The West Coast Marine and Coastal Environment

An Initial Report for the West Coast Marine Protection Forum

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marine
protection forum

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Cover images from top:
Blue cod, South Westland. *Photo: P Ryan, DOC collection.*
Children playing with a reef star at Rapahoe beach. *Photo: S. Nimmo*
Fishing vessel leaving the Greymouth Harbour. *Photo: S. Nimmo*
Sandy beach and Karamea-Otumahana Estuary on the Karamea coast. *Photo: T. Hume, NIWA*

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Contents

Acronyms and abbreviations

The following acronyms and abbreviations have been used in the report. Where appropriate, the full meaning of some of these terms has been explained in the glossary.

DOC	Department of Conservation
EEZ	Exclusive Economic Zone
FMA	Fisheries Management Area
FSA	Fisheries Statistical Area
GNS	Geological and Nuclear Sciences (Institute of)
in prep	in preparation
km	kilometres
m	metres
MfE	Ministry for the Environment
MFish	Ministry of Fisheries
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MPA	Marine Protected Area
NIWA	National Institute of Water and Atmospheric Research
NZMS	New Zealand Map Series
pers comm	personal communication
QMS	Quota Management System
RNZN	Royal New Zealand Navy
RV	Research Vessel
TAC	Total Allowable Catch
WCRC	West Coast Regional Council

CHAPTER 1

Planning For Marine Protected Areas

1.1 Introduction

The New Zealand Biodiversity Strategy contains a Government objective to build a comprehensive network of Marine Protected Areas (MPAs). By using a range of protective measures, a fully representative range of New Zealand's marine and coastal ecosystems and habitats are to be protected. Government's "Marine Protected Areas: Policy and Implementation Plan" (2005)[1] states that the aim is to have 10% of New Zealand's marine environment with some form of protection by 2010. One representative example of each habitat or ecosystem type is to be protected in a marine reserve.

The resulting MPA network aims to protect both representative areas and areas that are outstanding or rare. A range of measures will be used, including marine reserves, Fisheries Act regulations and the Resource Management Act[2].

Planning and developing New Zealand's marine protected area network will involve a range of central and local government agencies, marine and coastal area users, tangata whenua, and those with an interest in the marine environment.

A regional forum (the West Coast Marine Protection Forum) has been established with people from the West Coast community and other stakeholders, to make recommendations on areas for marine protection. This is so that sites and protection measures can be identified by the same communities that will be using and enjoying the marine protected areas.

1.2 The West Coast Marine Protection Forum

The West Coast Marine Protection Forum is a special planning group that has been set up to work with the Department of Conservation, the Ministry of Fisheries and the wider West Coast Tai Poutini community. The Forum was set up by the Conservator, Department of Conservation, West Coast Tai Poutini Conservancy to provide advice on options for integrated marine protection. The job of the Forum is to use the MPA Policy tools to recommend the best overall protection of marine and coastal habitats and ecosystems that are representative, outstanding or rare within the West Coast region.

The Forum is made up of local people, tangata whenua and others who have an interest in the West Coast's marine and coastal environment.

The Forum aims to:

- Understand the social, biological, recreational and commercial characteristics and dynamics of the West Coast marine and coastal environment;
- Facilitate opportunities for community, stakeholder and user input into consideration of options for integrated protection of West Coast marine and coastal diversity;
- Identify the habitats and ecosystems of the West Coast marine environment;
- Evaluate options to achieve integrated protection of marine and coastal biodiversity that is representative, outstanding, and rare of the West Coast consistent with MPA policy;
- Apply nationally consistent site selection and protection criteria to identify habitats and ecosystems to recommend as candidates for protection within a national network of Marine Protected Areas;
- Recommend MPA's that minimise the impacts on existing users, on the marine environment, or on Treaty of Waitangi settlement obligations; and

1 Dept of Conservation and Ministry of Fisheries, 2005.

2 Dept of Conservation and Ministry of Fisheries, 2005.

- Ensure that the public, stakeholders and tangata whenua are informed about the process and able to participate in it.

1.3 West Coast Marine and Coastal Environment Report

This initial report is an attempt to bring together relevant information about the West Coast marine and coastal environment in one document. It has been written for the West Coast Marine Protection Forum to assemble information about the physical, biological, and social features of the marine and coastal environment of the West Coast Tai Poutini.

The information in this report, as well as further information contributed by members of the public, tangata whenua and stakeholders will provide the Forum with a physical, biological, and social picture of the marine and coastal environment of the West Coast. In addition, the Department of Conservation and the Ministry of Fisheries are jointly developing a marine and coastal classification system, a protection standard, and an inventory which will be used by the Forum to assist it in recommending what areas need to be protected.

Public response is sought on this initial version of the report so that any errors of fact, omissions, or misrepresentations in the report can be corrected before the report is finalised.

The final report will be used to help identify marine and coastal habitats that may be suitable for protection when the Forum considers MPA recommendations to the respective Ministers of Fisheries and Conservation. Recommendations that are accepted by Ministers will then be subject to a statutory consultation process. The Forum will use the national classification and protection standards, in addition to an inventory of existing protection. Information in this report should help the Forum identify marine and coastal habitats; as well as appreciate in more detail how people use and value the West Coast marine and coastal environment.

The report may also be regarded as base line information about the West Coast marine and coastal environment and as such be a useful source of information for all interested in protecting the marine and coastal environment.

Note that this report does not contain any recommendations, or reach any conclusions about how any particular habitat could (or should) be protected. When the Forum reaches that point in the process, it will report its draft conclusions back to communities of interest, stakeholders and tangata whenua to ask for comment before finalising its recommendations to the Ministers of Conservation and Fisheries.

1.4 Scope of the Report

The area covered by the report extends from Kahurangi Point (40° 47′ S) in the north to Awarua Point (44° 16′ S) in the south. A national workshop of marine scientists[3] identified Jackson Head as the southern limit of the West Coast marine and coastal biogeographic region. However, this boundary is disputed by the Forum and is instead placed at Awarua Point for the purposes of this report (see page 13).

At the time the Forum was set up it was agreed that the seaward boundary of the area under consideration was the territorial waters generally out to 12 nautical miles offshore. The landward boundary was the coastline to mean high water springs (MHWS), including the numerous tidal estuaries, lagoons and river mouths of the West Coast coastal marine area, the upper limits of which are defined by the West Coast Regional Coastal Plan. Throughout the report this area is referred to as the '**West Coast coastal marine area**'. The Forum is aware of an alternative seaward boundary that proposes 12 nautical miles or the 200 m depth contour (whichever is closer to shore), and the Forum may need to take this into consideration in its eventual recommendation of any MPAs.

3 Walls 2006a

The report is divided into 5 parts. The report does not attempt to provide information at a fine level of detail; however, it is well referenced so that material cited in the report can be easily found.

Chapter 1 describes the background to the report, its scope, and invites public feedback.

Chapter 2 describes what we know of the physical features and processes at work in the West Coast marine and coastal environment.

Chapter 3 explains the biological diversity within the main marine and coastal environmental domains. By this we mean, what plants and animals (e.g. seaweeds and fish) that you might find in different habitats.

Chapter 4 describes human uses (past and present) of the West Coast's marine and coastal environment. It also outlines some hazards and management measures set out in the West Coast Regional Coastal Plan.

Chapter 5 presents the marine and coastal features of the West Coast in more detail, The 600 km-long coastline and seabed out to the 12 nautical mile limit is broken up into 14 segments, and mapped at a larger scale to be more useful for the Forum and the community. These segments do not represent ecological divisions or habitat types that will pre-empt any recommendations by the Forum. They are merely sequential geographic segments, allowing us to examine the West Coast in smaller localities and thereby increase our understanding of the information available.

1.5 Public Input

Public input is sought on this initial report so that any omission of information, errors of fact, or misrepresentation can be corrected before the report is finalised. For instance, you may have information on uses and features of the marine and coastal environment. Anyone with an interest in the marine and coastal environment of the West Coast Tai-Poutini is encouraged to provide us with feedback and comments on the content of this report.

Information provided by people who know about the West Coast marine and coastal environment can assist the Forum to evaluate potential MPA locations and management tools. One of the planning principles of the MPA Policy and Implementation Plan is to minimise the impacts of protection decisions on local users. It will also take into account obligations that arise from Treaty of Waitangi commitments to tangata whenua (included in marine management legislation and Treaty settlement legislation).

1.6 Information Principles

The Forum is tasked to ensure that information used to select sites for marine protection is science and knowledge based using the best available information. The respective Ministers will consider the recommendations and use the relevant statutory and public consultation framework to establish formal protection.

This report has drawn on information from a variety of sources. The primary objective of the report is to present the best available information. This means that information contained in the report should be relevant and of good quality.

Quality information is generally characterised by being the best available, relevant to the issues, and having a high level of reliability.

For this reason public submissions should be based on information that can be referenced to personal observation or experience, technical or scientific reports or customary knowledge.

If you believe that information in the report should be corrected, or you have information that you believe has been omitted and is worth being published, or you believe some information is not represented correctly, your submission needs to explain this and to provide your name, address, telephone and/or email contact details.

1.7 Where to from here?

The Forum will apply the information principles to information received during the public submission phase and the report will be finalised. The report, along with the national protection and classification standards, will then be used by the Forum to select possible MPAs.

These draft recommendations will be brought back to the various communities of interest, stakeholders, and tangata whenua for public discussion before any conclusions are reached about potential sites for MPAs, or the management regime [e.g., a Fisheries Act regulation or marine reserve] that may be appropriate.

The Forum will then consider community feedback and make recommendations to Ministers for MPA site selection on the West Coast.

Before any MPA can be established by regulation or gazettal the respective Ministers must follow the statutory process set out by the Marine Reserves Act and the Fisheries Act which requires them to consult on the protection measures to be taken.

Please send your submission, and address any enquiries, to:

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Phone +64(0)3 755 6510
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The report is also available on the internet at www.westmarine.org.nz
and submissions can also be made through this website.

CHAPTER 2

Physical Environment of the West Coast Coastal Marine Area

An understanding of the physical setting and processes at work in the West Coast marine and coastal environment is fundamental to any description of its biodiversity, and any ecosystems and habitats which might eventually be protected through the Marine Protected Areas process.

This section of the report describes the physical characteristics of the West Coast within the wider New Zealand marine environment. It then goes on to describe the region in terms of physical attributes like coastal and seafloor geology, underwater and coastal landforms, the impact of tides, waves and weather patterns, and variability in sedimentation and river discharges to the seawater. The physical environment of the West Coast coastal marine area is then characterised in terms of its depth, substrate and exposure.

2.1 New Zealand in the Southern Ocean

New Zealand lies at the boundary between the subtropical waters of the southwest Pacific Ocean and the subantarctic waters in the latitudes of the Southern Ocean known as the 'Roaring Forties'.

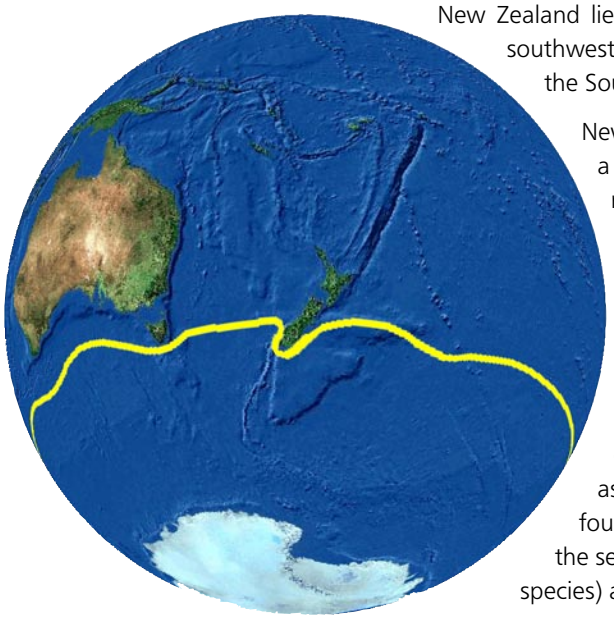


Figure 2.1: New Zealand in the SouthernOcean, showing approximate boundary of subtropical convergence.

New Zealand's position in southern temperate latitudes within a largely oceanic hemisphere makes its location unique in many respects and significant for a wide range of marine biodiversity. A comprehensive description of New Zealand's marine biodiversity is not the intent of this report[1], but several points about New Zealand in the context of the global marine environment are worth noting:

- About 8000 marine species have been described in New Zealand waters, (and there are doubtless many more to be discovered). Marine scientists estimate that perhaps as much as 80 percent of New Zealand's indigenous biodiversity is found in the sea. While many of our marine species are found in the seas around other countries, some (especially bottom dwelling species) are endemic to New Zealand.[2]
- The complex topography of New Zealand's ocean floor includes a great diversity of plateaux, canyons, ocean depths, shelves and seamounts.
- The hydrology of New Zealand's marine waters produces a complex system of oceanic and coastal currents that affect the distribution and biology of marine species.

The New Zealand land mass lies across one of the most significant ocean boundaries in the southern hemisphere – the Subtropical Convergence[3]. This circum-global front separates subtropical water in the north from subantarctic water in the south. It is accompanied by strong physical and nutrient gradients which have major implications for the growth of plankton and the richness of the surface waters[4]. The location of the boundary between the polar and temperate waters varies with the seasons and from year to year, but Figure 2.1 shows the generally accepted 'average situation'[5].

1 E.g., see Morton 2004, Goff et al 2003
2 Dept of Conservation and Ministry for the Envirionment 2000
3 Robertson 1982
4 Vincent et al 1991
5 Heath 1985

2.2 West Coast in the New Zealand Marine and Coastal Context

The West Coast coastal marine area that is under consideration by the West Coast Marine Protection Forum lies between Kahurangi Point in the north and Awarua Point in the south. This coastal and marine environment extends for some 600 kilometres along the windward side of the South Island out to the 12 nautical mile limit, and is the area described in this report in terms of its physical and biological features and its human uses (see Figure 2.2). The Forum is aware of an alternative boundary that proposes 12 nautical miles or 200 m depth (whichever is closer to shore).

The West Coast marine and coastal environment has a number of physical features which, in combination, distinguish it from other New Zealand coasts. In particular, it is very exposed to prevailing westerly winds and high energy wave action. Other distinguishing physical features include: the pronounced effects of sedimentation (including glacial sediments and sand scour), its dynamic shelf and river hydrology, and spectacular coastal landscapes (within a setting of a mountainous hinterland), which include many headlands and an extensive network of relatively unmodified tidal wetlands.

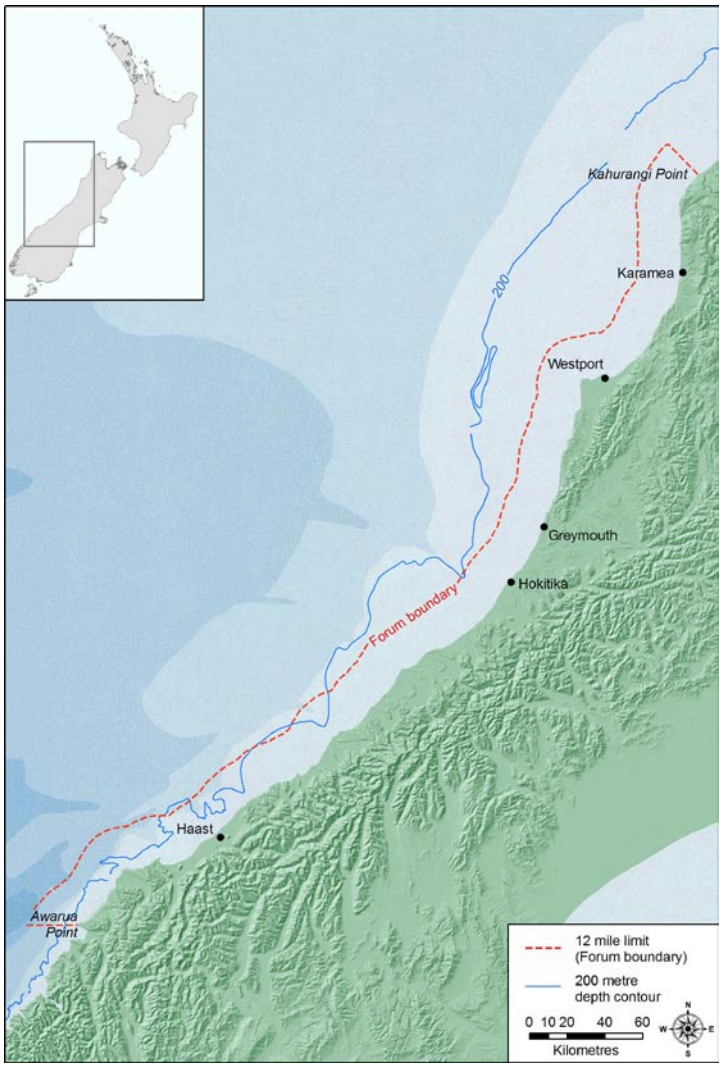


Figure 2.2: West Coast Coastal Marine Area

The West Coast marine and coastal environment is very exposed to high energy waves. *Photo: S. Nimmo.*

Many large rivers, like the Haast, carry high loads of suspended sediments to the beaches and seafloor of the West Coast. *Photo: T. Hume, NIWA.*

Recent studies have shown that the West Coast marine environment shares many biological characteristics with other South Island coastal regions, in respect to fish[6] and algae[7.] Nevertheless, a number of physical features make the West Coast clearly different from:[8]

- the North Island west coast (because of the West Coast's more southerly latitudes, hydrography and geology);
- the Fiordland coast (because of the West Coast's lack of sheltered inlets, the dominance of sediments on its beaches and broad continental shelf);
- the South Island east coast (because of the West Coast's exposure to prevailing westerly storms, higher rainfall and sedimentation, including glacier derived sedimentation, and its very different geology);
- the Stewart Island/Rakiura coast (because of the prevalence of mobile sediments on the West Coast); and
- the greater Cook Strait coasts (between Farewell Spit and Taranaki) (because of the West Coast's higher exposure to westerly waves and absence of sheltered bays).

These physical differences have a major bearing on the biological features that are found in the West Coast marine and coastal environment. For these reasons, a draft national nearshore marine classification system being developed within the MPA Policy framework[9] considers the West Coast to be a distinct marine ecological region, with features that are not represented elsewhere in the country (nor indeed the rest of the world).

