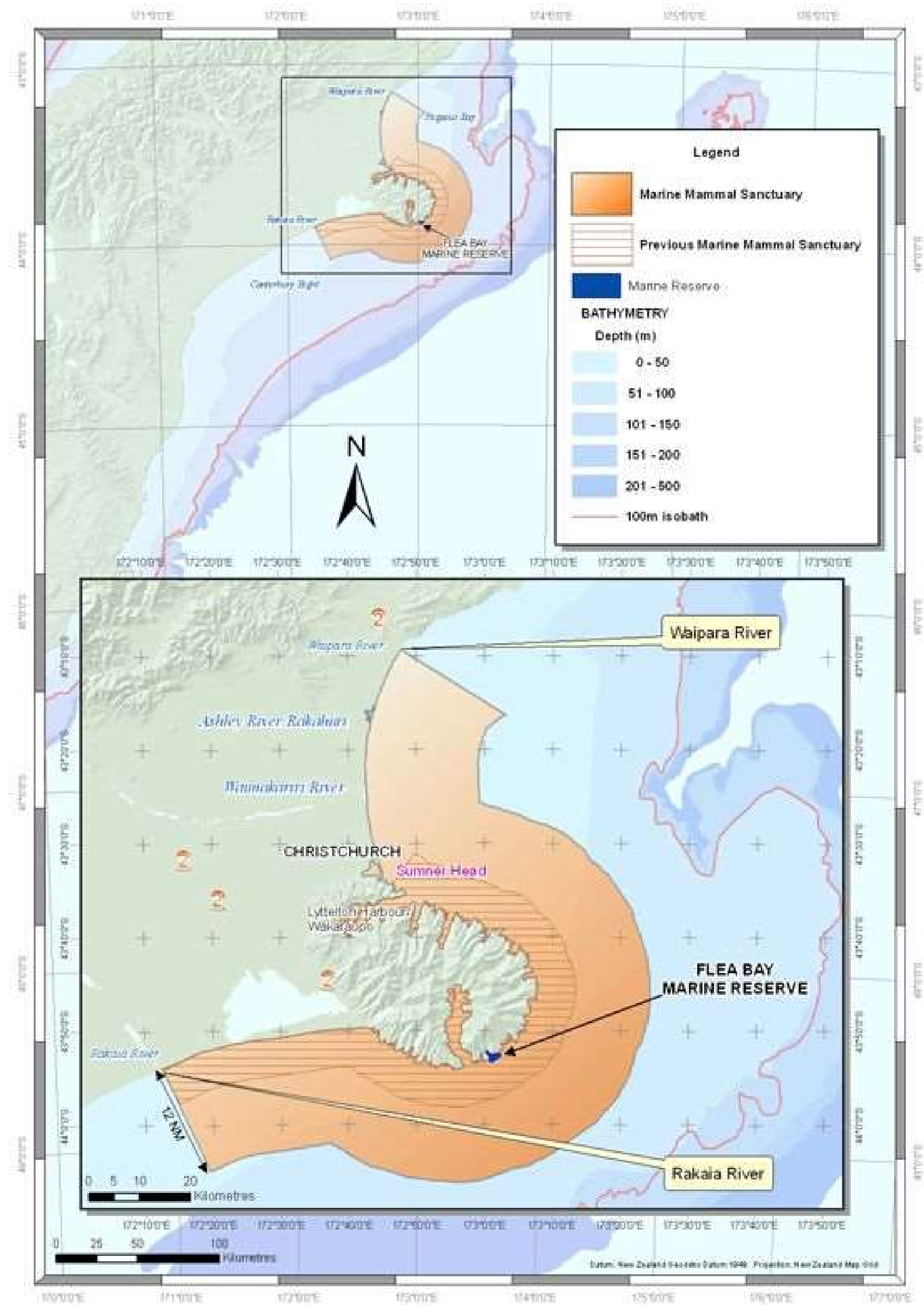
2.4.2 Banks Peninsula Marine Mammal Sanctuary

Banks Peninsula has been identified as a hotspot for Hector's dolphin on the east coast of the South Island. Its many bays and harbours are an ideal habitat for Hector's dolphins and for many other marine animals. New Zealand's first marine mammal sanctuary was created around Banks Peninsula in 1988, to protect the endangered Hector's dolphins from bycatch in set nets. When the sanctuary was first created, it covered an area of 114,000 hectares. It extended from Sumner Head to the Rakaia River, and out to a distance of 4 nm. Twenty years later (2008), the sanctuary boundaries were extended as it was recognised that further efforts to protect Hector's dolphins were necessary. The Banks Peninsula Marine Mammal Sanctuary encompasses now approximately 413,000 hectares and covers 389.31 km of coastline, extending from the mouth of the Rakaia River to the mouth of the Waipara River and out to sea 12 nautical miles (see map).

[9] Internal DOC reports on assessing / monitoring Pohatu (requested):

- Rutledge, M. 1996: A preliminary intertidal and subtidal survey of Flea Bay. Internal report, Canterbury Conservancy, Department of Conservation, Christchurch. 9 p.
- Davidson, R.J.; Barrier, R.; Pande, A. 2001: Baseline biological report on Pohatu Marine Reserve, Akaroa, Banks Peninsula. Report to the Department of Conservation, [Christchurch], prepared by Davidson Environmental Ltd. 22 p.
- Davidson, R.J.; Abel, W. 2003: Second sampling of Pohatu Marine Reserve, Flea Bay, Banks Peninsula (September 2002). Report to the Department of Conservation, DeVauchelle, Canterbury, prepared by Davidson Environmental Ltd. Survey and Monitoring Report No.

[*https://www.doc.govt.nz/nature/habitats/marine/other-marine-protection/banks-peninsula/*]



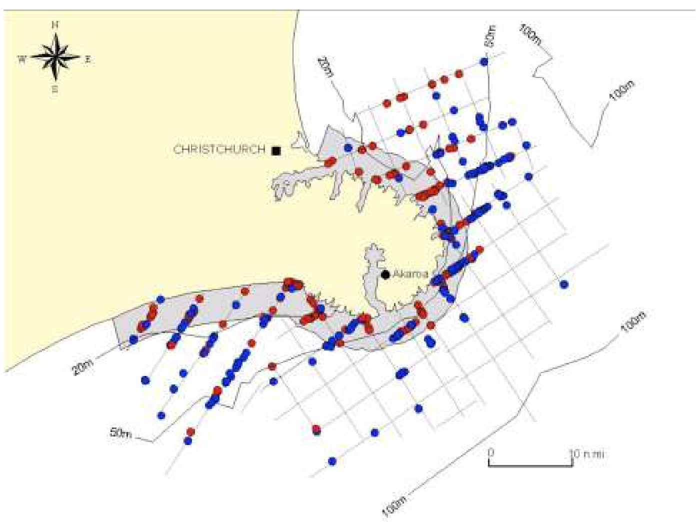
The main fishery restrictions in place within the sanctuary are:
[*https://www.doc.govt.nz/nature/habitats/marine/other-marine-protection/banks-peninsula/*]

- A year-round ban on amateur set netting.
- Seasonal set netting for flounder is permitted in the designated Flatfish areas from 1 April to 30 September.
- There are also restrictions on commercial set netting and trawling.

Fishers are encouraged to respect the Amateur Fisheries Regulations and Banks Peninsula Marine Mammal Sanctuary Regulations.

Acoustic seismic surveys are now also regulated within the extended sanctuary area, but there are still no restrictions on fishing beyond 4 nm. Thus, at this point, changes have resulted in additional restrictions on gillnetting to the north and south of the previous existing sanctuary, but no difference has been made to the offshore extent of the gillnet prohibition in the sanctuary (*Gormley et al. 2012*).

And while the current protection measures have shown first effects with annual survival increasing by more than 5% and population numbers being almost stable, after having been in decline at a of 6% per year before [*http://whaledolphintrust.org.nz/projects/hectors-dolphins/*], a recent study showed that the resulting level of population growth may be insufficient to adequately protect the population and as such not allow for full population recovery (*Gormley et al. 2012*). Hector's dolphins remain to be killed in set-nets (*Yeoman et al. 2018*). Not least as around Banks Peninsula, dolphins range out to 20 nm offshore, way beyond the current extent of the gillnetting ban area 4 nm offshore). It has been found that the dolphins' distribution depends much more on water depth than distance from shore.
[*http://whaledolphintrust.org.nz/projects/hectors-dolphins/*]



On the map above, dolphin sightings are shown as blue dots (winter) and red dots (summer distribution). The grey area is the protected area, where gillnets are not allowed to be used.

The NZ Whale & Dolphin Trust has requested to extend protection for Hector's dolphins to all waters less than 100 metre deep. Throughout NZ dolphin habitat it is necessary to ban gillnets and trawl nets as well as encourage the fishing industry to make the transition to fishing methods that do not kill dolphins (including fish traps and hook and line fishing). In addition, a study from 2019 on coastal Hector's dolphin hotspots during summer (*Brough et al. 2019*), has identified possible candidate areas for further protection from potential threats other activities not prohibited in the Banks Peninsula Marine Mammal Sanctuary.

2.4.3 Marine Important Bird Areas (IBA)

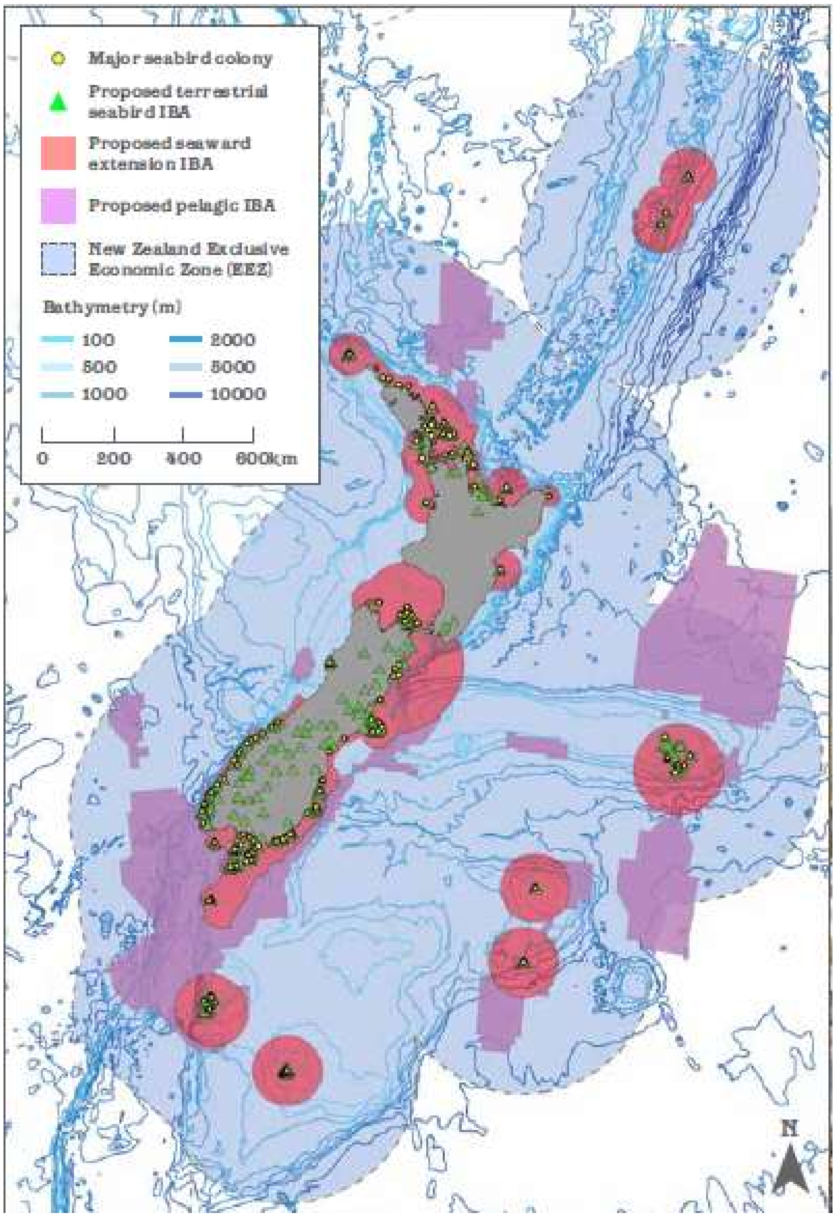
A report on IBA with regards to seabirds species in New Zealand has been put forward by F&B in partnership with BirdLife International and OSNZ in (*Forest & Bird 2014*):