6 Francis 1996
7 Adams 1994
8 Neale & Nelson 1998
9 Walls 2006

2.3 Physical Features and Processes Influencing the Marine and Coastal Environment

2.3.1 Oceanic Currents and Freshwater Inflows

The movement of oceanic water masses has a large effect on the ecology of the West Coast's marine and coastal environment. Key oceanographic features affecting the West Coast are shown in the map (Figure 2.3), and the italic numerals in brackets in the following discussion refer to the numbered features in the figure.

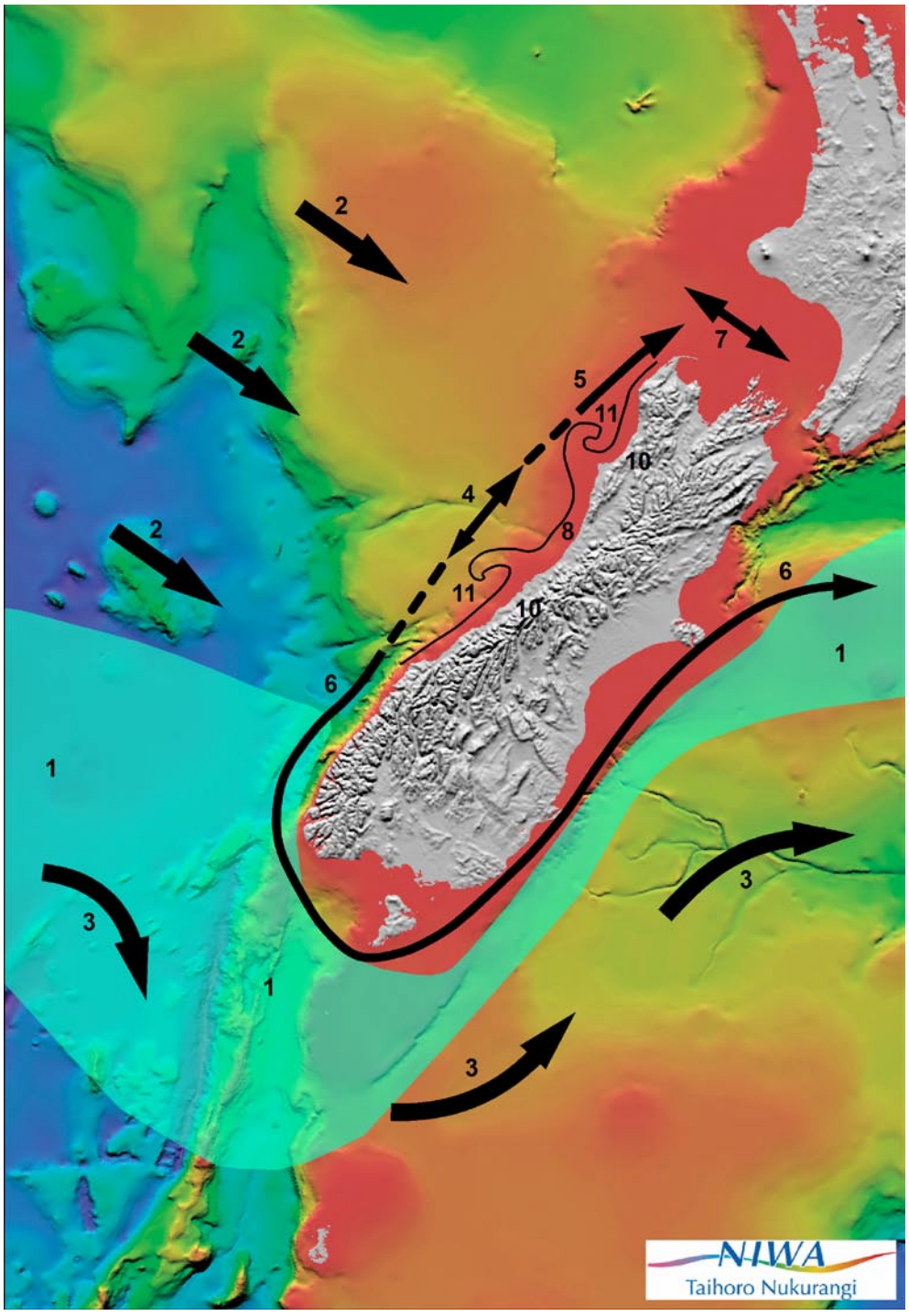


Figure 2.3
Oceanography and Currents of the West Coast
(Source: Neale & Nelson 1998 and NIWA base map)

Numbers refer to features described in the text, as follows: 1 = Subtropical Convergence, 2 = Tasman Current, 3 = Antarctic Circumpolar Current, 4 = West Coast shelf surface currents, 5 = Westland Current, 6 = Southland Current, 7 = Wind-generated oscillations in Cook Strait, 8 = West Coast inshore zone, 9 = Upwelling (not depicted), 10 = Freshwater inflows, 11 = "Squirts".

The West Coast lies near the southern limit of the subtropical oceanic water mass, to the north of the Subtropical Convergence (1). Ocean surface currents (2,3), driven primarily by wind systems, flow on either side of this convergence. In the north of the West Coast, the Tasman Current (2) is considered to be a broad, slow flow of warm northern water derived from the East Australian Current that approaches the West Coast from across the Tasman Sea[10]. To the south of the Subtropical Convergence, the strong westerly winds of the "Roaring Forties" drive a cool westerly ocean current (a component of the Antarctic Circumpolar Current (3) that lies north of the Subantarctic Front), but this current does not have a direct impact on the West Coast.

The New Zealand continental shelf and coastline act as a barrier to the ocean currents, which are forced to flow around the landmass as surface currents (4). On the West Coast, the current is fed mostly by the warmer water derived from the Tasman Current. The direction of the surface current along the coast is determined primarily by local winds (which prevail from the south-west) and "coastal trapped waves" (see below). As a result, the West Coast is washed by a northward-moving current (the Westland Current (5)) on some occasions and a southward-moving current (the beginnings of the Southland Current (6)) on others[11]. Over most of the region, the mean flow moves weakly northward towards Taranaki and Cook Strait[12].

A pattern of very long wave formations runs along the West Coast, at least as far south as Milford. These waves are generated by the combined effects of the wind component parallel to the West Coast and the slow wind-generated oscillation of water (7) in the northern Cook Strait/ Taranaki Bight region[13]. Because these waves are often thousands of kilometres long and only a few centimetres high, they are virtually imperceptible but can be measured by sensitive tide gauges. The Earth's rotation causes these "coastal-trapped waves" to move southward down the West Coast, their speed of travel modified by the slope of the sea bed. These waves in turn cause the West Coast's coastal surface current to speed up or slow down (and regularly to change direction) every few days, much as normal sea waves will cause a floating stick to rock back and forth on the surface.

The Southland Current (6) begins in the vicinity of Westland/ northern Fiordland[14], forming from southern subtropical water. It flows southward and around the bottom of the South Island, and continues northward along the South Island's east coast as far as Canterbury/ Marlborough, becoming less saline and cooler through incorporation of subantarctic water. While the Southland Current is relatively warm for those latitudes, the South Island east coast tends to be cooler than the west coast, and this has a great effect on the comparative ecology of the two coasts.

The water that probably most affects the ecology of the West Coast's shores is a distinct inshore zone (8) approximately 30 kilometres wide, extending from the coastline out to depths of 100 to 200 metres. It comprises relatively cool seawater with a lowered salinity[15]. However, the subtropical water in this zone is impacted by both coastal upwelling and river inflow. Coastal upwelling (9) occurs when cool water rises to the surface from depths of up to 200 metres[16], and this can occur right along the West Coast under westerly or south-westerly winds[17].

The inflow of fresh water (10) from the West Coast's many large rivers is another key physical factor affecting the marine environment. The West Coast of the South Island is one of the wettest regions in New Zealand, with in excess of 2400 mm of rain annually (and annual precipitation as high as an extraordinary 17,000 mm measured in parts of the mountainous

10 Heath 1985
11 Stanton 1976
12 Heath 1982
13 Cahill et al. 1991
14 Heath 1973
15 Moore & Murdoch 1993
16 Shirtcliffe et al. 1990
17 Heath & Ridgway 1985

hinterland). Consequently, many major rivers drain out into the West Coast continental shelf[18] and their fresh water mixes with the upwelling water to produce a shallow surface layer that readily exchanges heat with the atmosphere, further decreasing the temperature of the inshore zone[19]. The sediment content of the inshore zone water is high compared to the oceanic waters because of two physical processes: the load of suspended sediment arriving from the rivers (particularly during floods), and the disturbance of sea bottom sediments by waves as they approach shallow water. The marked hydrographical differences between the inshore zone and the open sea inhibit mixing of these waters, and the visual boundary between the two water masses is usually quite clear.

Another physical process of importance in exchanging coastal and oceanic water across the continental shelf, and to the biological productivity of the shelf, is water escaping the inshore zone in the form of transient plumes or "squirts" (11) [20]. These shallow surface layers of low salinity water extend up to 75 kilometres seawards and are associated with specific topographic features (e.g. Hokitika Canyon). The plumes stabilise the surface layer, preventing the mixing of surface phytoplankton to deeper levels in the water column[21]. The water within the plumes eventually merges with the more saline seawater offshore.

The inflow of freshwater (and suspended sediment) is a key physical factor affecting the marine environment. Waita River, South Westland. *Photo: T. Hume, NIWA.*

18 Heath 1982
19 Moore & Murdoch 1993
20 Moore & Murdoch 1993; Vincent et al. 1991
21 Moore & Murdoch 1993

The windward shores of the West Coast are more exposed than those of eastern coasts, leading to a greater inter-tidal zone.
Photo: D. Neale, DOC.

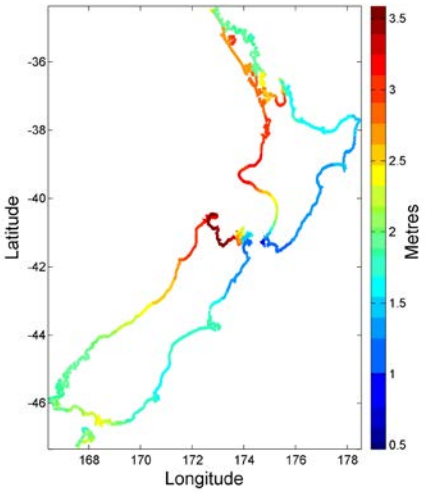


Figure 2.4. Tidal range of the West Coast (compared with the rest of NZ)
Source: T. Hume, (NIWA)

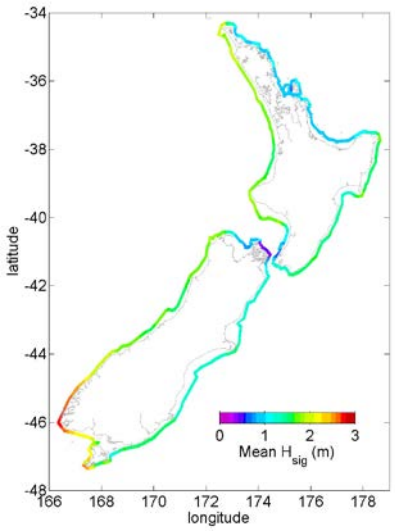


Figure 2.5. Significant wave height
Source: T. Hume (NIWA)

2.3.2 Tides

Tides have a major role in determining the location of the zones of plant and animal life on the shore. Tides vary in their physical character – their daily pattern, their energy, and the levels they reach on the shore. The West Coast, like the rest of New Zealand, has a dominantly twice-daily tide of a 12.4 hour cycle[22]. Due to the anticlockwise movement of the tidal wave around the New Zealand coast, the West Coast's tides tend to become progressively later towards the south, with Jackson Bay tides lagging those at Karamea by about 75 minutes. Spring tides at Westport rise and fall by up to 3.7 metres, while the difference between high and low water at neap tides is as little as 1.2 metres[23]. The tidal range right along the West Coast is broadly similar to this, but a NIWA model (Figure 2.4) indicates that the tidal range is significantly greater in the north than in the south.

2.3.3 Exposure to Waves and Weather

Exposure to the weather and the sea has an important effect on the ecology of rocky shores, and the West Coast is extremely dynamic in this regard. Since New Zealand lies across a belt dominated by westerly winds, the West Coast is on a windward shore. This causes wave conditions to be generally rougher than on the eastern coasts and weather conditions to be generally more humid. Such conditions typically increase the vertical widths of intertidal zones, since organisms can satisfy their water requirements further up the shore than they could on dry, sheltered shores.

Daily visual observations made at Punakaiki over ten years, from 1984 to 1994, give an indication of the sea wave climate along the shoreline along the entire West Coast[24]. There, high energy wave events (wave heights at the shore greater than 1.5 m) occur 36% of the time, but waves seldom exceed 3.0m height. About twice as many high energy wave events arrive from the south than from the north. A NIWA model (Figure 2.5)[25]shows that the wave exposure along the coast is broadly similar along most of the West Coast, ranging between 1.5 and 2.0 metres significant wave height, but increasing slightly towards the south.

22 Stevens & Chiswell 2007
23 OceanFun 2006
24 Jones 1994
25 Reproduced with permission from T Hume, NIWA

2.3.4 Surface Temperature

Inshore surface water temperature means in the summer (winter) range from 17.75° C (12.5° C) in the north to 16.25° C (12°C) in the south[26]. Bottom water temperatures over the shelf are warmer in winter than summer by about 1°C, probably reflecting increased influence of the East Australian Current during winter[27]. Mean sea surface temperature (SST) in February is shown in Figure 2.6. Note the cooler nearshore water off the West Coast, most likely caused by the inflow of river water and the northward movement of the Westland Current.

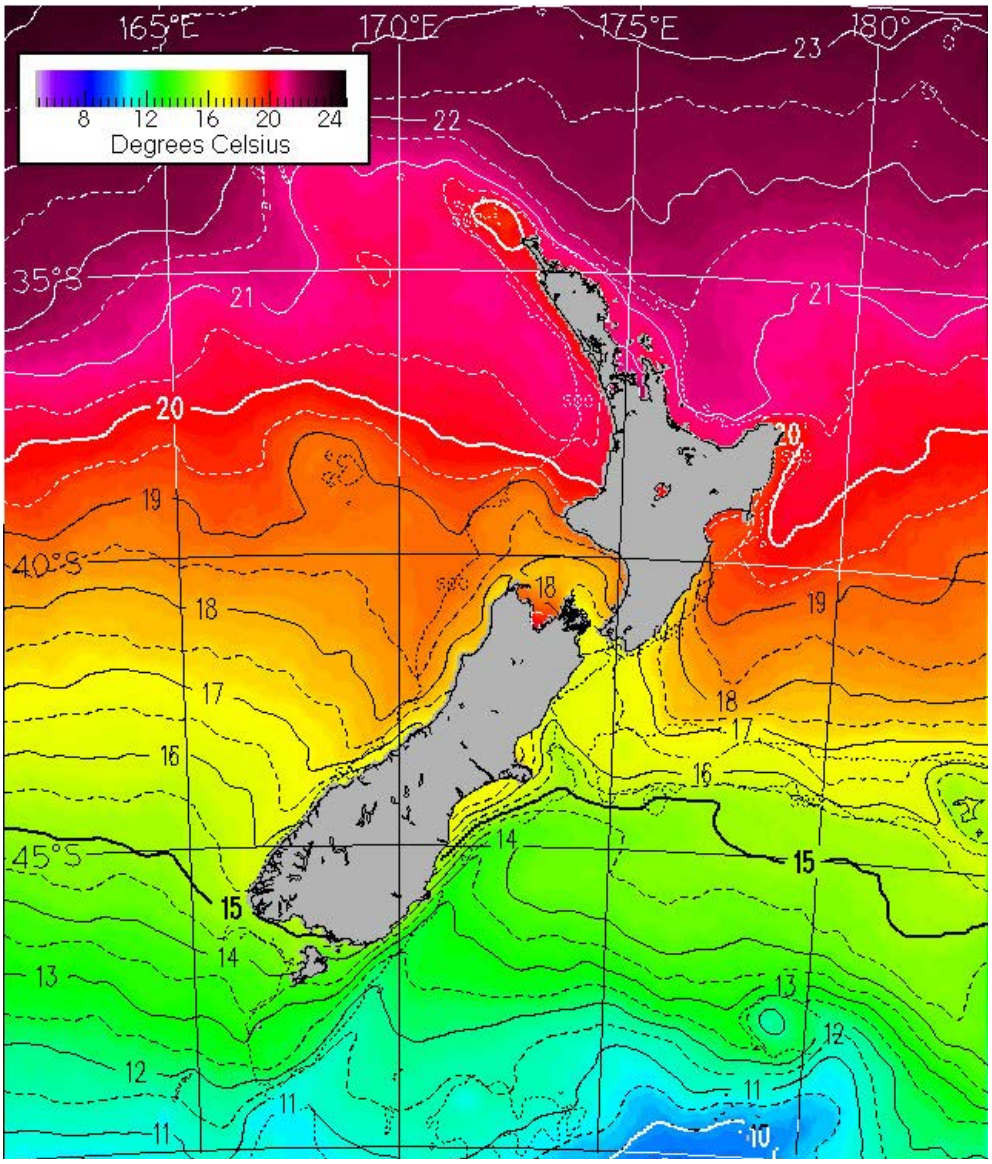


Figure 2.6: Average February (summer) sea surface temperatures (SST) in New Zealand waters. *Source: NIWA.*