Important Bird Areas (IBAs) are sites that are recognised as internationally important for bird conservation and known to support key bird species and other biodiversity. The function of the IBA Programme is to identify and help focus and facilitate conservation action for a network of sites that are significant for the long-term viability of naturally occurring bird populations, for which a site-based approach is appropriate. The IBA Programme is global in scale and the network may be considered as a minimum essential to ensure the survival of these species across their ranges, should there occur a net loss of remaining habitat elsewhere through human, or other, modification.

Since IBAs are identified, monitored and conserved by organisations and individuals working together on the ground, the **IBA Programme can be a powerful way to build national and local institutional capacity and to set an effective conservation agenda**.

Important Bird Areas (IBA) for New Zealand's seabirds fall into four categories:

1. Ninety-seven IBAs have been identified for sites on land, including offshore islands, principally colony sites, but also including major roosts and non-breeding congregation sites.
2. Forty-four sites on inland rivers (for inland breeding gulls and terns) and in coastal areas such as harbours, estuaries and lagoons have been identified as IBAs under the current project.
3. Twenty-six seaward extensions for foraging of limited range species and coastal and continental shelf areas.
4. Forty-three areas for pelagic seabirds have been identified to date.



Given the long periods that seabirds spend at sea, the multiple threats they face there and the vast distances they cover, identifying a network of priority sites for their conservation in the marine environment is critical to ensure their future survival. Determining seabird high-use areas and the **identification of marine IBAs** will make a vital contribution to initiatives to gain greater protection. This will include valuable input to the identification of Marine Protected Areas and will also contribute to efforts to ensure sustainable management of resources within New Zealand's EEZ.

Areas for pelagic species are those marine areas remote from land where they regularly gather in large numbers, whether to feed or for other purposes. These areas usually coincide with specific oceanographic features, such as shelf-breaks, eddies, upwellings and convergence zones, and their biological productivity is invariably high. BirdLife's *Tracking Ocean Wanderers: global seabird tracking database* comprises extensive data on distributions of seabirds at sea (originally for Procellariiformes – albatrosses and petrels), but more recently to include other seabirds collected from tracking devices deployed by research scientists. This database has proved to be a vital resource for the identification of marine IBAs relating to non-breeding congregations, migratory bottlenecks and at-sea areas for pelagic species.

The whole New Zealand EEZ is a globally important area for seabirds. There is a bewildering array of layers that seabirds utilise spatially and temporally. Foraging areas change through different stages of breeding. Most birds breed annually, some biennially, and at different times of the year. They can remain in New Zealand waters all year round or migrate away for short or long periods. To date (February 2014) tracking data for only 17 species of New Zealand's albatrosses and petrels has been entered into the *Tracking Ocean Wanderers: global seabirds tracking database* – http://www.seabirdtracking.org/. While this is an area of seabird research that is proliferating, the coverage of both species and study sites (ie. colonies where birds are tracked from) remains patchy. The resulting analysis for marine IBA purposes is in a formative state. Yet, despite this the picture that is emerging of how seabirds use New Zealand's marine environment from the tracking studies (combined with other data) is a complex one.

From a conservation perspective, identifying a network of priority sites for their conservation is a challenge but vital to ensure their future survival. BirdLife's Marine e-atlas, launched in 2012, is the first global inventory of these sites [*http://maps.birdlife.org/marineIBAs/default.html*]. Marine IBAs must be seen as a living process. As new data is added to the tracking database, this will result in new areas being defined, with some existing areas modified. Researchers are urged to continue submitting datasets to the *Tracking Ocean Wanderers: global seabirds tracking database*, including non-Procellariiform tracking datasets (ie. penguins, gannets, boobies, shags (cormorants), gulls and terns).

2.5 Cultural importance

The North Canterbury marine and coastal environment also plays a significant role in the Māori economy and way of life. A source of food and other resources since Māori first settled in New Zealand, the moana (ocean) is also spiritually and culturally important. Māori mythology and cosmology feature the sea god Tangaroa, son of the Earth Mother Papatūānuku and the Sky Father Ranginui. Traditionally, the sea provided transport and a way to trade with other tribes. Kaimoana (seafood) was served to show hospitality at hui (meetings), tangi (funerals), and other gatherings. The marine environment remains important to Māori, from both customary and commercial perspectives [*https://www.mfe.govt.nz/publications/environmental-reporting/environment-aotearoa-2015-marine/why-condition-our-marine*].

Ngāi Tahu are the **Tangata Whenua** (People of the land) who hold ancestral and traditional relationships for the area of Christchurch City and the Avon-Heathcote Estuary/ Te Ihutai. Ngāi Tahu is formally recognised through the Te Rūnanga o Ngāi Tahu Act 1996, which established Te Rūnanga o Ngāi Tahu (TRONT) as the legal identity and representative of the tribe. Te Rūnanga is made up of eighteen Papatipu Rūnanga who represent the whānau and hapū interests of particular areas.

In Christchurch there are six Rūnanga – Te Ngāi Tūāhuriri, residing at Tuahiwi in north Canterbury, but with traditional associations with the area of Christchurch; and four Rūnanga on Banks Peninsula (Ōnuku at Akaroa, Koukourārata at Port Levy, Wairewa at Little River and Te Hapū o Ngāti Wheke at Rāpaki in Lyttelton Harbour). Taumutu Rūnanga, with a marae near Leeston, also have interests in part of the Christchurch City area. Each Rūnanga has a territory (takiwā) that reflects their traditional areas used by their tīpuna (ancestors) for settlements (pā, kāinga) and resource gathering (mahinga kai). [Ngai Tahu and Te Ihutai 2009]

Ngāi Tahu Whanui is Tangata Whenua within the rohe (territory) of Ngāi Tahu. The iwi is made up of whanau and hapū (family groups) who hold traditional authority – **mana whenua**, over particular areas. Mana whenua is determined by whakapapa - genealogical ties and confers traditional political authority over an area. Once acquired, mana whenua is secured by ahi kā - continued occupation and resource use.

Kaitiakitanga is the expression of Māori authority, mana, ethics and guardianship. Tangata Whenua are the keepers and caretakers of knowledge relating to natural resources and the protectors of those resources. Kaitiakitanga is fundamental to the relationship of Tangata Whenua and the environment. Kaitiakitanga in relation to a particular resource can only be exercised by the particular Tangata Whenua who are the Kaitiaki (guardian) for the area. Kaitiakitanga is an environmental decision-making system, which has been developed by Tangata Whenua, and in this case Ngāi Tahu, to fulfil their responsibility towards the environment. The responsibility of Kaitiaki is twofold: first, there is the ultimate aim of protecting mauri (life force), secondly, there is the duty to pass the environment to future generations in a state which is as good as, or better than, the current state.

Kaitiakitanga is a broad notion which includes the following ideas:

• Guardianship

• Care

• Wise management

• Resource indicators, where resources themselves indicate the state of their own mauri.

Kaitiakitanga may be practised through:

• The maintenance of wahi tapu, wahi tipuna and other sites of importance.

• The management of fishing grounds (mahinga mātaitai, taiāpure).

• Protecting the environment from degradation and mitigating adverse effects

(*Environment Canterbury Regional Council, Ebox Series)*

Tangata Whenua Values:

Ngā Wai (water), **Te Moana** (sea), **Mahinga Kai** (traditional food) and **Tauranga Waka** (landing sites for canoes) are all examples of taonga (treasured elements of a tribe's existence). Ngāi Tahu therefore has specific concerns regarding protection of these. Concerns include:

(a) Water Quality

The general concern of Ngāi Tahu is that the water quality of the Canterbury region should be suitable for cultural purposes. The quality of the water should not be altered in a way that affects the cultural use of water as the environment that embodies the culture and nourishes kaimoana (sea food). Specific concerns include:

• Amenity value, the ability to swim in water.

- The discharge of human excrement into water bodies.
- Dairy shed and other agricultural/industrial run-off.
- Riparian land use that has downstream effects.
- Facilities such as sewage outlets that are constructed without consultation with, and approval of, the Rūnanga.
- Risk to kaimoana from discharges into water.
- Discharge of chemicals and other potentially hazardous waste.
- Dumping of waste into the sea.

(b) Mahinga Kai

- Effects on the habitat of traditional fish species.
- Protection of spawning sites.
- Access to rivers and beaches where mahinga kai is gathered.
- Guaranteed access to areas such as wāhi tapu and mahinga kai.
- Consultation with Ngāi Tahu regarding general access to cultural sites.

Rūnanga also have issues in relation to resource management within their individual rohe, for example:

- Water quality in Akaroa Harbour and Lyttelton Harbour /Whakaraupō.
- The effects of dredging of the channel for commercial shipping in Lyttelton Harbour/Whakaraupō.
- Sewage and other discharges affecting shellfish beds.
- The future of hāpua or coastal lagoons.
- Sedimentation affecting shellfish beds and the abundance of other seafood.
- Access and fishing easements.

<u>Mahaanui Kurataiao Ltd</u>

a charitable resource and environmental management advisory company established in 2007 by the six Papatipu Rūnanga to assist and improve the recognition and protection of tāngata whenua values in their takiwā.

We have a general mandate to represent the interests of these Papatipu Rūnanga who hold manawhenua rights and interests over the lands and waters within their respective takiwā (from the Hurunui River in the north, to the Hakatere/Ashburton River in the south, and inland to Kā Tiritiri o Te Moana (the Southern Alps). Mahaanui Kurataiao Ltd also supports the articulation of Rūnanga values and positions through making submissions on behalf of the Rūnanga to statutory notifications.