26 Dept of Conservation 2004
27 Booth et al 2005

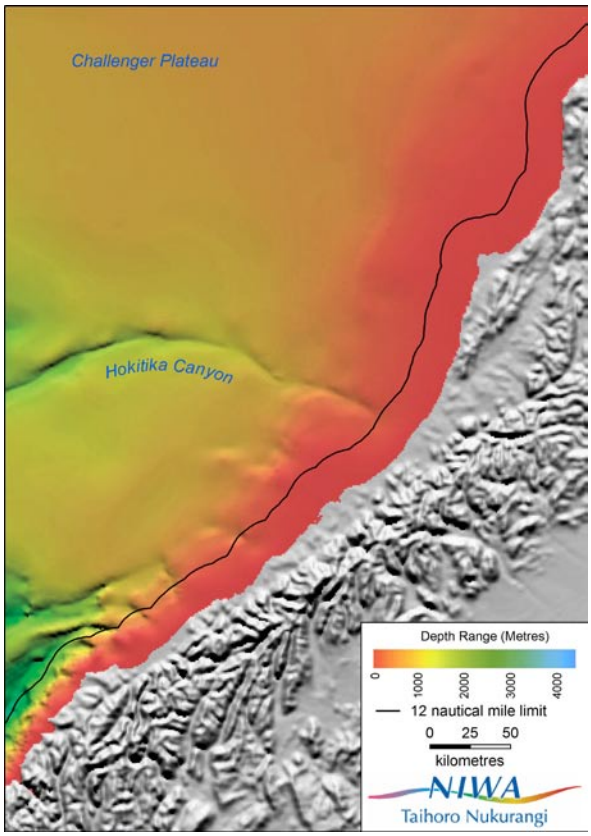


Figure 2.7: Undersea landform features of the West Coast

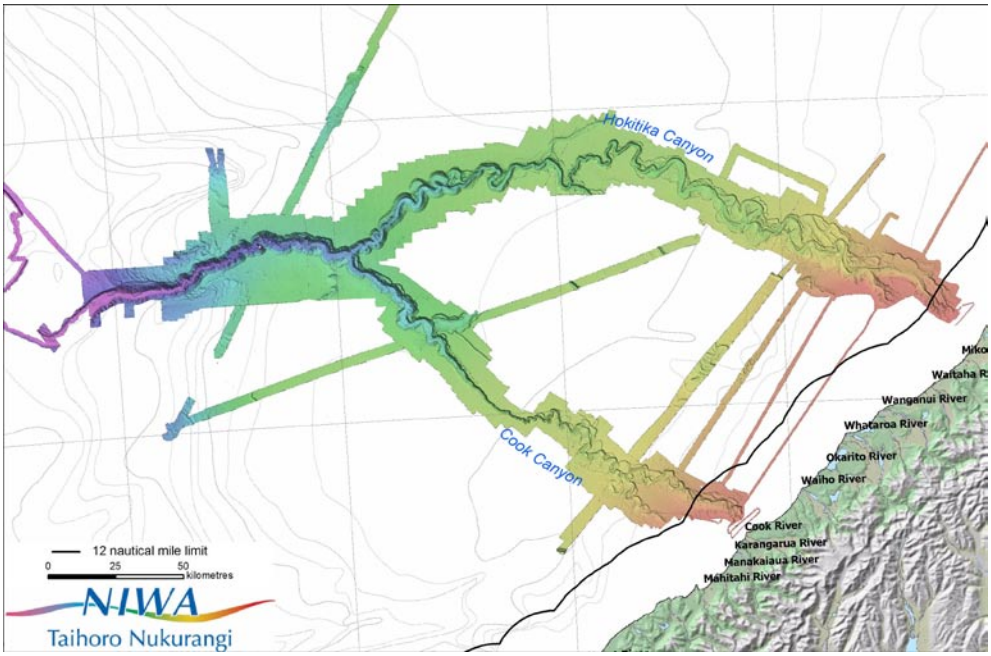
2.3.5 Seabed Topography

The topography of the seabed off the West Coast is complex[28]. In the north of the West Coast, the seabed is dominated by the continental shelf that slopes gradually out to the Challenger Plateau which extends well beyond the territorial limit. South from about Hokitika, the shelf narrows considerably and becomes dissected by a series of submarine canyons that extend to within the coastal marine area. The continental slope that marks the edge of the shelf comes in closer to the coastline in the southern parts of the region, forming the margins of the Tasman Basin lying to the south of the Challenger Plateau. The extent of the continental shelf, the continental slope, and the position of the main underwater canyons off the West Coast are shown in the NIWA map (Figure 2.7). The boundary between the continental shelf and the top of the continental slope is around the 200 m depth mark (see also depth classes in section 2.4.1).

NIWA has recently completed multibeam swath mapping and sediment coring in the vicinity of the Hokitika and Cook Canyons off the West Coast[29]. This work was generally done for the purpose of assessing New Zealand's paleoclimatic conditions (climatic and tectonic conditions throughout geological time), and is based on West Coast sediment dispersal from the Southern Alps to the Tasman Basin. Some initial results of this work are presented in Figure 2.8, and these very accurate and detailed charts of the seabed show intricate submarine channel networks. This project has shown that the two canyons are active features of the continental shelf, draining the longshore drift of shelf sediments into deeper waters. Seabed mapping of other parts of the West Coast coastal marine area is generally less detailed, and mostly shown in the bathymetric charts produced by the Hydrographic Office and New Zealand Oceanographic Institute (NZOI) dating back to the 1970s and 80s.

Figure 2.8: Hokitika & Cook Canyons. *Source: NIWA.*

(Explanation: This figure shows the NIWA survey tracks concentrating on the two canyons, overlaid on the previously recorded (and less accurate) bathymetric contour lines.)



28 e.g. see CANZ 1996, Carter 1981, Norris 1979, Norris & van der Linden 1972

29 P Barnes pers comm 2006, publication pending

2.3.6 Geology and Geomorphology

The geology and landforms of a region create the basic physical structure on which its habitats and ecosystems are to be found. They also influence the natural physical processes that affect the marine and coastal environment. The West Coast contains a wide variety of geological formations, ranging from some of New Zealand's most ancient pre-Cambrian rocks to more recent glacial formations and Holocene beach deposits[30]. This section summarises the region's geology and landforms, especially as they relate to the coastal and marine environment.

Typical ancient basement rocks are exposed in the Charleston locality. *Photo: D. Neale, DOC.*

Softer, younger (Tertiary age) sedimentary rocks are a feature of the Punakaiki coastline. *Photo: P. Ryan, DOC*

BASEMENT GEOLOGY – THE OLDEST ROCKS

The basement rocks of the West Coast were formed from ocean sediments of the ancient Gondwana 'supercontinent' between 300 million and 540 million years ago.[31] Basement rocks appear in coastal exposures on parts of the Kahurangi and Foulwind-Paparoa coasts, along with metamorphic rocks like gneiss.

SEDIMENTARY ROCKS – 'TERTIARY' GEOLOGY

In many places the oldest 'basement' rocks have been overlain by younger (less than 65 million years old) sedimentary rocks (which are usually softer and often calcareous). The coast from Kahurangi Point to Punakaiki has several areas of limestone shoreline, with coastal 'karst' features (of soluble rock types like limestone), the most spectacular being the 'pancake rocks' and blowholes at Dolomite Point near Punakaiki. The coast between Barrytown and Greymouth presents a geologically informative time-sequence of Tertiary-age sedimentary rock types. Included in this sequence are softer mudstone and sandstone shorelines, features which are also present in parts of South Westland.

Further out at sea, the rocks of the continental shelf seabed are mostly Cretaceous-Tertiary sedimentary rocks[32], but these are mainly covered by a blanket of recent sediments derived from the West Coast river discharges. In a study of the West Coast's continental shelf north of the Waiau (Waiho) River, Norris (1978) identified a complex variety of fault lines, shorelines, channels and glacial features that are almost all buried beneath the mantle of present-day shelf sediments.

30 e.g. see geological maps and reports such as Suggate & Waite 1999, Rattenbury et al 1998 and Nathan 1996

31 Morton 2004

32 Carter 1975

TECTONIC UPLIFT

The active uplifting of the West Coast has played a large part in shaping the physical structure of the coastal and marine environment – a process which continues today. Many large rivers flowing from the mountainous hinterland carry down massive amounts of sediment from the naturally-eroding uplifted mountains, forming long beaches of sand and gravel, while the finer mud and silt-sized particles are swept out to settle as fine sediments on the sea floor. In places, tectonic uplift of the landscape has left steep bluffs leading down to rocky shorelines.

As well as the obvious signs of uplift on the land, there are a series of ancient fault lines and other formations on the seabed right along the West Coast[33]. These have helped to shape the structure of the seabed, but are now mostly smothered by the fine sediments of the continental shelf (see above). These features are most easily detected by seismic and coring surveys that reach below the seabed surface.

ICE AGE GLACIATIONS

Historic glaciation has had a major effect on the geomorphology of the West Coast shoreline. During the last (Otiran) glaciation (10 000+ years ago), glaciers extended out beyond most of the present coastline from Hokitika south to Fiordland (though the sea level at that time was 100 to 200 metres lower than present)[34]. Rock deposits of glacial origin (moraines) show that glaciers once extended well beyond the present shoreline, especially in the southern parts of the West Coast and in Fiordland.

Coastal landforms such as the Cascade Plateau and all of the moraine headlands between Hokitika and Paringa are the remains of deposits laid by these glaciers. Since that time, sequences of coastal lowland outwash terraces and sandplains have been formed from sediments brought down by the rivers. Today, the coast between Hokitika and Paringa consists of many long beaches at the mouths of rivers with glaciated catchments. These beach and dune deposits are intersected by lateral moraines that have been truncated into steep bluffs and boulder shores by the eroding sea (see photo bottom left). South of Paringa, the Haast Glacier Tongue 14,000 years ago extended out around 10 km beyond the present-day coastline between Ship Creek and Jackson Head; but today these catchments of the Haast, Waiatoto and Arawhata contain only remnant glaciers in their headwaters.

Beyond the coast, old shorelines, channels, moraines and other glacial features buried by silt have been found to occur at several locations, such as off the Waitaha, Whataroa and Waiau (Waiho) Rivers[35]. These date back to the Pleistocene 'Ice Age' times when the sea level was up to 200 metres lower than it is today. Offshore beds of old river gravels are also mostly covered by silt, but are sometimes exposed in a few places such as indicated by a 1983 study of the 'Harvester Prospect' area near the head of the Hokitika Canyon[36].

Photos –top: Plate movement around the Alpine Fault has played a major role in shaping the physical structure of the coastal and marine environment. Looking north-east along the faultline in the Jackson Valley, towards Jackson Bay/Okahu and the Haast coastline in the distance. *Photo: D.L. Homer, GNS*

Bottom: Looking south across the mouth of the Cook/Weheka River. The lateral moraines straddling each side of the path of the former Cook Glacier have subsequently been truncated by wave erosion, leaving bluffs and boulder shores at Otorokua Point (foreground) and Cook Bluff (middle distance). *Photo: T. Hume, NIWA.*

33 Norris 1978
34 Soons & Selby 1992
35 Norris 1978
36 Price 1983b

SEDIMENTATION AND RIVER DISCHARGES

Sedimentation – the movements of organic material, mud, silt, sand, gravel and boulders – affects the West Coast's marine environment in many ways. The effects of sediments depend on a variety of factors: the size of the sediment particles (texture), the nature of the seabed, and the ability of currents to move them. Consider the mobility and effects of the following sediment classes (in diminishing particle size):

(a) **boulders** mostly enter the coastal marine area by falling from eroding coastal bluffs, forming 'ramps' that create fairly stable surfaces and broken terrain on the shore.

(b) **cobbles, gravels** and **coarse sands** mostly come from river-borne sediments or from the erosion of deposits left behind on the seabed or shoreline during (or soon after) the ice ages. They form beaches, river beds and seabeds that are generally less suitable for burrowing animals, and the scouring they cause with wave action can greatly affect the survival of bottom-dwelling plants and animals.

(c) **fine sands** tend to occur at the mouths of some estuaries, and a little offshore beyond the direct impact of waves; they can similarly contribute to sand scouring, but provide a generally more suitable habitat for the likes of surf clams and other seabed species.

(d) **very fine silts and muds** settle in low energy areas like the upper reaches of estuaries or the outer continental shelf. They are a habitat for some species of shellfish, worms, crabs and saltmarsh plants. The prevalence of these very fine sediments in West Coast waters also has a major effect on water clarity, most clearly seen during flood and storm events when the inshore waters of the coastal marine area become laden with suspended silt, reducing underwater visibility and light penetration.

When such sediments reach the dynamic coastal system, they are moved around and broken down to smaller sizes by the abrasive action of waves and other energy sources.

Each row from left: The size and shape of coastal and marine sediments varies widely:
(A) Boulders.
Photo: D. Neale, DOC.
(B) Cobbles.
Photo: T. Hume, NIWA.
(C) Gravel.
Photo: L.F. Molloy.
(D) Sand and Gravel.
Photo: T. Hume, NIWA.

Driftwood on Hunts Beach, typical of many intertidal shores. *Photo: T. Hume, NIWA.*

Timber and other plant materials are washed from forested land into the sea on the West Coast in considerable volumes. While wood is not known to be the dominant component of the substrate at any location, it is present as driftwood on intertidal shores and at the sea surface, and as sunken logs on the seabed of the shelf[37] and in deeper waters[38].

Suspended sediment discharge models for river catchments indicate that the major rivers of the central and southern West Coast have some of the highest sediment loads in New Zealand (see Table 2.1 below)[39]. South Westland rivers originate in schist rock catchments and transport a higher proportion of sandy sediment and less gravel to the coast[40]. The high sediment loads contribute to low seawater clarity and the high amounts of mud, sand, gravel and boulders accumulating on the beaches and continental shelf.

Table 2.1 Suspended sediment loads of West Coast rivers (in million tonnes per year). *[Derived from Hicks and Shankar 2003].*

River	Mt/yr
Karamea	0.15
Mokihinui	0.29
Buller	2.70
Grey/Mawheranui	2.10
All other rivers between Grey R & Farewell Spit	1.26
Total northern West Coast	**6.50**
Taramakau	2.20
Hokitika	6.20
Waitaha	2.80
Whataroa	4.80
Waiau (Waiho)	3.40
Haast	5.90
Arawhata	7.20
All other rivers between Taramakau R & Big Bay	29.50
Total southern West Coast	**62.00**
Total West Coast	**68.50**

The surface sediments on the West Coast shelf are mostly derived from these recent river sediments. In the northern parts of the shelf there is a simple correlation of sediment texture with depth; that is, the seabed sediments become finer as one goes from the shoreline to the outer shelf. Considerable attention has been focused on beach sands and shelf sediments because of their economic potential, such as the presence of gold, ilmenite and other heavy minerals.[41]

Although sediment thickness on the continental shelf may reach 300 metres or more in some places, the most typical situation is of a lens-shaped prism of sediment about 20 to 70 metres thick lying on older faulted and folded rocks. The lens of sediment is typically thickest in water depths of about 50-60 metres. It thins to about 20-40 metres thick both toward shore and toward the shelf edge.[42] (see Figure 2.9).

37 I McKenzie pers comm 2006
38 Arnold 2003
39 Hicks & Shankar 2003
40 Goff et al 2003, p167
41 e.g. Carter 1975, Price 1983a, b
42 Norris 1978

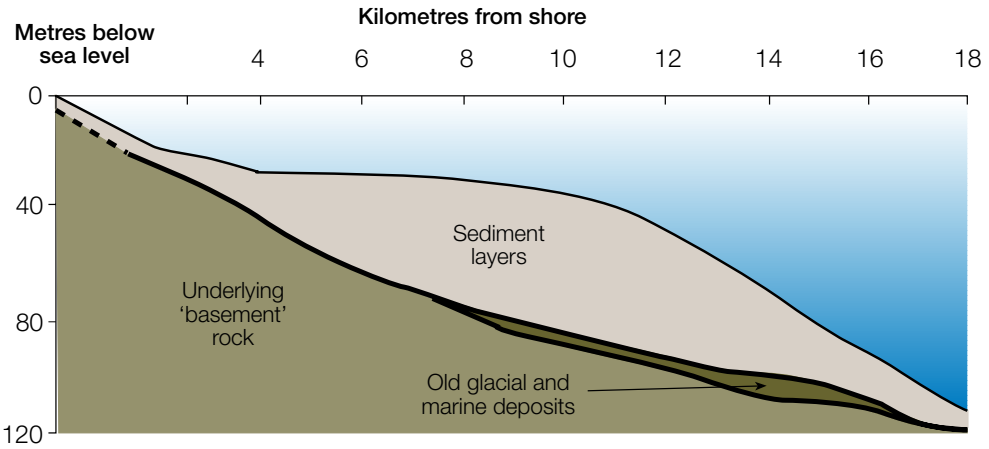


Figure 2.9: Example of a 'typical' sediment profile off the West Coast, showing the 'lens' of recent sediment beds covering older glacial and marine sediments and the underlying 'basement' rocks.
Source: adapted from a profile off Greymouth in Norris 1978.

GEOPRESERVATION INVENTORY

The New Zealand Geopreservation Inventory[43] "aims to list the best examples of the wide diversity of natural physical features and processes that together characterise each part of New Zealand and document its long and complex geological history, the formation of its landforms and evolution of its unique biota." The inventory gives a rating for each site according to its geological importance for scientific, educational or aesthetic values, and its vulnerability to human activity. The inventory lists a number of West Coast coastal features as being of international, national or regional importance. Two coastal locations of international significance are listed in the inventory (Gillespies Beach, the type locality for the mineral, huttonite and the fossil deposits at Perpendicular Point). Geopreservation Inventory sites that extend into or near the coastal marine area are shown in the sections of Chapter 5.

Fossil oysters at Perpendicular Point.
Photo: DOC.

43 Hayward & Kenny 1999

2.3.7 Coastal Margins and River Catchments

The hinterlands (coastal margins and catchments) of the coastal and marine area are beyond the immediate scope of the West Coast Marine Protection Forum. Nevertheless, the nature of the hinterland has a considerable influence over the marine environment. The major landscape feature of the hinterland is the Southern Alps/Ka Tiritiri o te Moana and their associated ranges, from which a large number of rivers flow out to the coast. These rivers carry large volumes of water and sediment to the coast, providing important physical and ecological linkages between their catchments and the sea. Smaller rivers and streams arise in lowland areas and coastal ranges, while the coastline itself can be bounded by a variety of landforms, like sand plains, coastal terraces, headlands, coastal wetlands, and dune systems.

2.3.8 Variation in Physical Character from North to South

Research[44] indicates that the physical character of the West Coast marine and coastal environment changes from north to south, especially in terms of its geological history, topography, and rock types. In the north, from Kahurangi Point to Point Elizabeth, there is diverse geology but no glacial history. The shores consist of both bedrock and coastal sediments that enclose tidal flat estuaries on some of the coastal plains. Beyond the surf zone, the continental shelf is relatively flat and shallow, and coastal currents are mostly towards the north (commonly known as the 'Westland Current').

In the central area south to about Heretaniwha Point, there are more biologically rich and relatively unmodified tidal wetlands and estuaries. Here, the shore has been, and still is, very much dominated by glacial activity and high discharge of sediments from the rivers. In common with the northern area, this central area is dominated by species adapted to the heavy action of the rough wave conditions, murky silt-laden water and moving sand. The continental shelf in this central area is dissected by two major submarine canyons – the Cook and the Hokitika – and coastal current directions vary between northward- and southward-moving.