Our Role: Mahaanui Kurataiao Ltd supports the Rūnanga in achieving their objectives and aspirations for environmental management in their takiwā. We also provide environmental and cultural advisory and environmental planning to a range of local authorities, government agencies and private sector clients.

Mahaanui Kurataiao Ltd provides values-based advice on resource and environmental activities such as plan changes, resource consents, works in waterways, reserves management, infrastructure installation and repair, and other Council policy and planning, including area plans and stormwater management plans. We also facilitate consultation with ngā rūnanga for individuals, companies and organisations.

2.6 Regional Issues / Conservation concerns

The Banks Peninsula/Pegasus Bay region is subject to a variety **of anthropogenic influences**, supporting a wide range of commercial, recreational and cultural activities. Both local and international fishing vessels heavily fish the region during the spring and summer and the coastal areas are subject to sewage outfall and mussel farm operations (*Reynolds-Fleming & Fleming 2005*). Like many coastal areas in New Zealand, the North Canterbury marine environment faces threats including overfishing, climate change, and the erosion and sedimentation associated with changing land use, sea level rise and reclamation. [*Brough et al. 2018*]

The regional issues identified by Environment Canterbury (ECan) include (*Environment Canterbury Regional Council, Ebox Series*):

- Damaging effects of human activities and discharges of contaminants on the life-supporting capacity of coastal ecosystems.
- The need to provide for use and development of coastal resources while maintaining the natural character of the coastal environment.
- Adverse effects of activities on cultural and heritage values including those values important to Tangata Whenua.
- The effects of natural hazards such as coastal erosion and inundation.

Issues specific to a certain area include:

- Sand dune protection and vehicle access in northern Pegasus Bay.
- Flooding of coastal land on the South Canterbury coast.
- Sedimentation in Lyttelton Harbour/Whakaraupō.
- Marine farming around Banks Peninsula.

The management of the environmental resources of the coastal marine area in Canterbury is carried out by ECan. They prepare regional coastal plans and approve coastal consents under the Resource Management Act (*Environment Canterbury Regional Council, Ebox Series*).

2.6.1 Marine farming

Graham et al. (2003) on the potential ecological effects of marine farming:

Depletion of phytoplankton may interfere with natural populations of filter feeders and reduce the supply of planktonic larvae returning to adjacent benthic and shore communities.

Sedimentation of organic particles from farmed species' faeces and pseudofaeces can affect bottom faunas, either positively or negatively, depending upon water movement, water depth and bottom sediment characteristics.

Shell drop and accumulation can alter bottom communities, especially if extensive mussel reefs develop. Although poorly understood, the effects of shell drop and accumulation seem generally adverse for fishes, birds, and ecosystem functioning.

Marine farm structures and mussels support **substantial growths of fouling**, suspension-feeding organisms. Their presence may exacerbate depletion problems and contribute to shell drop.

Marine farming may facilitate the **spread of alien marine species** by transporting them on vessels and equipment, as well as providing hard substrates and rich food sources.

Translocation of farmed or farm-associated species from one location to another may disrupt natural evolutionary processes by altering gene frequencies. Translocation of green-lipped mussel spat has **altered natural gene frequencies in native populations** at one location and, probably, at others also.

Marine farming **fragments the coastal area**. This may interfere with the normal activities of dolphins, whales and birds, as well as creating entanglement hazards, disturbance from farm-related noise and activity, and problems associated with marine debris.

Potential direct **effects of marine farms on seabirds** include physical changes to the seafloor, resulting in changes to the food species available to some seabirds; habitat exclusion; human and support vessel noise; and entanglement. Marine farm induced changes to the benthos via, for example, accumulation of shell debris, are likely to alter the nature of prey items available to diving birds, notably shags and penguins, with unknown consequences, but the extent of such changes will depend on the scale of farming.

On the plus side, a marine farm could well attract pelagic and schooling species of fish, and so increase the abundance of prey available to these three species of seabirds. Equally, the farm structure and changes to the underlying seafloor could decrease the availability of their usual prey. Marine farms can also provide refuges that attract fishes, among other organisms, as well as protecting some habitat from other harmful human activities, such as bottom trawling.

Yet, **scale and cumulative effects seem significant for marine farming in the region**. The main concerns are changes to benthic habitats and communities through shell drop, plankton depletion and potential cumulative effects arising from marine farms occupying a significant proportion of specific habitat types, such as the near-shore marginal strip overlying the sediment-rock boundary.

Compliance in Canterbury's marine farming industry has transpired as a result of collaborative efforts with ECan and the marine farming community. The majority of marine farms have introduced new internal processes to ensure on-going compliance. These processes involve new maintenance, monitoring and reporting programmes and many farms have increased the frequency of operational and maintenance farm checks. Seventy five percent are now compliant, with work being done to achieve compliance with the other 25%. Alongside goals for continued compliance, the Banks Peninsula marine farmers are working over and above towards A+ sustainability (under the government and industry funded Sustainable Aquaculture Scheme). ECan is working with other regional councils to ensure marine monitoring is consistent across regions [*https://www.ecan.govt.nz/get-involved/news-and-events/2017/going-beyond-compliance-to-a-sustainability/*].

2.6.2 Effects of climate change

Climatologists have shown that continuous burning of fossil fuels and the emission of greenhouse gasses is causing stronger and more frequent marine heatwaves (MHW). The recent MHW affecting NZ waters in 2017/18 has seen substantial die-offs of bull kelp (particularly Durvillea poha) along Canterbury coasts [*M. Thomsen, pers. comm. 2019]*.

Southern bull kelps (Durvillaea spp., Fucales) are 'primary' foundation species that control community structures and ecosystem functions on temperate wave-exposed rocky reefs. It is unknown whether 'alternative' foundation species can replace lost southern bull kelps and its associated communities and networks (*Thomsen & South 2019*). Researchers from the University of Canterbury aim to follow plots and reefs in Lyttelton harbour and other places where bull kelp has been lost/decimated over the next 2-10 years. Very little is known about how marine habitats change over time in Canterbury. The lack of long-term consistent data from NZ hinder our current ability to understand and predict what is going to happen in the future [*M. Thomsen, pers. comm. 2019*]. To date, no government funded long-term running monitoring programs of important marine habitats have been set up in Canterbury. Consequently, nobody knows exactly how much bull kelp has been lost because so far it hasn't been monitored over longer time scales.

3 Areas / Options for F&B NC to engage

The following options are presented in no particular order with regards to priority but are organised under the overarching topics of:

- Promote, Drive, Support Research
- Science Communication
- Advocacy
- Become a Stakeholder / Project Supporter

These options / ideas mostly result from conversations had with people who are working in the marine conservation realm in North Canterbury but also in part driven by the author's interest and questions.

3.1 Promote, Drive, Support Research

3.1.1 Filling in the gaps: Offshore surveys of marine mammals and birds

Information is missing with regards to the importance of North Canterbury waters to marine mammal and bird species, both resident and migrant.

Current information originates from:

- Aerial surveys of marine birds (1996; 4-10 nm off Banks Peninsula).
- Aerial surveys of Hector's dolphins (2004; 15 nm offshore).
- Reports from seabird interactions during trawl surveys in Pegasus Bay.
- Incidental reports / recordings from shore-based observations.

Missing:

- Systematic at-sea survey of Pegasus Bay and offshore waters of Banks Peninsula, out to or beyond continental shelf edge.

Idea:

- Repeat boat-based surveys done by researchers from Otago University (contact: Will Rayment).
- Opportunity to collaborate with Will/Otago University regarding logistics and scientific advice.

3.1.2 Learn more about our iconic species

3.1.2.1 Tracking White-flippered penguins

Penguins are ocean sentinels. They are accessible and appreciated by the public, and they herald changes to coastal and marine habitat, helping to focus conservation efforts (*Borboroglu et al. 2015*).

What we know:

- WFP mainly observed in inshore waters (but this might have spatial and temporal bias).
- Tracking of LBP from Oamaru found them to generally forage within 30km of the coast in waters less than 50m deep; birds were staying within a radius of 25km of their colony. But when leaving for longer periods, they headed further away up north.

Questions of interest:

- Where do WFP go during breeding vs winter?
- Can we identify important foraging areas?
- Do WFP make use of Banks Peninsula marine reserves, e.g. Pohatu on the doorstep of the largest colony at Flea Bay?
- Do WFP overlap with YEP? (The latter received funding for tracking study of chicks but breeding success low/non-existent; explore option to track YEP adults?)
- Potential for collaboration with other groups and researchers. E.g., support offered by Thomas Mattern from the newly established 'New Zealand Penguin Initiative', who want to encourage community driven mark-recapture and tracking programs across NZ. John Cockrem, researcher from Massey University, formed the 'kororā conservation network' and is looking at opportunities to track penguins on Banks Peninsula and Motunau Island[10].

3.1.2.2 Update population surveys (seabirds)

a. White-flippered penguin

What we know:

- WFP population is in recovery; numbers and breeding areas are increasing.

[10] Email excerpts with more info in Appendix.

- Last systematic full population survey done in 2000/2001.

Questions of interest:

- How much did the population increase?
- Are we only gaining breeding area / colonies or have we also lost some? (e.g. after EQ's altered parts of the area?)
- Does Motunau Island still hold half of the WFP population?

b. <u>Motunau Island seabirds</u>

What we know:

- The island has an intricate array of seabird species who would not be able to breed in Pegasus Bay (due to predation etc) if it wasn't for this rock.
- The island held the largest colonies of WFP, Sooty shearwater, Fairy prion and White-faced storm petrel in all of Canterbury.
- Last (published) survey done in 1997 (pre Boxthorn removal)

Questions of interest:

- Number and status of seabird breeding populations post Boxthorn removal.
- Potential for further research on species of interest?

3.2 Science Communication

3.2.1 Research and monitoring in local marine reserves

- The methodology used for fish and invertebrate monitoring in Banks Peninsula marine reserves (Baited Underwater Video, BUV) is fairly modern and fancy and provides a lot of visual and hands on learning opportunities for school kids. Tom Mactavish (from DoC in Duveauchelle) recommends exploration of areas like this in order to dissiminate scientific results and information.
- Liaison with Tom Mactavish (DoC), EnviroSchools, local community / teachers and science communicators to encourage curiosity, understanding and support of what is going on within our marine reserves.
- Opportunity to feed back science results to the community. Adding value to research results.

3.2.2 Impact of climate change (Bull kelp die-offs)

- Bull kelp appears to be an obvious indicator for the impact of climate change / global warming, suffering substantial die-offs during recent marine heatwaves;
- Liaison with researchers from UC (e.g., Mads Thomsen) to communicate results and identify / support ongoing monitoring options.

3.3 Advocacy

3.3.1 Promote undervalued species in need of profile raise

a. <u>Spotted shag</u>

- Banks Peninsula / North Canterbury region is a stronghold for the species.
- Current status of ‘Not Threatened’ might need reconsideration (A. Crossland, pers. comm. 2019).
- Numbers in decline; reasons for this need further investigation.
- Work with Andrew Crossland (CCC) on science communication once population survey reports are finished.

b. <u>Red-billed gull</u>

- Acknowledged as threatened and in decline but needs support for ongoing population monitoring and raising of public profile (‘stealer of chips’, ‘annoying’, ‘too many’).
- Take or promote ‘community ownership’ of largest local RBG colony at Scarborough Head? (A. Crossland, pers. comm. 2019).