Further south to Awarua Point, there is a history of glaciation, but the sediments now reaching the shore are predominantly from non-glaciated catchments. Consequently, 'glacial flour' has a lesser influence and the sea is often quite clear close inshore. Large river mouths are common in the south and are often associated with slower-flowing tidal lagoons. Several offshore islands, rock stacks and reefs provide habitats less affected by sand scour. Further offshore, the continental shelf is much narrower than further north, and it is heavily dissected by five main submarine canyons – the Moeraki, Haast, Arawata, Jackson and Cascade. Coastal currents are mostly towards the south, forming the beginnings of the 'Southland Current'.

Photo –top: The coastline in the northern part of the West Coast has diverse geology and no history of glaciation. Te Miko locality north of Punakaiki. *Photo: D. Neale, DOC.*

Centre: The coastline of the central part of the West Coast is influenced by past and present-day glacial activity and has murky seawater caused by high silt discharges from rivers; tidal estuaries and lagoons are also prominent features. Looking south across the mouth of the Whataroa River to Okarito Lagoon and the Southern Alps/Ka Tiritiri o te Moana. *Photo: T. Hume, NIWA.*

Bottom: In the southern part of the West Coast, the sea is often clearer close inshore and islands and stacks are less affected by sand scour. Looking south-east across Jackson Head to Jackson Bay/Okahu. *Photo: D.L. Homer, GNS.*

44 e.g. Roberts et al 2005, Dept of Conservation 2004, Neale & Nelson 1998, Shears in prep, Grange 1990, RNZN (various), Carter 1981, Eade 1972, Norris 1979, Norris & van der Linden 1972,

2.4 Characterising the Marine and Coastal Environment

Over the years several science-based classification systems have attempted amongst other things, to spatially classify the different estuarine, coastal and marine environments of the West Coast[45]. In the absence of a finalised national marine classification being developed for use with the Marine Protected Areas: Policy and Implementation Plan (MPA Policy)[46], this section characterises different domains within the West Coast marine and coastal environment according to several important physical factors. The West Coast Marine Protection Forum can consider the physical patterns and processes explained above, and the characterisation based on depth, substrate and exposure outlined below, but will be guided mostly by the national classification under the MPA Policy when it is released.

Recent work relating to the MPA Policy by DOC and MFish officials on behalf of Ministers[47] indicates that there are three important physical elements which help in describing and mapping the country's marine habitat diversity. They are:

- depth;
- substrate; and
- exposure (or energy).

Accordingly, information on the West Coast's marine and coastal environment is presented below in terms of depth, substrate and exposure. However, it is emphasised that the way this has been applied does not necessarily relate to the number of ecosystems, habitats, or areas the Forum will recommend for protection.

In the West Coast coastal marine area, water depths obviously range from shallow at tidal limits on open coasts and at river mouths, out to much greater depths across the continental slope and submarine canyons offshore. Substrates can vary according to their texture, geology and shape. The degree of exposure to energy sources such as waves, tides, and currents can have an important bearing on the character of a coastal area. Depth, substrate and exposure are to some extent interrelated and in combination they can lead to the formation of a variety of landforms, ecosystems, and habitats.

2.4.1 Depth

Depth has an important influence on the character and biology of the marine environment and the depth zonation of shores has been a key concept in marine science for a long time. The physical and biological changes are very obvious as one goes from the terrestrial and freshwater margins of the marine environment out to the ocean depths.

The coastal marine area of the West Coast covers a wide range of depths from shallow terrestrial and freshwater environments to ocean floors at over 2000 metres depth. The following list describes the different depth zones, with a brief definition of what each term means. They are illustrated in Figure 2.10.

45 e.g. King et al 1985, McEwen 1987, Francis 1996, Neale & Nelson 1998, DOC 2004, Roberts et al 2005, Walls 2006a, b

46 DOC & MFish 2005

47 Walls 2006a

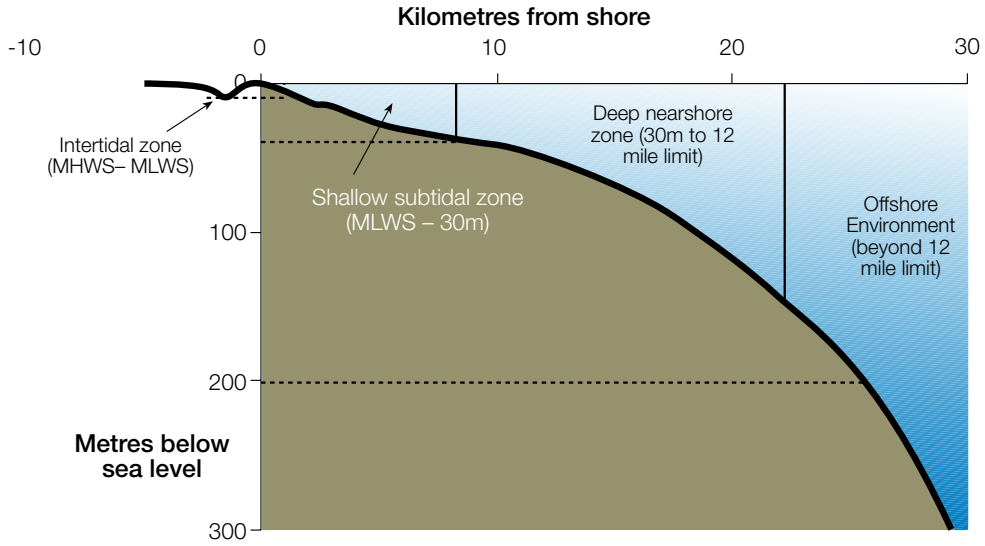


Figure 2.10:
A schematic diagram of depth zones of the West Coast, based on a profile off the Karangarua River mouth.

- **Terrestrial and inland areas** are all those areas above the limits of the coastal marine area, and include a variety of coastal hillslopes, dunes, river catchments and wetlands.
- The **intertidal zone** forms the transition between dry land and the sea. On the open coast, this includes beaches and rocky shores; in enclosed coastal wetlands (the 'estuarine environmental domain'), it can include tidal flat estuaries and the margins of tidal lagoons and river mouths.
- The **shallow subtidal zone** (to about 30 metres depth) represents the water depth to which sunlight can easily penetrate; it is also the zone most affected by wave action and surface mixing.
- The **deep nearshore zone** extends from about 30 metres depth to the 12 nautical mile limit, and mostly comprises the bed and waters of the continental shelf (to about 200 metres depth), and some deeper areas of continental slope and submarine canyons lying within territorial waters.
- The **offshore environment** lies beyond the 12 mile limit, and is not a direct consideration of the West Coast Marine Protection Forum.

2.4.2 Substrate

The term 'substrate' refers to the surface of the seabed or land. Substrate also influences the marine biology of an area: that is, different species can often be found to live on different substrates. One of the most obvious substrate contrasts is that seen between 'hard' rocky shores and 'soft' sandy beaches. Hard substrates usually comprise:

- **bedrock** substrates, that are formed from the massive underlying rock formation, and
- **boulder** substrates, that are formed from large individual rocks (larger than 256 mm diameter) which are not readily moved by wave and current action.

These two substrates are typically dominated by species that need to attach to the hard and immobile surfaces of the rocks (such as mussels and seaweeds).

Soft substrates are those that are more readily moved by the action of waves and currents near the coast and at most continental shelf depths. They include (from largest to smallest size range)

- **cobble**, particles from 16 to 256 mm diameter, such as the platy stones that are found on many West Coast beaches.
- **gravel**, comprising particles of 4-16 mm diameter in size.
- **sand**, comprising particles from 2-4 mm diameter in size.
- **silt and mud**, comprising the finest range of sediments.

These substrates often support species (such as surf clams and worms) that can burrow into unconsolidated sediments that move with the waves and tides.

Substrate types can vary widely according to:

- texture (size range) and mobility of their constituent parts;
- form (e.g., smooth or rough surfaces at a range of scales);
- geological composition (e.g. limestone or granite); or
- sedimentation dynamics (erosion, transport and abrasion patterns); and
- complexity (e.g. a patchy rock reef within a sandy bay).

There is some information on where these different sediment types occur on the bathymetric data on the regional map in Figure 2.13 later in this chapter and on the more detailed maps shown in chapter 5.

2.4.3 Exposure

'Exposure' refers to the levels of energy that a site is subjected to by natural processes. Exposure (or energy) tends to have a more subtle effect on the biology of an area than depth and substrate. While the exposure of a site is usually considered in relation to waves, the exposure or energy levels might also be influenced by other features, such as currents, tides, winds, gravity and infrequent catastrophic events (e.g. flood, storm surge, or submarine landslide). A convenient way to consider the relative exposure of different sites is by dividing them into

- **Exposed**
- **Moderately exposed**, and
- **Sheltered**

The exposure of a substrate to wave energy tends to be greatest on intertidal marine shores, diminishing both landwards (onto the land and up rivers) and seawards (into greater depths). A clear example of these variations in exposure is given by contrasting an estuarine sand flat with an intertidal sandy beach. While both may be at the same elevation and of the same sediment type, the greater exposure to waves in the beach system makes it (among other things) steeper and more mobile than the estuarine flat.

OTHER FACTORS

Other physical factors can also affect the character of the coastal and marine environment. Two factors that have received particular attention in the scientific literature of the West Coast[48] are salinity and the ways that the coastal and ocean currents affect the coastal marine area.

Left: Exposed Paparoa coastline. *Photo: D. Neale, DOC.*

Right: Sheltered coastline, Jackson Bay/Okahu. *Photo: N. Shears, Auckland University*

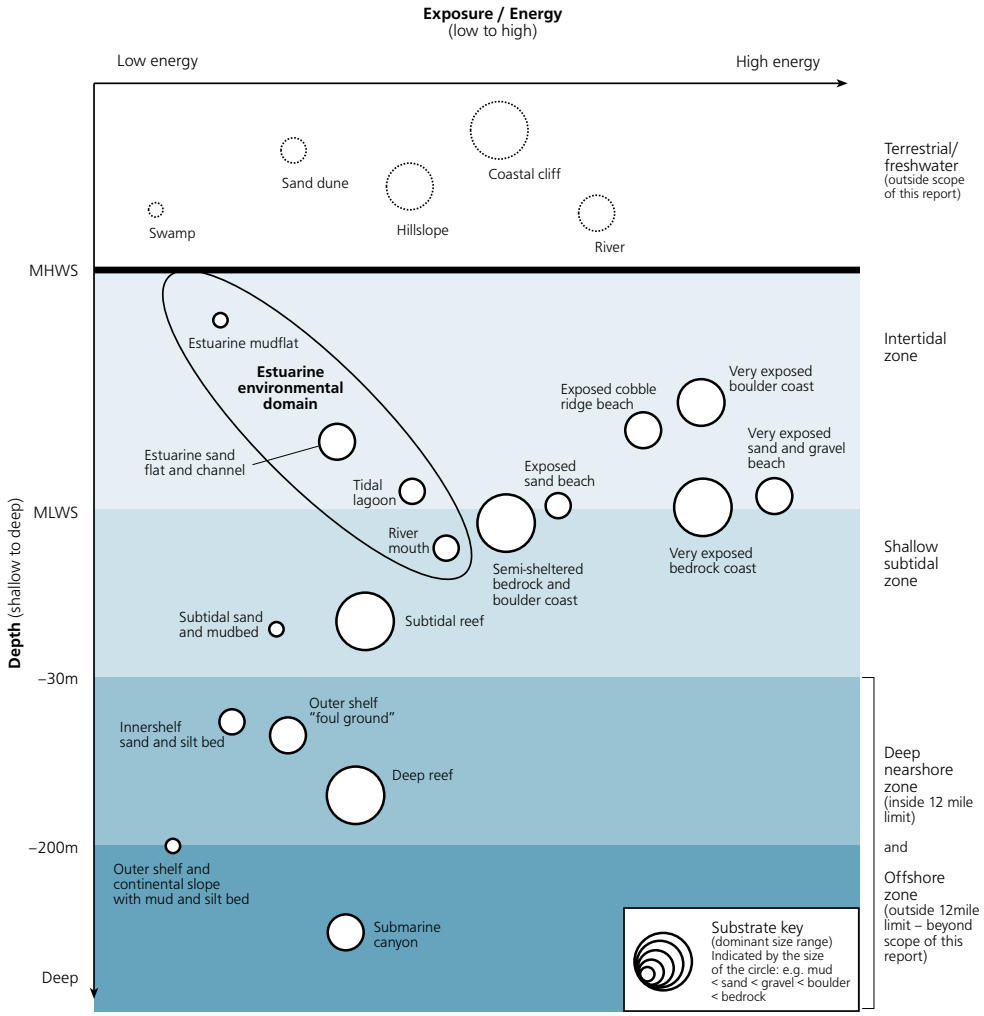
48 e.g. Heath & Ridgway 1985, Moore & Murdoch 1993, Heath 1982, Stanton 1976

2.5 Ecosystems Based on Depth, Substrate and Exposure

2.5.1 Spatial Distribution of Ecosystems Based on Depth, Substrate and Exposure

The primary drivers of depth, substrate, and exposure/energy (outlined in section 2.4 above) can be used to give a 'three-dimensional' picture of the physical nature of the West Coast marine and coastal environment, and thence the distribution of the main ecosystems. Figure 2.11 is a 'two-dimensional' attempt to show the widely varying spatial distribution of the main ecosystems along the depth and exposure axes, with the substrate dimension embodied partly in the size of the circles and partly in the 'substrate descriptor' for each ecosystem name (e.g. 'sand and silt' or 'bedrock').

Figure 2.11. Distribution of common examples of coastal and marine ecosystems on the West Coast, according to their depth, exposure/energy and substrate.
Note: positions and sizes of each circle are indicative only.



It is important to note that the ecosystem types shown as named circles in the figure are simply illustrative of common examples that occur on the West Coast. They are not intended to be a comprehensive classification of the coastal marine area. In reality, while there are sometimes sharp physical boundary changes, there is more often just a gradual transition. For example, the intertidal depth zone steadily deepens out to the shallow subtidal and beyond, or some tidal lagoons flow out through river mouths to a sand or gravel beach.

2.5.2 Four Marine and Coastal Environmental Domains

The spatial distribution of the main ecosystems in Figure 2.11 admittedly looks complex. So to simplify the discussion to follow in Chapter 3 of the biological character of the West Coast's marine ecosystems and habitats, the physical environment has been split into four broad 'environmental domains' (see Figure 2.12 and definition in box).

> Environmental domains are areas with similar physical environmental conditions (as defined by factors including solar radiation, temperature, moisture and geological substrate) that have been demonstrated to have high correlations with plant and animal distributions.

These four environmental domains in the West Coast coastal marine area are the:

- Estuarine domain;
- Intertidal (open coast) domain ;
- Shallow subtidal (open coast) domain; and the
- Deep nearshore domain.

The boundary of one of these domains, the 'estuarine environmental domain', is outlined in Figure 2.11.

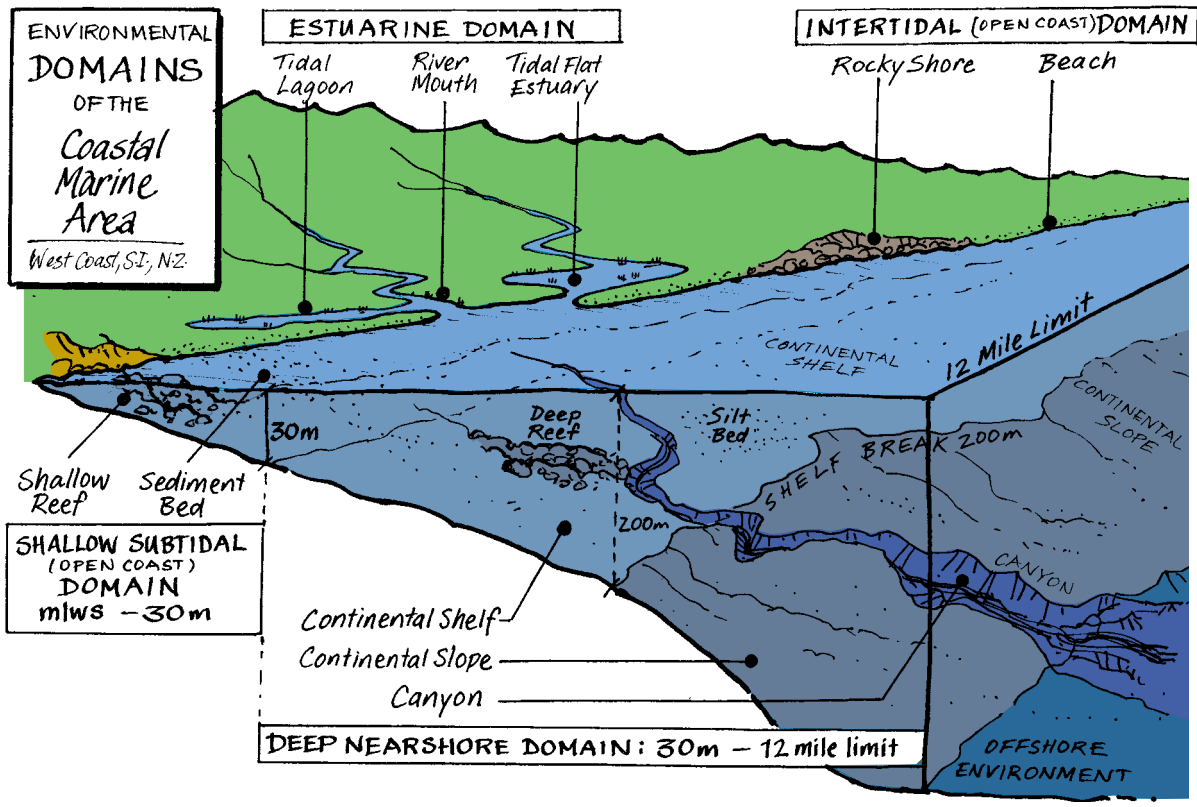


Figure 2.12: Environmental domains of the West Coast coastal marine area

The names of the last three of the environmental domains listed above are related to the relevant depth zones (in section 2.4.1 above). One of the clearest physical divisions in the West Coast coastal marine area is between the 'estuarine' environments and the more 'marine' environment. In terms of their depth, the estuarine ecosystems shown in Figure 2.11 are mostly intertidal (but also include some shallow subtidal areas). However, they differ markedly from the open coast because they generally have a much lower level of exposure, and finer sediments. Compared to the intertidal beaches and rocky shores of the open coast, the estuarine environmental domain has lower salinity water, and riverine processes that are less affected by the influence of sea waves and coastal currents.

From left: A tidal flat estuary (Three Mile Lagoon).
Photo: T. Hume, NIWA.

A tidal lagoon (Totara Lagoon).
Photo: D. Neale, DOC.

A river mouth (Whataroa River).
Photo: T. Hume, NIWA.

ESTUARINE DOMAIN

The West Coast has many enclosed estuaries and river mouths that connect with the sea through narrow entrances across barrier beaches. Intertidal mud and sand flats are prominent features of these areas, with permanent tidal channels that extend below the intertidal zone. Estuarine environments on the West Coast include broad tidal flat estuaries (e.g. Three Mile Lagoon), tidal lagoons (e.g. Totara Lagoon) and gravelly river mouths (e.g. Whataroa and Grey/Mawheranui Rivers). These are discussed in more detail in Chapter 3.

INTERTIDAL (OPEN COAST) AND SHALLOW SUBTIDAL (OPEN COAST) DOMAINS

The intertidal (open coast) domain extends from the MHWS line down to MLWS, and the shallow subtidal (open coast) domain reaches from MLWS out to about 30 metres depth. While the intertidal (open coast) domain can be quite different to the shallow subtidal (open coast) domain, the two are combined for the purposes of this section of the report. These two domains are areas where sharp physical changes occur across relatively short distances at a scale of metres or less. The effects of tides, currents and wave action are felt on the shore and seabed from the highest levels of the tide to depths of several tens of metres, and they dominate the physical dynamics of these domains. Breaking waves impart high levels of energy on the intertidal shore, reducing to lower levels with increasing water depth. The regular flood and ebb of the tide affects the environmental conditions and helps to determine the physical and biological patterns that are discussed in more detail in Chapter 3.

A typical rocky shore with reefs, off the Paparoa Range coastline. Seal Island in the foreground
Photo: D. Neale, DOC.

Because the West Coast faces generally towards the prevailing westerly winds and waves, most of the intertidal (open coast) and shallow subtidal (open coast) domains are very exposed to the waves and sea conditions of the open coast. The frequent sea storms and abundant supply of gravel from the rivers cause the West Coast's 'open coast' shores to be heavily battered by waves and affected by sand and gravel scour.

Consequently, only a few areas on the West Coast shoreline are relatively less exposed to the direct impact of wave action and/or currents. These include sheltered bays and rocky shores with deep water immediately offshore (such as around headlands and islands). The lower energy conditions occurring in such places make them less affected by turbulence and sand scour.

The substrate at any particular place in these shallow marine domains is a distinguishing feature of the location's physical nature. Relatively immobile hard rocky substrates (e.g. bedrock and boulders) contrast sharply with the mobile soft sediments (e.g. cobbles, gravel and sand). A combination of these sediment types often occurs at any particular site, but one or a few types are usually dominant The following discussion looks at the physical character (particularly substrates) of the two main types of open coast: rocky coasts and beaches.

Shallow subtidal reef near Cape Foulwind. *Photo: DOC collection.*

(a) Intertidal and Subtidal Rocky Substrates

Rocky shores and reefs are formed along the West Coast where mountain ranges approach the coastline. Examples are: the Kahurangi National Park mountains, Karamea Bluffs, Paparoa Range, Paringa-Moeraki coastal ranges, and Cascade-Awarua hill country. The geology, form and character of these rocky shores are quite varied, and they range in age from the Precambrian gneiss at Charleston to the Quaternary moraine deposits of central Westland and the Cascade Bluffs[49].

The substrates of rocky coasts are mostly of bedrock and boulders and the type of rock can have an influence on the physical form and stability of the shoreline. Bedrock coasts are generally the most physically stable type of coastline. However, they can vary according to the geology of the rock, from resilient and steep granite coasts to more erodable sandstone and mudstone coasts. Bouldery coasts are less static, for the boulders can sometimes move under heavy wave action.

A typical small island with reefs and stacks. Wall Island off Tauranga Bay, near Cape Foulwind. *Photo: DOC.*

Only a few islands occur off the West Coast, but small rock stacks are a landscape feature in some areas. The largest and most biologically significant islands of the West Coast are the kilometre-long Open Bay Islands (Taumaka and Popotai), located some four kilometres off Haast[50] (see Chapters 3 and 5 for a fuller account of islands and stacks).

(b) Intertidal and Subtidal Soft Substrates

Uplift of the mountainous hinterland east of the alpine fault, coupled with the region's high rainfall, has led to constant and on-going erosion of the land. It has been estimated that anywhere from 68 to 127 million tonnes of sediment is carried down the West Coast's rivers and glaciers to the sea every year[51], giving this region one of the greatest terrestrial erosion rates in the world. Most of this sediment is sorted into two main locations:

- deep beds of fine sand and mud clothing the seafloor on the continental shelf; and
- sand/gravel beaches that fill embayments or enclose tidal lagoons and estuaries along much of the coast.

The longshore drift of sediments on West Coast beaches is mostly caused by wave action (which prevails from the southwest) which typically yield high volumes of sediment northwards, with net rates for most beaches probably in the range of 0.1 to 1 million cubic metres per year[52].

49 Thornton 1985
50 e.g. see Neale (2006e)
51 Griffiths & Glasby 1985
52 Benn & Neale 1992

From left: a steep cobble beach, Ngakawau.

A gently-shelving sandy beach, Kohaihai.

Photos: T. Hume, NIWA.

West Coast beaches vary greatly in their physical composition, character and functioning. From a 'bird's eye view', their forms are largely determined by the presence or absence of rocky headlands and major rivers. 'Pocket' beaches, such as those nestled between headlands on the Kahurangi, Paparoa and Paringa coasts, contrast sharply with the long beaches found where broad river plains meet the sea (such as those in the Karamea, Foulwind, Greymouth-Bruce Bay, and Haast localities).

When viewed in profile (horizontally), beach forms are predominantly a result of the shape and size range of their sediments. Consequently, there is a wide range of profiles, ranging from the gently shelving sand beaches of the Karamea and Cape Foulwind plains to the steep cobble beaches near Granity, Barrytown and Greymouth. Along considerable lengths of the West Coast, especially in areas between about Paparoa and Jackson Head, the beaches are not dominated by a single sediment size class, but are instead composed of a mixture of sand, gravel and cobbles.

Despite the prevalence of strong onshore winds, West Coast sand dunes are mostly low in height due to the coarse, heavy and moist nature of the beach sediments, which are unable to be moved far inland by the wind.

A mixed sand and gravel beach, Gillespie Beach.
Photo: T. Hume, NIWA.

DEEP NEARSHORE DOMAIN

The deep nearshore domain extends from depths of about 30 metres (the outer edge of the shallow subtidal depth zone) out to the 12 nautical mile limit (the limit of the territorial waters). This domain mostly comprises the bed and waters of the continental shelf (which extends out to depths of about 200 metres), and some deeper areas of continental slope and submarine canyons lying within New Zealand's territorial waters.

Off the northern part of the West Coast, the continental shelf ('the shelf') reaches out beyond the 12 nautical mile limit to the broad Challenger Plateau. In the southern part, the shelf narrows greatly toward the south, dropping off down the continental slope quite steeply in some places, to the depths of the oceanic environment of the Tasman Sea. The shelf becomes virtually non-existent at the southern end of the West Coast and off the steep coast of Fiordland (Fig 2.7). Between Hokitika and Big Bay, the West Coast shelf is dissected by submarine canyons, the largest of which originates near the Hokitika and Cook/Weheka Rivers.

The shelf is mostly covered with a deep bed of sediments ranging from fine muds to coarse sands and gravels. Not surprisingly, sedimentation rates on the West Coast's shelf bed are among the highest in New Zealand, estimated by Norris (1978) to be 1.3 mm/year. The patterns of sedimentation for this coast have been summarised by Carter (1975), Price (1983) and others. Most sediment is supplied by the major rivers and it is mainly deposited on the beaches and continental shelf, or is lost offshore via the Hokitika and Cook Canyons and northwards alongshore toward the Challenger Plateau and Farewell Spit/Cook Strait regions. The sediments tend to be finer further offshore, but beds of gravels left by rivers during times of lowered sea levels (lag deposits) may be exposed in some locations.

Bathymetric charts show the more complex form of major nearshore features (e.g., the narrow shelf and the presence of canyons) in the south compared to the north. However, the substrates and other characteristics of the seabed south of about the Cook Canyon have not been documented in much detail.

Most studies report a predominance of fine sediments over most of the West Coast portion of the continental shelf. However, there are also some reports in published charts and literature of reefs and 'foul ground' (areas that are difficult or unable to be bottom-trawled, due to the predominance of snags, reefs or otherwise uneven seabed). In particular, Stevenson (2004) has mapped at a broad scale the distribution of foul ground identified by the NIWA trawl surveys, and these are shown in Figure 2.13. Other nearshore submarine reefs occur off the West Coast in depths greater than 30 metres. These include the Kahurangi Shoals in the north of the region, and some unnamed reefs off southern South Westland.

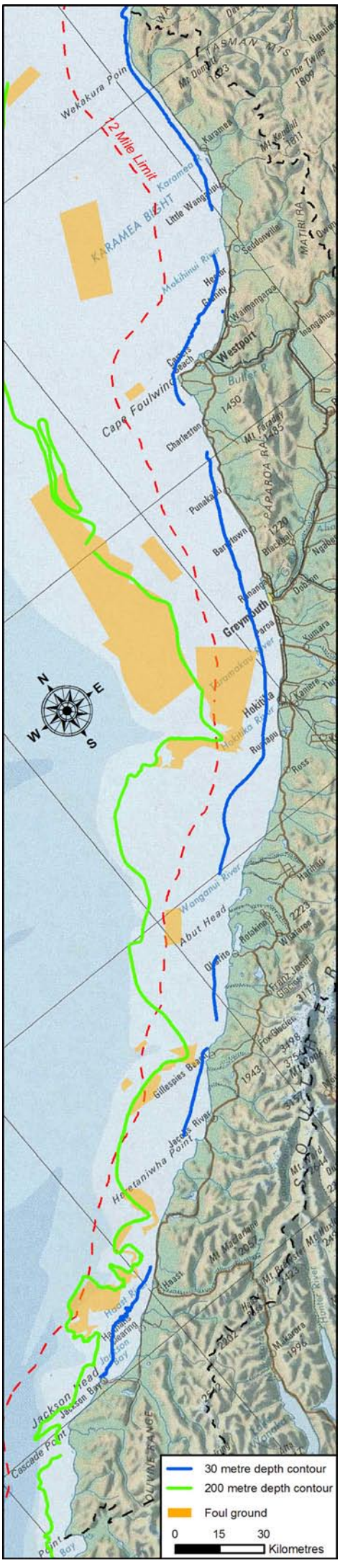


Figure 2.13: 'Foul ground' areas off the West Coast, as identified from NIWA fishery trawl surveys. *Source: Stevenson 2004, RNZN (various dates).*

CHAPTER 3

Biological Environment of the West Coast Coastal Marine Area: an outline of Marine and Coastal Ecosystems and Habitats

3.1 Introduction

The biodiversity of the West Coast's coastal and marine environment is influenced by the interplay of many of the geophysical factors already outlined in Chapter 2, e.g.:

- Oceanic and coastal currents and freshwater inflows;
- Tides, waves, weather patterns and sea temperature;
- Seabed and coastal topography; and
- Geology and geomorphology, including sedimentation and river discharges.

This chapter looks at the biological environment of the West Coast coastal marine area, using the four environmental domains identified in section 2.5 of Chapter 2; that is, the:

- Estuarine domain;
- Intertidal (open coast) domain;
- Shallow subtidal (open coast) domain; and
- Deep nearshore domain.

After an initial look at the range of marine and coastal plant and animal species on the West Coast, the biodiversity associated with the different ecosystems (as delineated on the basis of varying depths, substrates, and exposures and other physical features found in these domains) is outlined. The chapter then concludes with an account of some habitats on the margin of the West Coast marine and coastal area.

3.2 Plant and Animal Species

The West Coast marine and coastal biological environment contains a variety of plant and animal species living in the variety of ecosystems described in Chapter 2. The main groups of species that occur here include:

- Marine mammals;
- Birds;
- Fish;
- Invertebrates;
- Plants – Seaweeds and vascular; and
- Plankton.

This overview section only summarises the features of these broad species groups. However, some individual species and species assemblages are discussed elsewhere in this chapter within their preferred environmental domain.

MAMMALS

Marine mammals are among the biggest and most noticeable of marine animals. At least 21 species (12 whales, six dolphins and three seals) have been reported from the West Coast[1], including 11 threatened species[2]. Most feed on a variety of small fish and squid, but the large baleen whales (e.g. minke, southern right and blue whales) are plankton feeders. Two of the most obvious and well-studied marine mammals on the West Coast are the New Zealand fur seal and the Hector's dolphin.

New Zealand fur seals have a fluctuating West Coast population estimated at about 12 500 mature animals[3]. Fur seals regularly come ashore to rest at more than 20 'haul-out' sites on the West Coast, and breed in at least seven of these[4]. They travel widely within and beyond the region, feeding on fish and squid.

Hector's dolphins are a threatened species found only in New Zealand, with about 5400 (three quarters of the total population) on the West Coast[5]. They live in nearshore waters mostly shallower than about 70 metres, and individuals seldom travel more than about 60 kilometres along the coast in their lifetime.

Hector's dolphin (aihe) and NZ fur seals (kekeno) are two of the most obvious marine mammals on the West Coast. *Photos: DOC collection.*

BIRDS

A full inventory of the West Coast's coastal and marine birdlife has not been compiled, but they have been recorded from all environmental domains and include at least 18 threatened species[6].

Seabirds such as albatrosses, petrels, shearwaters and gannets occur in the open sea, feeding on small fish and other species, and often congregating around fishing boats for an opportunistic feed. Some seabirds nest on the coast, such as Westland petrels near Barrytown, and fairy prions and sooty shearwaters on a few of the islands, rock stacks and headlands that provide refuge from predatory animals. The threatened tawaki (Fiordland crested penguins) have important nesting areas in South Westland coastal forests, and feed near the edge of the continental shelf[7]. Blue penguins have more dispersed nesting areas along the region's coastline[8].

1 Neale 2005
2 Hitchmough et al 2007, see Appendix 4
3 Best 1998
4 Neale & Best 1999
5 Slooten et al 2002
6 Hitchmough et al 2007, see Appendix 4
7 McLean et al 1997
8 Hughes 2005

From left: Westland petrel (taiko). *Photo: DOC collection.*
Tawaki (Fiordland crested penguin). *Photo: P Ryan, DOC collection.*
Variable oystercatcher (torea). *Photo: D Neale, DOC.*

Shorebirds (e.g. gulls, terns, oystercatchers and dotterels) live on beaches, estuaries and rocky shores, while wading birds and waterfowl (e.g. godwits, stilts, herons, crakes, ducks and swans) depend on estuarine tidal flats, saltmarsh and channels for their roosting areas and food sources of small fish, shellfish and other invertebrates.

FISH

West Coast fish species vary widely in their size (from the 3 cm-long pygmy sleeper to the 9 metre basking shark), diet (including seaweeds, invertebrates and other fish) and habits (e.g. nocturnal or diurnal, freshwater or marine, demersal or pelagic). Surveys on the West Coast have recorded at least 90 species from the nearshore shelf environment[9] and 86 coastal reef and estuarine fish[10], including nine threatened species.

From left: Shortfinned eels (tuna). *Photo: S Moore, DOC collection.*
Sea perch (pohuiakaroa). *Photo: P Ryan, DOC collection.*

9 Stevenson 2002
10 Roberts et al 2005

INVERTEBRATES

West Coast invertebrates (animals without backbones) include at least ten phyla (major taxonomic groups). A full inventory of species has not been attempted, but they number at least in the hundreds[11]. Some of the main groups found on the West Coast are molluscs (e.g. shellfish, octopus and squid), arthropods (e.g. crabs, lobsters and hoppers), sponges, seasquirts, echinoderms (e.g. starfish and kina) and bryozoans. The only invertebrate species protected under the Wildlife Act is black coral.