3.3.2 Support campaigning for Hector’s dolphins

a. <u>Submission towards Hector’s and Māui dolphins Threat Management Plan (TMP) review</u>

- MPI has released public consultation documents: https://www.mpi.govt.nz/news-and-resources/consultations/hectors-and-maui-dolphins-threat-management-plan-review/?fbclid=IwAR0CxKjWbhe2kDPtxbyshpLL6cwIspzPy_lmm-CxNXadz2VeHPaQRuBVI6I
- Submission deadline 4 August.
- Let members know and make submissions.
- Support the pledge of NZ Whale & Dolphin Trust regarding flaws in the proposed TMP.

  http://whaledolphintrust.org.nz/take-action/100m-campaign/?fbclid=IwAR3ml7qS5aCnFb-gKAqa_HniVDpGJxdcl6doUt4WSJc61iCnB_MMD7UTua8

  https://theconversation.com/dolphin-researchers-say-nzs-proposed-protection-plan-is-flawed-and-misleading-118997?fbclid=IwAR2R05Aodrg6oBSmLnrUn_8vXJAn7Dc3fXi1PVfcgHzRBjex0d8PZdGdPcM

b. <u>Expansion of marine mammal sanctuary</u>

- Support the IUCN recommendation to ban fishing methods that kill dolphins (gillnets and trawling) throughout the habitat of Hector’s dolphins, out to the 100 metre depth contour, including harbours.

- Work with NZ Whale & Dolphin Trust (e.g. Liz Slooten) on options where and how best to support.

c. Environmental Impact Mitigation campaigns

- "*There are various activities in Lyttelton Harbour including dredging, dumping of dredge spoil, pile driving, pile removal and 'reclamation' where it would be great if F&B could keep an eye on, make submissions, etc. We could provide information, expert witness work, etc*." (Liz Slooten, pers. comm. 2019)
- Investigate / raise awareness of species bycatch in (local) fisheries, including basking sharks, other sharks, seabirds and marine mammals other than Hector's dolphins. (This could support case for wider control of detrimental fishing methods regarding Hector's / marine mammal sanctuary).

3.4 Become a stakeholder / Project Supporter

3.4.1 Seabird Restoration Project on Banks Peninsula

- CCC (Andrew Crossland) is looking at rolling out a program to re-establish colonies of seabirds formerly or already (but in small numbers) breeding in the area.
- Current target species: Mottled petrel, Sooty shearwater, Fairy prion, White-faced storm petrel.
- Current target area: Te Oka Bay.
- Initial steps would involve fencing off suitable areas (headlands) and planting them up according to habitat required for target species.
- Community Group Partner needed for this project. Could be F&B NC? (We can offer expertise / 'man-power' for planting and restoration work, i.e., through activate member base, as well as the 'on-board' seabird ecologist ;D)
- Latest update from A. Crossland (19 June 2019): "*spoke with my manager again today about the seabird colony we'd like to create at Te Oka Bay headland and reminded him that F&B were potentially keen to be a partner in this project. He advised that a funding bid has been put into the long-term plan and the sense is that feeling around the project is positive, however because the local runanga own the adjacent land (Tumbledown Bay) and are likely to have cultural significance values associated with the seabird colony site we're investigating, he wants us to have conversations with them and get their approval.*

  So, in terms of timeline, subject to the runanga being supportive, we're probably looking at starting the planting programme next winter. Given the previous involvement by yourself and others in F&B with the Kaikoura Peninsula Hutton's Shearwater colony we're certainly very keen to have F&B team up with us."

3.4.2 DoC Marine Monitoring Network

- New initiative to set up a suite of parameters (i.e., develop common indicators) to be measured for monitoring purposes within marine reserves nationwide.
- DoC project lead Monique Ladds interested in adding F&B NC to stakeholders list to discuss implementation of monitoring network at local/regional level.

3.4.3 Helping IBA Monitoring and Conservation

- Forest & Bird (NO) and Birds New Zealand (OSNZ) encourage the public to help monitor and conserve IBAs.
  - Publicise: share the IBA report and the supplementary documents with friends and colleagues; become familiar with the online IBA resources and send the links to interested people.
  - Identify IBAs in your region.
  - Champion: publicise the value of your IBA to local people and government; talk to your community – to neighbours, friends, schools or special interest groups.
  - Join or create a local IBA support group or a larger regional group.
  - Observe and monitor an IBA.
  - Volunteer for pest control and revegetation projects in an IBA.
- NC branch could investigate options to support this.

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5 People providing input to this report

- Andrew Crossland (Christchurch City Council)
- Anita Spencer (Department of Conservation, Christchurch)
- Chris Challies (Manager Harris Bay Penguin colony)
- John Cockrem (kororā conservation network)
- Liz Slooten (University of Otago)
- Mads Thomsen (University of Canterbury)
- Mike Hickford (University of Canterbury)
- Monique Ladds (Department of Conservation, Wellington)
- Thomas Mattern (New Zealand Penguin Initiative)
- Thomas Stracke & Kristina Schuett (Christchurch Penguin Rehabilitation)
- Tom MacTavish (Department of Conservation, Duveauchelle)
- Will Rayment (University of Otago)

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7 Appendix

Emails holding relevant information not fully included but referenced in report:

Email Thomas Mattern on 20 June 2019:

Hi Lorna.

Not to cause any confusion, my eudyptes.net email is still valid. But since I'm now also working for the NZ Penguin Initiative I also have a flash, new second email address.