Some of the many kinds of invertebrates which occur in the West Coast marine environment.
Top row: Jellyfish; Red rock lobster; Anemone
Second row: Zooanthids; Sponges; Seven armed star
Third row: Octopus; Snakestail star; Shrimp
Bottom row: Kina and seaweeds; Biscuit star; Cancer crab

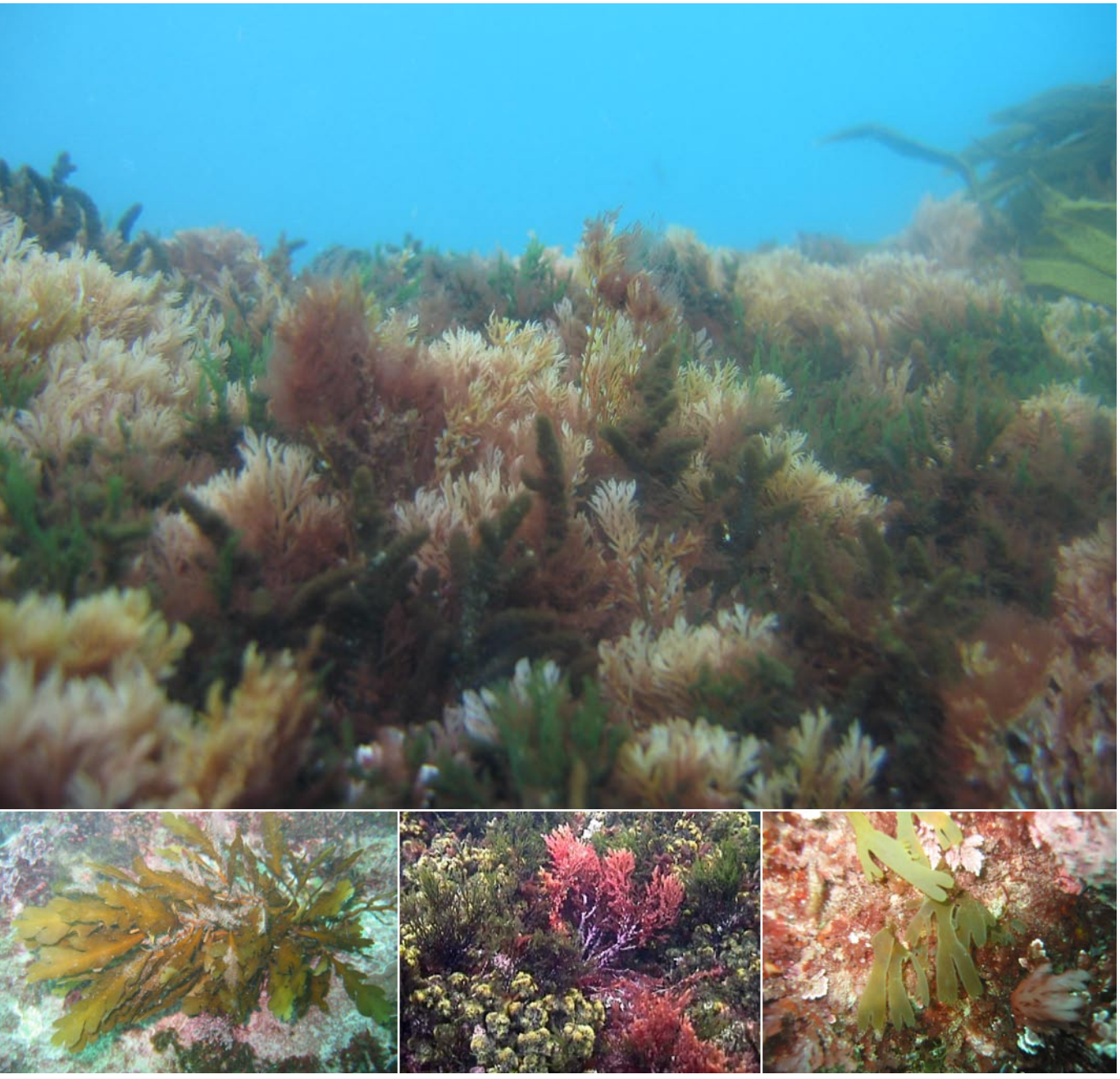
Photos: Paddy Ryan, DOC Collection

11 Neale 2007

PLANTS

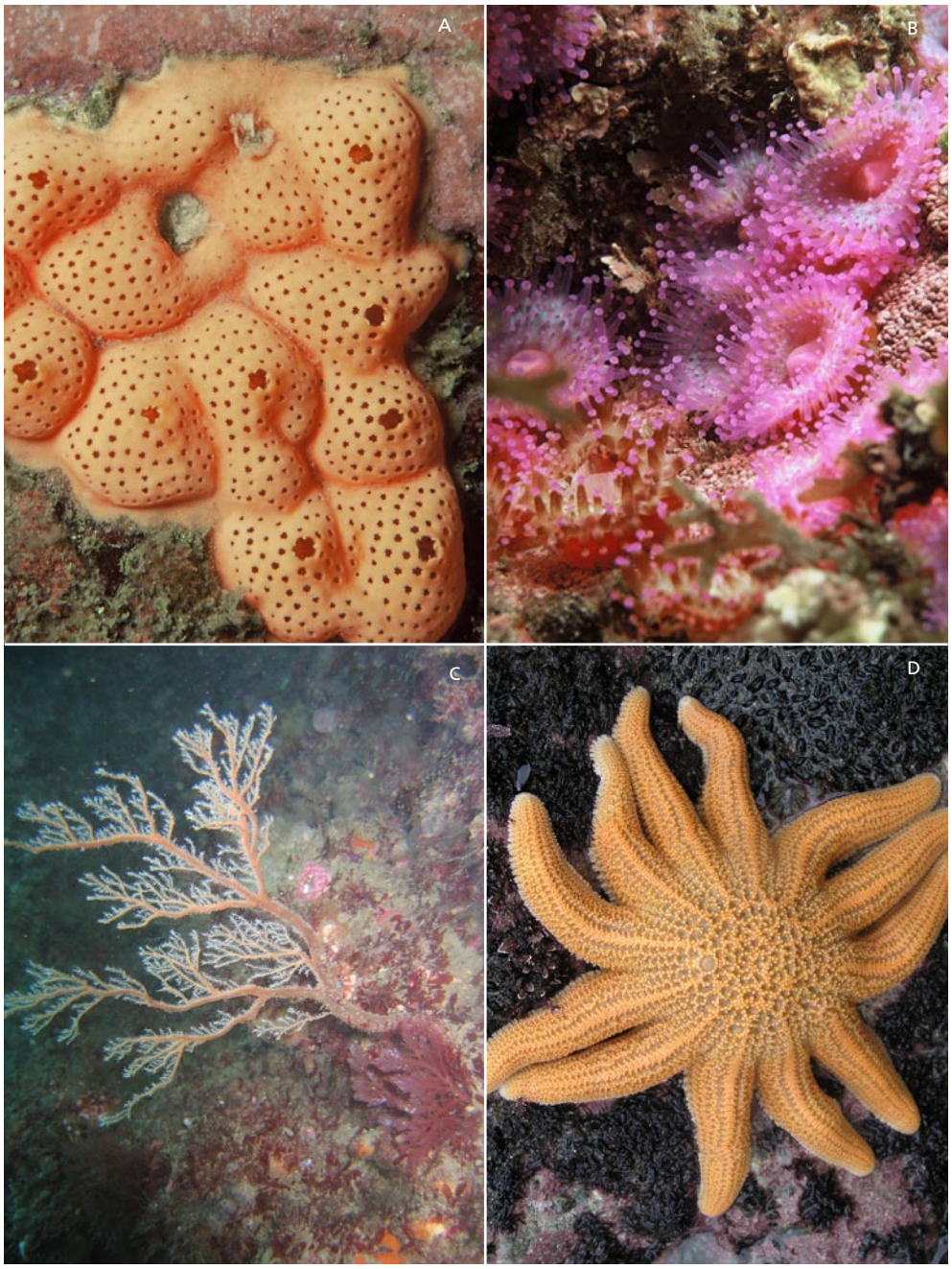
Seaweeds (a group of marine algae that attach to rocks or shells) occur mostly on intertidal and shallow subtidal reefs, as well as some estuarine environments. Surveys have recorded at least 175 species of seaweed from the West Coast[12]. Bull kelp is the most obvious of these, but others including smaller 'turfing' and 'encrusting' species also occur there, providing food and shelter for many invertebrates and fish.

Vascular plants such as saltmarsh plants, coastal herbs, shrubs and trees occur in intertidal estuarine environments and on the coastal margins of sand dunes, wetlands and hillslopes. At least four of these species are regarded as threatened[13].



Top: Turfing seaweeds
Bottom row: Oak leaf seaweed; Turfing seaweeds centre and right
Photos: N. Shears

12 Neale & Nelson 1998
13 Hitchmough et al 2007, see Appendix 4



Some other marine invertebrates:
A. Sea squirts;
B. Jewel anemones;
C. Hydroid colony
D. Reef star
Photos: Paddy Ryan, DOC Collection

PLANKTON

Plankton is a diverse group of free-swimming biota near the sea surface that can 'bloom' in large masses under some sea conditions, ranging from microscopic single-celled plants and animals, to the young larval stages of larger fish, crabs and other species. The plankton on the West Coast has been studied in relation to the region's current patterns and the upwelling of nutrients from the deeper seabed, and their contribution to the marine foodweb of the region's fish stocks and other biota[14].

14 e.g. Bradford 1991, Bradford 1985, Chang & Bradford 1985, Bradford & Roberts 1978

Sea foam created by decaying plankton.
Photo: P Ryan, DOC collection.

3.3 The Estuarine Domain

The estuarine domain occurs along the entire coastal landscape of the West Coast and can be divided into three main ecosystem types based on their landform and degree of tidal influence:

- Tidal flat estuaries
- River mouths
- Tidal lagoons.

3.3.1 Tidal Flat Estuaries

Tidal flat estuaries occur in low-lying land behind a barrier beach/dune system. They are dominated by broad expanses of mud and sand flats that are exposed at low tide and flooded at high tide. Generally they have a high saltwater content because of the relatively low amounts of freshwater entering this type of habitat. Tidal flat estuaries are most common in the central and northern parts of the West Coast and are mapped in Figure 3.1 (which also shows the distribution of river mouths and tidal lagoons).

A typical tidal flat estuary on the West Coast would have the following features:

- a mouth dominated by tidal currents (flowing in on the flood tide and out on the ebb tide), and sediments similar to the adjoining beach. These areas are a migration route for 'freshwater' fish that spend a period of the life in the sea (e.g. the five whitebait species and flatfish) and other species (including larval stages). The mouths of estuaries are often mobile and can sometimes be temporarily blocked by the interaction of sea conditions, beach accretion and river flows;
- fine sand flats and permanently submerged channels inside the mouth area and in the middle reaches of the estuary. This is where beds of bivalves (e.g. cockles and clams) tend to occur, along with crabs and worms that together form a rich food source for fish and wading birds;
- mudflats towards the upper reaches of the estuary where tidal influence and water movement are reduced. The beds in this area are dominated by animals such as estuarine snails;
- saltmarsh areas (usually growing on mud or fine sand) that are dominated by rushes, reeds and turfs that provide for habitat cover for birds and insects;
- estuary margins that grade from intertidal wetland habitats to dryland areas covered in forest, pasture or residences; and
- rivers and smaller waterways that feed into the upper reaches of the estuary.

A tidal flat estuary, Okarito Lagoon. *Photo: T Hume, NIWA.*

From left above:
Saltmarsh margin at Okarito.
Photo: DOC collection.

Saltmarsh rushes at Okarito.
Photo: DOC collection.

Estuarine saltmarsh occurs in coastal wetlands throughout the West Coast, but the largest areas of saltmarsh are found on the tidal flats of the estuaries. These communities are typically dominated by tall rushes and sedges, as well as smaller turfing species, but their species and structure are mostly distributed according to their salinity tolerances[15]. Other common plants in this coastal habitat are sea rush, jointed rush, noded sedge, shore pimpernel, remuremu, manuka and a variety of coastal dune and turf plants.

Sea rush (wiwi) is a common estuarine plant on the West Coast. It often grows in dense stands up to 75 cm tall, characteristically mixed with other saltmarsh species including sea primrose, other rushes and introduced pasture at higher-shore levels[16].

Estuarine and freshwater fish surveys have been undertaken by the Department of Conservation, NIWA, the Museum of New Zealand and other agencies[17]. Largely due to habitat diversity, it is difficult to assess relative abundances of the species that have been recorded. However, it appears that bullies, inanga, flatfish, estuarine stargazers, triplefins and yellow-eyed mullet are among the most abundant fish in estuary and river mouth areas. While the numbers of fish in the West Coast estuaries can be quite high, the species diversity of these sites is quite low in the national context, with quite a strong freshwater influence on the types of fish present.[18]

Below:Tidal flat estuaries are occupied by numerous fish and waterbirds:
Inanga (whitebait).
Photo G Eldon, DOC collection.
Kotuku (white heron).
Photo: P McClelland, DOC.

Kotuku (white heron) are found throughout Australasia and Southeast Asia, but a colony of about 30–50 pairs[19] on the Waitangiroto River is the only breeding site for the New Zealand population of this species. The kotuku feeds in nearby tidal flat estuaries, such as Okarito and Saltwater Lagoons, during the spring-summer breeding season. It then disperses more widely throughout New Zealand for the rest of the year. It is ranked as a 'nationally critical' threatened species[20], though numbers of the same species are stable overseas.

Tidal flat estuaries support populations of lowland and coastal plants and animals that have otherwise been reduced by land development on the West Coast (and elsewhere throughout New Zealand)[21]. These include a range of species unique to this habitat – cockles and other shellfish, migratory wading birds, lowland freshwater fish, and saltmarsh vegetation. In all, some of these species are confined to a total area of only several hectares within the West Coast.

15 Jones & Marsden 2005
16 Jones & Marsden 2005
17 e.g. NIWA (database), Roberts et al 2005
18 M. Morrison pers comm 2006
19 C Wickes pers comm 2006
20 Hitchmough et al 2007
21 Morse 1981, Coker and Imbodem 1980

An exposed cockle bed in the Orowaiti Lagoon tidal flat estuary, where these shellfish reach densities of several hundred per square metre, and are a food source for fish and wading birds
Photo: M Rogers, DOC collection.

Saltmarsh provides habitat for a range of species including invertebrates such as estuarine snails and provides good cover for secretive wetland birds such as bitterns, crakes and fernbirds.

Tidal flat estuaries of particular note with above average rankings for their natural wetland values[22] include:

- Karamea-Otumahana Estuary[23] – A large and diverse wetland with extensive saltmarsh within conservation lands, and intertidal shellfish beds. This estuary is considered to meet stated criteria for international conservation importance[24];
- Orowaiti Lagoon[25] – A large estuary with partly developed margins but extensive shellfish beds, and saltmarsh within conservation lands;
- Buller River mouth wetlands[26] (Lost Lagoon, Floating Basin and Bradshaw's Creek). These are outside the coastal marine area as legally agreed between Councils and the Minister of Conservation under the Resource Management Act, but have features characteristic of estuaries;
- Okari Lagoon[27] is a site of cultural importance; while less diverse than some other estuaries, it has some areas of saltmarsh and shellfish beds;
- Saltwater Lagoon Pouerua[28] is a large estuary with natural forested margins and catchments. Pouerua is considered to meet stated criteria for international conservation importance[29];
- Okarito Lagoon[30] – the largest estuary in the West Coast, with diverse habitats of sand flats, channels, mudflats and saltmarsh. This lagoon is also considered to meet stated criteria for international conservation importance[31]; and
- Oparara and Three Mile[32] Lagoons also have some notable features but are generally smaller and have less habitat diversity compared to other West Coast estuaries.

Wetlands of national importance to freshwater fisheries were ranked by Davis (1987)[33]. A number of West Coast estuaries considered to be 'outstanding' (an 'A' classification) were:

- Orowaiti Estuary and associated wetlands
- Saltwater Lagoon Pouerua
- Okarito Lagoon
- Okuru/ Turnbull/ Hapuka Lagoon

Those ranked as 'significant' (a 'B' classification) were:

- Otumahana Estuary
- Okari Estuary
- Grey River Lagoon

22 Partridge 2004
23 Neale et al 1993
24 Cromarty & Scott 1996
25 Rogers et al 1996
26 Neale 1995, Stevens 1995
27 Neale 1998a
28 Neale 1998b
29 Cromarty & Scott 1996
30 Goff et al 2001, Neale 1998b
31 Cromarty & Scott 1996
32 Neale 1998b
33 See Appendix 3

An example of a river mouth with substantially modified margins, Hokitika River.
Photo: D Neale, DOC.

3.3.2 River Mouths

The river mouth ecosystem type on the West Coast refers to those estuarine environments which occur around the mouths of the large rivers which rise in the mountainous hinterland. These rivers typically have a high content of freshwater, open expanses of waterway, coarse beds of sand and gravel, and a relatively small tidal influence. River mouths are common throughout the entire 600 km coastline of the West Coast, from Kahurangi Point to Awarua Point and are mapped in Figure 3.1.

River mouths provide habitat for many coastal birds, such as dotterels, oystercatchers, terns and gulls. They are also migration routes for 'freshwater' species such as inanga, other galaxid fish, lampreys and eels, they provide habitat for those species as well as others like flounder, kahawai, smelt and bullies. River mouths often form essential connections between the sea and wetlands.

River mouths of particular note with above average rankings for their natural wetland values[34] include:

- Heaphy
- Karamea
- Little Wanganui
- Buller
- Taramakau
- Arahura
- Hokitika
- Mikonui
- Karangarua
- Waita
- Haast;
- Okuru;
- Waiatoto
- Arawhata
- Cascade.

An example of a river mouth with less modified margins, Arawhata River.
Photo: T Hume, NIWA.

A number of river mouths are connected to non-tidal freshwater wetlands that are considered to be of international conservation importance[35] . They include (with the wetland):

- Waita River (Tawharekiri Lakes)
- Waiatoto and Arawhata Rivers (Burmeister Morass)
- Cascade River (Hermitage Swamp)
- Whataroa and Waitangitaona River (part of the Whataroa Ecological Region coastal wetland complex)

34 Partridge 2004, see Appendix 3
35 Cromarty & Scott 1996, see Appendix 3

3.3.3 Tidal Lagoons

Tidal lagoons are relatively widespread on the West Coast and include the 'hapua-type' lagoons[36], a brackish wetland usually enclosed in a backshore dune hollow. Tidal lagoons are often natural channels at the outlets of small to moderately-sized coastal streams or swamps. Their water levels typically rise and fall with the tides, but the intrusion of salt water is mostly confined to the immediate vicinity of their outlet to the open sea.

In this report, "tidal lagoons" are distinguished from "estuaries" because they have a generally narrower form that tends to reduce the encroachment of saltwater and tidal influences (see photo of New River tidal lagoon). The steeper channel margins of a tidal lagoon mean that tidal flats and saltmarsh habitats are mostly absent or greatly reduced, and the tidal stream channel is the main feature of these wetlands. Care should be taken to avoid confusion where the term "lagoon" is sometimes applied in common usage to wetlands that are defined in this report as "tidal flat estuaries" (e.g. Okarito Lagoon).

A tidal lagoon, New River/Kaimata. *Photo: D Neale, DOC.*

Tidal lagoons occur throughout the West Coast, but tend to be less common in the north (see Figure 3.1), where land development has sometimes led to the loss of these habitats. Many tidal lagoons flow to the sea via the mouth of a larger river, whereas those flowing directly to sea are often associated with unstable mouths that occasionally migrate alongshore or temporarily block up. Up to about 30 hapua-type lagoons have been identified on the West Coast (Neale, 2006a) and some of these have been studied in detail, often as part of resource consent investigations.

The channels and riparian margins of tidal lagoons provide habitat for fish (e.g. whitebait) and bird life. The diverse forest and wetland communities that occur there are used by a wide variety of native birds, fish and other animals on a seasonal or year-round basis. Park (1993) notes the ecological importance of coastal lagoons (both tidal and non-tidal) to the natural functioning of lowland ecosystems. He also notes their historic depletion resulting from land development that has altered the habitats, margins and catchments of many such places.

36 Neale 2006a, Kirk & Lauder 2000, Hart 1999
37 Partridge 2004, see Appendix 3
38 Cromarty & Scott 1996, see Appendix 3

Figure 3.1: Estuarine ecosystems. *Source: Neale 2006a, Neale unpublished DOC data.*

Tidal lagoons that have been given above average rankings for their natural wetland values[37] in the West Coast region include:

- New River/Kaimata
- Totara Lagoon
- Te Rahotaiepa
- Hikimutu
- Waitangiroto
- Five Mile Lagoon
- Waikowhai Stream
- Ohinetamatea
- Hermitage Swamp (Cascade River).

Waikoriri Lagoon (Black Creek) provides a link to Shearer Swamp, a wetland of international conservation importance[38].

A tidal lagoon, Waikowhai Stream. *Photo: T Hume, NIWA.*

Wetlands of national importance to freshwater fisheries were ranked by Davis (1987)[39]. West Coast tidal lagoons considered to be 'outstanding' (an 'A' classification) were:

- Hermitage Swamp

Those ranked as 'significant' (a 'B' classification) were:

- Ship Creek Lagoon;
- Dune lakes and swamp between Haast and Waita Rivers; and
- Haast wetlands.

3.3.4 Existing Protection in the Estuarine Domain

The three types of estuarine ecosystems are mostly within the coastal marine area, with their marginal lands under a variety of land tenures. Saltwater Lagoon is the only fully-protected tidal flat estuary, as it lies wholly within conservation lands. Okarito, Okari and Three Mile Lagoons, three of the largest estuaries, have mostly protected margins and islands. Other estuaries have variable amounts of protection on their riparian margins. Totara Lagoon, Te Rahotaiepa River, Waitangiroto River, Five Mile Lagoon and Ohinemaka River are tidal lagoons in the West Coast coastal marine area that lie mostly within Crown conservation lands. There are also fifteen river mouths (listed in section 4.8.1) that lie mostly within Crown conservation lands. Several other estuarine ecosystems are partly within conservation land or have mostly protected margins of shrubland and forest. Several tidal lagoons are closed to whitebaiting under the Whitebait Fishing (West Coast) Regulations 1994 (see Chapter 5).

A tidal flat estuary, Saltwater Lagoon. *Photo: T Hume, NIWA.*

37 Partridge 2004, see Appendix 3
38 Cromarty & Scott 1996, see Appendix 3
39 See Appendix 3

Most estuarine areas on the West Coast are used by whitebaiters during the spring, such as here on the Taramakau River. *Photo: S Nimmo.*

3.3.5 Uses Associated with the Estuarine Domain

Estuaries, river mouths and lagoons are often places where the demands of land development and nature conservation are required to coexist. Their margins are often desirable sites for land development for housing, farming and other uses. Discharges often occur into the waters feeding some of these coastal wetlands, either as point discharges (sewage, storm-water, animal waste disposal) or as more dispersed surface runoff. Such uses are generally controlled under the Resource Management Act 1991.

The estuarine domain provides for a wide range of human activities. Estuary shellfish beds, whitebait and game birds are recreationally harvested and ecotourism, particularly bird-watching, is a feature of some estuaries like Okarito Lagoon. River mouths are a source of gravel aggregate. They provide for a wide range of recreational activities, including fishing and whitebaiting, boating, fossicking, birdwatching and sightseeing. Some rivers, especially those adjoining settlements, are subject to discharges from industrial, commercial, residential and stormwater sources. Tidal lagoons are used for recreational activities such as boating, kayaking, canoeing, birdwatching, whitebaiting and eeling. The margins of many are developed for farming, residential or other land uses.

The margins of some estuarine areas are developed for housing or used for recreation: Orowaiti Estuary *Photo: D Neale, DOC.*

Kayaks at Okarito wharf. *Photo: S Nimmo.*

3.4 The Intertidal (Open Coast) Domain

The intertidal (open coast) domain includes both rocky shores and sediment beaches, two very different habitats for marine plants and animals. Their distribution is mapped in Figure 3.2. In these habitats, certain types of species attach to the rocks (e.g. seaweeds and mussels) or burrow into the sediment (e.g. sandhoppers and worms). In addition, some mobile animals tend to congregate in specific locations within or near the intertidal zone, sometimes in predictable distributions related to their breeding, feeding, roosting or social behaviour. For example, Fiordland crested penguins, blue penguins and fur seals swim ashore on certain beaches adjacent to their breeding and resting areas.

3.4.1 Biodiversity associated with different Substrates

INTERTIDAL ROCKY SHORES, ROCK STACKS AND ISLANDS

Where mountain ranges and hill country reach down to the coastline, rock formations extend out into the sea to form intertidal rocky shores and shallow subtidal rocky reefs, as well as rock stacks and islands (see Chapter 2).

Intertidal rocky shores

Intertidal rocky habitats in the West Coast region have been studied for:

- seaweeds (Neale & Nelson 1996);
- intertidal communities (University of Canterbury Marine Ecology Research Group (MERG): http://www.biol.canterbury.ac.nz/MERG/index.shtml); and
- coastal reef fish (Roberts et al 2005).

The intertidal rocky shores of the central West Coast between Greymouth and Heretaniwha Point are less extensive and are considered to be less diverse than the northern and southern areas. They lack rock stacks and islands and are mostly dominated by species that prefer bouldery habitats and can withstand the heavy scouring effects of waves and sand. The rocky shores of the northern West Coast provide a stronghold for about six species that prefer shallow turbid pools and reefs (such as the giant triplefin, orange

Intertidal rocky shore zonation often includes separate bands of scoured rock, mussels, and barnacles. *Photos: D Neale, DOC.*

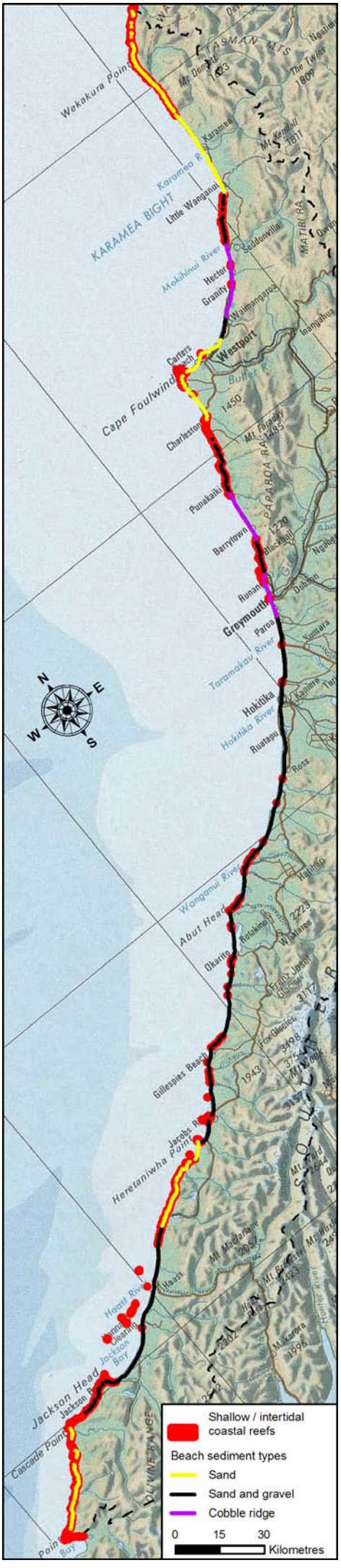


Figure 3.2:Intertidal (open coast) substrate types.
Sources: Neale 2006f, Neale unpublished DOC data.

clingfish and olive rockfish), while South Westland is more suited to some intertidal species that prefer holes, overhangs, and open turf/seaweed reefs (such as several species of triplefin). The form, geology and substrate of the rocky shores can help to determine the plants and animals that live there: for example, some invertebrates such as half crabs and green chitons prefer the shelter provided beneath boulders, to the more exposed nature of bedrock shores.

The West Coast intertidal reefs include a range of distinctive biota that are uncommon or absent in other parts of New Zealand. Together, these features produce ecological patterns which make the West Coast intertidal environment different to other parts of New Zealand. These biodiversity features include:

- a genetically distinctive wild population of greenlip mussels throughout the West Coast – Fiordland area[40];
- the mottled clingfish, a rockpool fish that is presently known from only two sites on the West Coast (at Mikonui and 14 Mile), despite extensive surveys around New Zealand[41];
- 'Gigartina' sp. 'terete', a little-known type of agar-rich seaweed that appears to have a stronghold on the West Coast among dense intertidal seaweed turfs between at least Cape Foulwind and Okarito. It is generally uncommon or absent from other parts of New Zealand[42];
- Karengo (*Porphyra* spp.), a genus of 'splash zone' seaweeds that, along with the closely related Bangia genus, have a high diversity at some sites on the West Coast[43];
- New Zealand fur seal colonies that support an estimated 20% of New Zealand's breeding population of this species[44], as well as large winter haulout colonies;
- Littoral spiders (such as *Amaurobioides maritimus*), a little known group of intertidal spiders with ancient origins, that has been found in high densities at Tauranga Bay, Seventeen Mile and Jackson Bay/Okahu[45]. New Zealand is the centre of diversity with seven of the twelve known species. The long beaches and large rivers of central Westland appear to act as a barrier between the northern and southern species in the group.

NZ fur seals (kekeno) gather in colonies on some of the West Coast's rocky shores: Arnott Point colony. *Photo: L.F. Molloy*

40 Star et al 2003
41 Roberts et al 2005
42 W. Nelson, pers comm 1998
43 W. Nelson pers comm 2003
44 H Best pers comm 2001
45 B. Opell, pers comm 2005

Rock Stacks and Islands

Many of the plants and animals around rock stacks and islands are discussed to some extent in the section above on rocky shores. However, intertidal shores around islands tend to be less affected by sand scour and turbidity, and provide sheltered sites on their leeward sides. Consequently, a greater diversity of species tends to occur at such sites.

In all, about 70 islands and vegetated rock stacks have been identified on the West Coast (Neale 2006e) and the distribution of these is mapped in Figure 3.3). Of this number, 24 have been visited and adequately surveyed to describe their natural features. The distribution of the West Coast's islands and rock stacks, and their significance as breeding habitats for many seabirds and marine mammals, is discussed in more detail in section 3.7.1.

SEDIMENT BEACHES

Sediment beaches occur along most of the West Coast, often interrupted by rocky shores, and varying in length from tens of metres to tens of kilometres (see Figure 3.2). There are three main types:

- sand beaches,
- sand and gravel (including pebble) beaches, and
- cobble ridge beaches.

From left: Sand beach at Kohaihai.
Sand and gravel beach at Bruce Bay.
Cobble ridge beach at Cobden. *Photos: T Hume, NIWA.*

Their physical composition depends not only on the types of sediment that is supplied to the coast by the nearby rivers, but also on the degree of wave exposure and the sediment transport dynamics of the beaches themselves. Consequently, the beach type tends to remain consistent along stretches of coastline up to several tens of kilometres in length.

Sediment beaches have mostly been studied in relation to their physical dynamics, sedimentation patterns and coastal hazards[46]. Biological studies and collections that have been done[47] indicate that West Coast intertidal beaches generally have a very low biological diversity. However, shallow water shellfish species can be found in the lower intertidal zone, especially on gently sloping sand beaches; they include the triangle shell, tuatua and the venus shell. Larger marine species, such as fish, seabirds and marine mammals, occupy the intertidal beaches depending on the state of the tide and are generally similar to those in the shallow subtidal zone

46 e.g. Benn & Neale 1992
47 e.g. Neale 2007, Davidson et al 2003, Grange et al 2001, Knox 1991

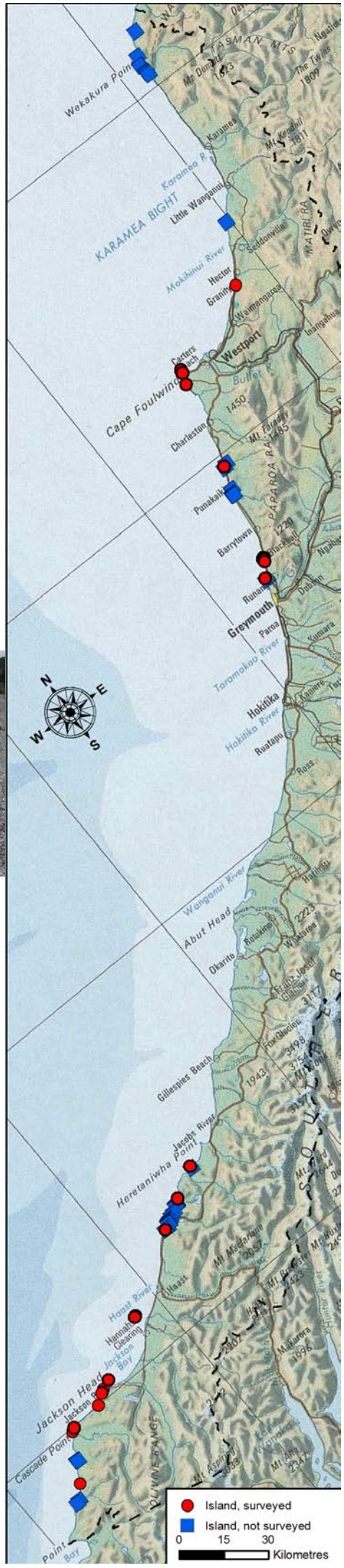


Figure 3.3: Islands and vegetated rock stacks
Source: Neale 2006e

Blue penguin (korora). *Photo: P Ryan DOC collection.*

3.4.2 Existing Protection in the Intertidal (Open Coast) Domain

The intertidal (open coast) domain is administered mostly under the Resource Management Act. Coastal erosion can affect the position of the foreshore in a variety of ways, and can sometimes cause Crown conservation land to become part of the intertidal zone. There are no substantial parts of the West Coast intertidal (open coast) domain that are clearly within Crown conservation lands. The Whakapoai and Jackson Bay Okahu Wildlife Refuges are an overlying Wildlife Act management regime that extends to 20 metres below mean high water spring (MHWS) (see sections 11 and 13 of Chapter 5).

The West Coast Regional Coastal Plan recognises several types of protection and management areas that include intertidal areas of beach and rocky shores such as: Coastal Protection Areas, Culturally Sensitive Areas, Coastal Recreation Areas, Coastal Hazard Areas, Marine Mammal and Bird Sites and Outstanding Natural Features and Landscapes.

3.4.3 Uses associated with the Intertidal (Open Coast) Domain

Intertidal rocky shores are used for fishing, shellfish gathering, fossicking/exploring, tramping, sightseeing, tourism and education. Some sites are used for scientific (e.g. biological and geological) studies. West Coast beaches are used by local communities and visitors and others for a wide range of activities including:

- recreation (e.g. swimming, surfing, beachwalking, fossicking, firewood gathering, quad biking, fishing);
- commercial operations (gravel extraction and mining, stone picking, firewood gathering, fishing, tourism); and
- cultural and social uses (e.g. access)

Some sites are used for scientific (e.g. biological and geological) studies including:

- Physical monitoring sites such as the NIWA sea level recorder at Constant Bay
- Geopreservation Inventory sites such as the internationally important Perpendicular Point fossil site; and
- Biological monitoring sites (e.g. by University of Canterbury and Oregon State University) such as at Gentle Annie Point, Twelve Mile and Ocean Beach.

Recreation is a common use of the intertidal (open coast) domain. *Photos: S. Nimmo*

3.5 The Shallow Subtidal (Open Coast) Domain

The shallow subtidal (open coast) domain extends out to depths of about 30 metres where wave action and light penetration begins to have a lesser influence at the seabed. The changes in physical environment that occur on the open coast over distances of just several metres can produce sharp changes and complex zonation patterns; these are mostly related to depth and substrate type, but also to the degree of the coast's exposure to wave energy. As a consequence, biodiversity patterns can occur in distinct bands: such as a low-tide 'fringe' of bull kelp below intertidal mussel beds, and clam beds on subtidal sand next to expanses of filter-feeding invertebrates on rocky reefs. Some open coast species, such as reef star, giant triplefin, Fiordland crested penguin, Hector's dolphin and juvenile inanga, are more common in the West Coast shallow subtidal domain than in most other parts of New Zealand.

While many of the species in the shallow subtidal (open coast) domain are widespread throughout the region, some species tend to congregate in specific habitats or locations along the coast, sometimes in predictable distributions largely related to their breeding, feeding, roosting or social behaviour. Examples include:

- Westland petrels that 'raft up' near the Barrytown flats prior to flying inland to their only breeding site in the nearby coastal hill country;
- Fiordland crested penguins (tawaki) and blue penguins that swim ashore on certain beaches adjacent to their nesting, moulting and roosting areas; and
- Other nesting seabirds, such as terns, shags, sooty shearwaters and fairy prions, that nest in small colonies on islands and coastal hillslopes.

3.5.1 Biodiversity associated with different Substrates

Soft substrates such as clean sand (<10% mud) and silty sand cover most of the inner continental shelf seabed of the shallow subtidal depth zone but gravel beds and areas of hard substrates like submerged rocky reefs are also common. These sea floor sediment types are mapped in Figure 3.4.

Logs and driftwood also occurs on the beaches, seabed and sea surface. Other than studies of some organisms (e.g. burrowing worms and other invertebrates) that live in or on the logs, and the biota of wharf piles and ship hulls[48], no information has been published on natural wood habitats in New Zealand marine waters[49].

SHALLOW SUBTIDAL ROCKY AND BOULDER REEFS

Where mountain ranges and hill country reach down to the coastline, the rock formations extend out into the sea to form intertidal and shallow rocky reefs. Patchy reefs are also found in other places, such as at the ends of bouldery moraine bluffs (see Figure 3.4).

Subtidal rocky reef habitats in the West Coast region have been studied for:

- seaweeds (Neale & Nelson 1996);
- coastal reef fish (Roberts et al 2005); and
- shallow subtidal communities (Shears, in prep.).

48 e.g. Morton 2004
49 Arnold 2003

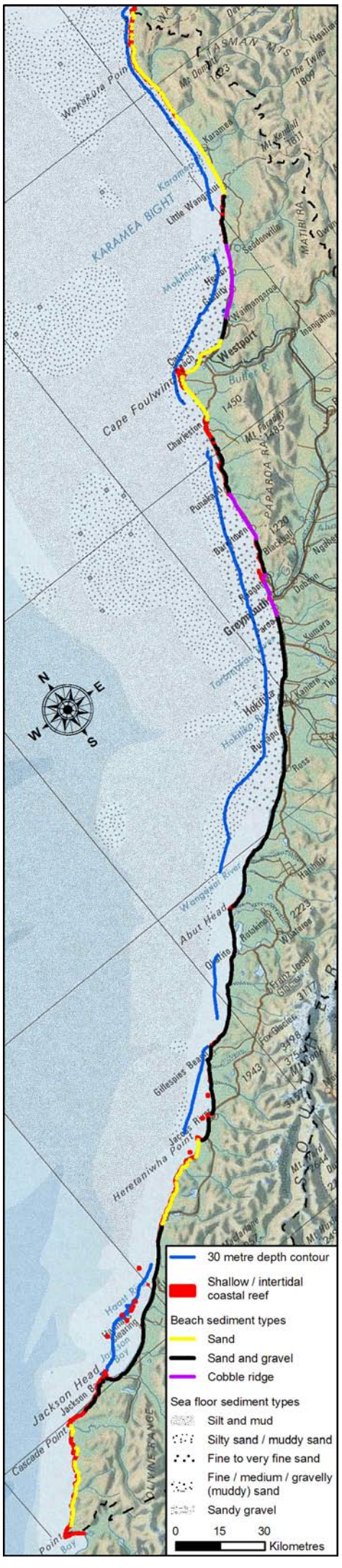


Figure 3.4: Shallow subtidal (open coast) substrate types
Source: Neale 2006f, RNZN (various dates), Mitchell 1987, Price 1983a & b, McDougal 1975 & 1982.