Also, let me introduce you to Richard Seed who is going to be working with me to make all these lofty ideas about improving our knowledge about penguins become a reality.

Let me give you a quick overview where we are coming from and where we would like to go from here.

Our goals for Little penguins derive from a comprehensive review I've co-authored with Kerry-Jayne Wilson (https://www.researchgate.net/publication/329075802_New_Zealand_penguins_-_current_knowledge_and_research_priorities). A major outcome of this review was the formation of the NZ Penguin Initiative by the T-Gear Charitable Trust with the aim of pursuing research and conservation priorities identified in the review.

At this stage, NZPI has two employees: me, as senior scientist and Richard as coordinator. We are in the process of forming an advisory group that will oversee NZPI's activities. The group will principally consist of people that are or have been actively involved in penguin research and conservation in New Zealand. At this stage, advisory group members are Kerry-Jayne Wilson (West Coast Penguin Trust), Peter Gaze (Nelson), Paul Sagar (NIWA), Dave Houston (DOC), Phil Seddon (University of Otago) and Pablo Garcia-Borboroglu (Global Penguin Society). Further group members will hopefully join in the coming weeks.

For the coming years, the NZPI goals are listed on our website: http://www.penguin-conservation.nz/current-projects/

As Little penguins are just one aspect of our work it is clear that we cannot conduct a lot the required work ourselves. Instead we will try to engage community groups to get the work done. Student projects would also be an option, although we really want to establish long-term projects rather than something that is limited to the term of a thesis only. Hence, student projects would have to be part of a community initiative.

Our focus is on two core aspects - demography and marine ecology.

- *We would like to encourage and empower community groups to conduct long-term mark-recapture monitoring programs using PIT tags ("microchips"). Marking individuals and following their progress over the years will provide us with information about key demographic parameters adult survival and recruitment. Combined with breeding success monitoring, this will allow us to determine population trends much more reliably than annual nest counts.*
- *With regards to marine ecology, we hope that community groups will also be able use GPS dive loggers on a regular basis to monitor the penguins' marine ecology which will allow us to put observed demographic parameters into an environmental*

context. Deployment, recovery and download of logger data has become pretty easy so that anyone can do it with some advice and training these days.

The NZ Penguin initiative plans to assist communities with the acquisition of the required gear, such as PIT tags and GPS dive loggers, and will assist getting required permits in place. We will furthermore train PIT tagging birds and logger deployments to get each group started and provide assistance where we can down the line.

The main requirement to obtain NZPI support is that each community group agrees to

1. *follow pre-defined monitoring protocols that allow comparisons results across regions,*
2. *make data available to researchers and students approved by NZPI; to this end we will develop a centralized database with moderated data access (in the vein of movebank.org),*
3. *accept that any gear supplied by NZPI remains property of the Initiative.*

At this stage, we plan to kick off a community group programme on the West Coast this year. It will be a bit of a trial balloon for us to see how all of the above comes together in the real world. Our plan for this year is as follows:

- *Establish a marked population of Little penguins at Charleston/West Coast*
- *GPS track 5 penguins during each of the main breeding phases, i.e. incubation, chick-guard, post-guard and, if feasible, pre-moult and winter. The idea is to establish this as a recurring marine ecology monitoring programme that is conducted every year.*

We plan to expand these activities to other regions from next year onwards. Besides the West Coast we currently have our eyes on the Chatham Islands.

We'd be more than happy to help you get something off the ground in your area as well.

Hope that gives you a better overview!

All the best,
Thomas

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Email John Cockrem on 31 July 2019:

Hello Lorna

Thank you for the email. It is great to hear that you are interested in kororā.

Tom may have mentioned that I am currently establishing new nest box colonies of kororā on Mana Island and Kapiti Island, on the Porirua coast, and at Napier Port in the Hawke's Bay. I'm also working with groups and organisations at other locations around the North Island South Island coasts to establish collaborative projects in which we can gather information about kororā at different locations and also conduct tracking studies of the birds to see where they go to feed.

Pohatu Penguins near Akaroa are keen on collaborative work to track penguins from their colony, and we are aiming to start tracking studies at Pohatu next year. Tracking work requires that we have a reasonable number of kororā established in nestboxes so that we can check nestboxes weekly and have birds accessible for the tracking work. Recently I went out to Motunau Island which has a very large kororā population. If birds could be established in nestboxes on the island, then it would be a great location for tracking as the population is a reasonable distance north of the Akaroa penguins. A while ago I met some people who have an interest in penguins on Quail Island. I think there may be nestboxes there, although I'm not sure how many.

I have formed what we call the kororā conservation network, and will be applying for substantial funding for our work. The work includes both biology and conservation, including advocating for the penguins and trying to limit the negative effects of dogs on penguins. I have made submissions on council dog bylaws and have helped groups with submissions. The title for my kororā project is "He kororā, he tohu oranga. The little penguin is the sign of life". The little penguin is the kororā in Maori, and in mātauranga Māori the success of kororā populations indicates the health of the coastal environment. My vision is to establish studies of kororā biology that will provide information on the foraging ranges and breeding success of kororā populations, to use improved knowledge of kororā together with advocacy for kororā to halt and reverse the current decline of the species, and to support iwi to exercise kaitiakitanga over their local marine environment. Themes for my work include penguin biology, mātauranga Māori and community science.

It would be good if we could have a chat - I always prefer talking to typing.

Tomorrow morning I go out to Mana Island for a four-day field trip, and then next week will be in Nelson and Golden Bay for penguin work. Friday next week would be a good time for me to talk on the phone.

Regards

John