From left: Filter-feeding mussels and robust starfish are a feature of northern subtidal rocky reefs such as these at Cape Foulwind.

Subtidal 'seaweed turfs' are a feature of the southern West Coast, such as here at Jackson Head.

Photos: N Shears.

Shears (in prep) surveyed shallow subtidal reef communities around the New Zealand coast, including 24 sites within eight general areas in the West Coast region, from Little Wanganui Head to Gorge Islands[50]. That report indicates that West Coast reef communities have clear ecological differences from other parts of the New Zealand coast. The marine biodiversity of the reefs of the northern West Coast were found to be different from those in the southern West Coast[51], mostly because of variability in the physical environment from north to south (see Chapter 2).

In the northern reefs from Kahurangi to Greymouth, the rocks typically extend to depths of only about 10 to 20 metres before 'bottoming out' to a sand/silt bed, and are usually dominated by filterfeeding invertebrates (such as mussels and sea squirts) and robust seaweeds. Characteristic species in these shallow reefs include bull kelp, blue and greenlip mussels, reef stars, and giant triplefins.

Reefs in the central West Coast are less extensive and less well studied, but they are mostly dominated by species that prefer bouldery habitats and can withstand the heavy scouring effects of waves and sand.

In the southern reefs from about Bruce Bay to Awarua Point, a wider diversity of species live among the rocks, including extensive subtidal seaweed 'turfs'[52] and a larger variety of reef fish[53]. These southern reefs tend to reach to greater depths (sometimes well beyond safe diving depths) and so support a wider diversity of species.

The subtidal reefs around rock stacks and islands tend to be less subjected to the effects of wave action, sand scour and turbidity than those closer to the coast, and the reefs often extend to greater depths. This feature can result in a different (and often greater) variety of marine plants and animals, such as is found at the Three Steeples off Cape Foulwind[54] or at Open Bay Islands (Taumaka me Popotai)[55]. Rock stacks and islands are also discussed in the intertidal section of this chapter.

The substrates of shallow rocky reefs include a variety of types, including boulder ramps, bedrock slopes and vertical faces. Elsewhere in New Zealand, these different substrates typically support different marine species assemblages, but no attempt has yet been made to assess such variability with West Coast reef type.

50 Karamea x3; Cape Foulwind x4; Moeraki x3; Open Bay Is x3; Jackson Bay x2; Jackson Head x3; Cascades x3; Barn Bay Coast x3.

51 e.g. Shears in prep, Roberts et al 2005, Neale & Nelson 1998

52 Neale & Nelson 1998

53 Roberts et al 2005

54 Shears in prep, Roberts et al 2005, Harvey et al 2005

55 Shears in prep, Neale & Nelson 1998, Parsons & Fenwick 1984

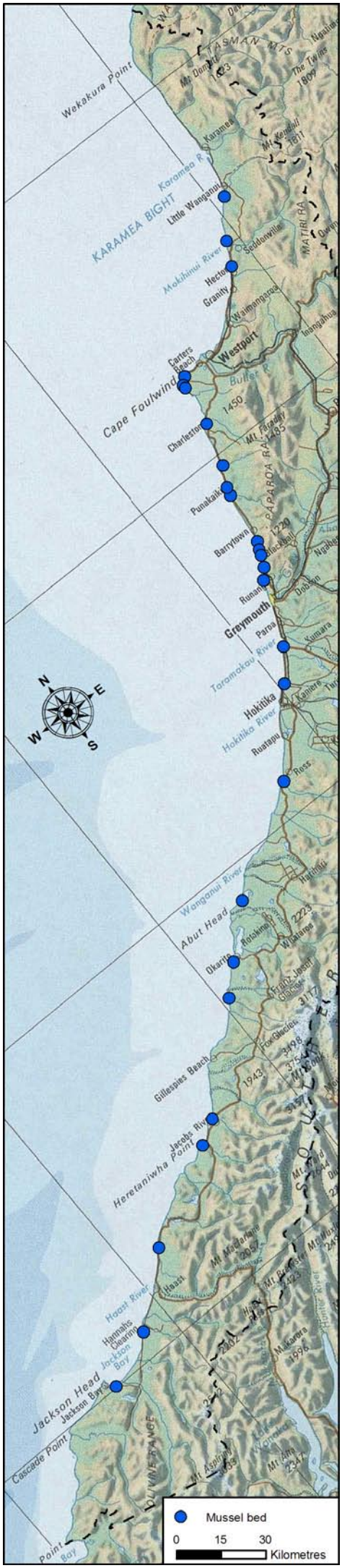
Each row from top left: Thornfish; Scarlet wrasse (püwaiwhakarua); Blue cod (räwaru); Blue-eyed triplefin.
Photos: P Ryan, DOC collection.

Several reports[56] examine the fish fauna of shallow rocky reef habitats on the West Coast (including parts of Fiordland). An analysis of the data from Roberts et al 2005 (Neale 2006b) shows that surveys have recorded 78 species of coastal reef fish on the West Coast; nine of these are common and widespread on the West Coast. The Buller/Westland area is a stronghold for about six species that prefer shallow turbid pools and reefs (such as the giant triplefin, orange clingfish and olive rockfish), while South Westland is more suited to about 22 species that prefer holes, overhangs, and open turf/seaweed reefs (such as the rockling, common roughy and several species of triplefin).

Neale & Nelson (1996) identified about 175 species of seaweed from the West Coast, growing in a variety of forms and habitats. That number continues to increase with additional surveys and knowledge. For instance, fourteen new records of crustose coralline algae species have recently been identified for the West Coast region by Harvey et al (2005). The most obvious seaweeds are the large brown types, such as the bull kelp *Durvillaea* that grows in the low tide zone on most rocky coasts. Bull kelp is a habitat-forming species which has a major effect on the structure of coastal reef communities. It attaches firmly to low tide rocks in exposed sites, and its blades of up to several metres length swirl in the surf, shading the rock surfaces below. Two species are present on the West Coast, the honeycomb-fronded *Durvillaea antarctica* and the stoutly-stemmed *D. willana*.

Bull kelp, *Durvillaea antarctica* is a feature of many West Coast intertidal rocky shores.
Photo: P Ryan, DOC collection.

56 Roberts et al 2005, Francis 1996, Neale 2006b



Other brown kelps, such as zigzag weed and oak leaf weed, grow in low densities at some locations; other kelps, such as paddle kelp, flapjack and *Lessonia*, are present at only one or two locations. Seaweed 'turfs' are common on intertidal rocky shores in the northern West Coast; these turfs are mainly made up of species of *Champia, Gigartina, Lophurella, Haliptilon* and *Scytothamnus*. In contrast, the seaweed turfs in South Westland occur more commonly in the subtidal zone, and consist of a different variety of species of *Plocamium, Anotrichium, Glossophora* and *Euptilota*. An area of particular significance is Taumaka me Popotai (Open Bay Islands), which supports the West Coast region's greatest recorded diversity of seaweeds.

A dominance of filter-feeding invertebrates (e.g. mussels, seasquirts and bryozoans) is a notable feature of rocky reefs in the northern West Coast. The likely cause of this is the predominance of water-borne food in coastal waters. Mussel beds are especially abundant in the northern parts of the West Coast, where they form large beds of up to several hectares on intertidal and subtidal reefs. These are mapped in Figure 3.5).

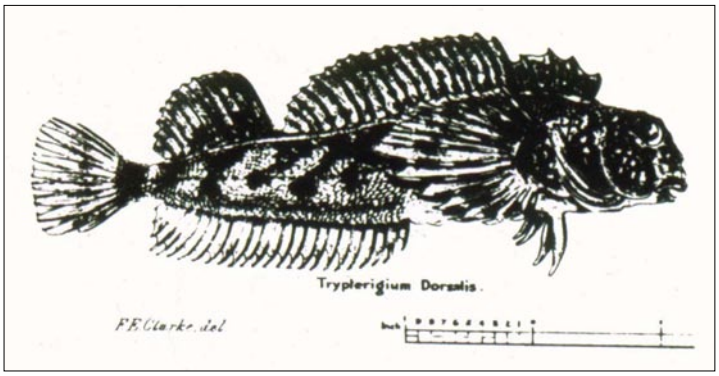
Spiders and insects are uncommon in the marine environment, but there are records of an intertidal spider (*Amaurobioides* sp.) at sites from Kohaihai to Jackson Bay/Okahu, and a marine caddisfly (*Philanisus plebeius*) at Jackson Bay/Okahu.

Some of the larger predatory marine animals on the West Coast – such as orca, fur seals, bottlenose dolphins, and some sharks – are often reported in the vicinity of inshore rocky reefs. While this may be partly due to their prey preferences, it could also be associated with other factors, such as the degree of shelter that such sites provide, or even the likelihood of people being at these sites to see them.

Several species of mussel / kutai (e.g. black, blue, ribbed and greenlip) occur on West Coast shores, living amongst barnacles, starfish, seaweeds and other marine life.
Photos: D Neale, DOC.

Figure 3.5: Mussel beds are especially common in the northern parts of the West Coast.
Source: Neale unpublished DOC data.

The West Coast rocky reefs include a range of distinctive biota that are uncommon or absent in other parts of New Zealand. Together, these features produce ecological patterns that make this habitat on the West Coast significantly different to other parts of New Zealand. These biodiversity features include:



Giant triplefin.
Drawing by F E Clarke.

- a genetically distinctive wild population of greenlip mussels throughout the West Coast – Fiordland area[57];
- large populations of the giant triplefin (a coastal reef fish that is rare elsewhere in New Zealand), especially in parts of the region north of about Okarito;
- a diversity of crustose coralline algae (the pink 'crusts' commonly seen on shore and sub-tidal rocks), which Harvey et al (2005) regard as a diverse and ecologically significant group of plants. A total of 15 species (out of 20 identified from the central New Zealand region) were recorded from four localities sampled on the West Coast, including ten species from the Steeples off Cape Foulwind;
- New Zealand fur seal colonies that support an estimated 20% of New Zealand's breeding population of this species[58], as well as large winter haulout colonies; and
- Unusual colour forms that have been recorded only from the West Coast, of two fish: a scorpionfish (at Taumaka in 1996) and a spotty (at Hokitika in 1867 and Jackson Bay/Okahu in 1995).

An unusually yellow scorpionfish.
Photo: P Ryan, DOC collection.

A number of conspicuous or readily-recognised marine species that are common in other parts of New Zealand are known on the West Coast from only one or a small number of localised sites. These include: seahorses (Jackson Bay/Okahu), paddle kelp (Open Bay Islands and Jackson Bay/Okahu), *Lessonia* weed (Open Bay Islands), and agar weed, *Pterocladia lucida* (Wekakura Point). While they might occur elsewhere in the region, these species are unlikely to be widespread due in part to their general aversion to exposed sites with high wave energy.

57 Star et al 2003
58 H. Best pers comm 2001

SHALLOW SUBTIDAL GRAVEL BEDS

The occurrence of gravel beds are indicated by seabed surveys at locations such as the Kahurangi Shoals and the 'Harvester Prospect', as well as adjacent to cobble and gravel beaches along the coast. However, the biology of such areas on the West Coast has not been specifically studied.

SHALLOW SUBTIDAL 'SOFT' (SAND AND SILT) BEDS

Sand and silt seabeds occur along most of the West Coast, often interrupted by rocky reefs. These are mapped in Figure 3.4. Their physical composition depends not only on the types of sediment that is supplied to the coast by the nearby rivers, but also on the degree of wave exposure and the sediment transport dynamics of the areas.

Soft sediment seabeds have mostly been studied in relation to their physical dynamics and sedimentation patterns[59]. The first thorough regional assessment of the physical character of the West Coast's shallow seabeds is nearing completion as part of NIWA's "NZ Coast" project. It is intended that this resource will be made publicly available via the NIWA website in the near future[60].

Several species of clams and other animals such as crabs, worms and snails live buried in the subtidal sediments. Seabed sediment core samples (left) can be sieved to reveal their inhabitants (right). *Photos: R Davidson.*

Soft sediment seabeds provide a habitat for a variety of worms, shellfish, fish and marine mammals. Shellfish beds such as clam beds occur as close inshore as the surf zone, and they include different species that are largely determined by water depth. Shallow water species include the triangle shell, tuatua and the venus shell, while further offshore there are heart urchins and crabs.[61] Several shallow sites have been found to support clam beds of probably quite high densities; they include Kongahu beach, the Cape Foulwind sand beaches from North Beach to Nine Mile Beach, and the Jackson Bay/Okahu – Neils Beach area (Neale 2007; Davidson et al, 2003).

A subtidal seabed snail, *Austrofusus glans*. *Photo: R Davidson.*

Fish and other larger marine species occurring in shallow zone are generally similar to those a little further offshore on the continental shelf. The more common species close inshore in these shallower coastal waters, include: rig, spiky dogfish, sevengill sharks, red cod, flatfish, kahawai, gurnard, flounders, yellow-eyed mullet, Hector's dolphins, terns, spotted shags and gulls.[62]

59 e.g. Benn & Neale 1992
60 T Hume pers comm 2006
61 e.g. Davidson et al 2003, Neale 2007
62 e.g. Neale 2007, Neale 2006c, Stevenson 2004, Rayment et al 2003, Anderson et al 1998

Bottlenose dolphins.
Photo: D Neale, DOC.

7-gill shark
Photo: S Wing, DOC collection.

As well as the seabed communities, the water column of these shallow subtidal ecosystems is a habitat for demersal (near the seafloor) fish species and marine mammals. Hector's dolphins reside almost entirely in these areas out to about 4–6 nautical miles offshore. New Zealand fur seals and seabirds such as penguins, gulls and terns are also locally common, and southern right whales are an infrequent but significant migrant making use of this shallow seabed habitat type.

3.5.2 Existing Protection in the Shallow Subtidal (Open Coast) Domain

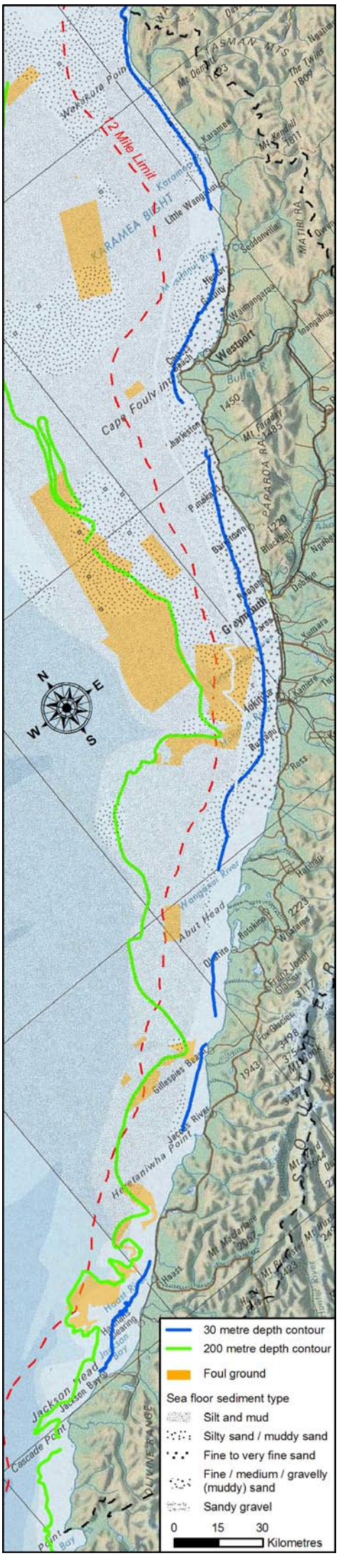
The West Coast Regional Coastal Plan recognises several types of protection and management areas that include some shallow subtidal areas such as: Coastal Protection Areas, Culturally Sensitive Areas, Coastal Recreation Areas, Coastal Hazard Areas, Marine Mammal and Bird Sites and Outstanding Natural Features and Landscapes. Coastal erosion can affect the position of the foreshore in a variety of ways, and can sometimes cause Crown conservation land to become part of the shallow subtidal (open coast) domain.

Other than these, and the general controls that apply within all territorial waters, there are no other specific protection or management areas over the shallow subtidal (open coast) domain within the West Coast coastal marine area.

3.5.3 Uses Associated with the Shallow Subtidal (Open Coast) Domain

The shallow subtidal (open coast) domain is used for fishing and shellfish gathering, including rock lobster, blue cod, kina, paua and mussels. Other recreational activities include boating and boat anchorage, diving, tourism, education and scientific (e.g. biological and geological) studies.

SSCUBA diving occurs mostly in shallow subtidal rocky areas
Photo: N Shears.



3.6 The Deep Nearshore Domain

The deep nearshore domain mostly comprises the waters and seabed of the continental shelf. However, some areas of continental slope (as well as the heads of underwater canyons) do lie within this domain (i.e., within the 12 nautical mile limit) in the southern part of the West Coast marine area. The extent of the continental shelf, the transition to the continental slope, and the position of the underwater canyons are shown in Figure 2.7 in Chapter 2. The distribution of sea floor substrates in the deep nearshore domain is mapped in Figure 3.6. Chapter 2 noted that for the purposes of this report, the deep nearshore zone extends from the 30 metre depth contour out to the 12 nautical mile limit. Both the 12 nautical mile limit and the 200 m depth contour are shown in Figure 3.6.

3.6.1 Biodiversity Associated with different Substrates

The distribution of substrates in the deep nearshore domain is not extensively documented. Probert and Swanson (1986) surveyed sediment texture between north of the Karamea Bight and the Whataroa River and other researchers have documented specific features in the region. Substrates and the biological environment in the deep nearshore domain are most easily discussed in relation to the three topographical features noted in section 2.3.5 and illustrated in Figures 2.7 and 2.12 – the continental shelf, the continental slope and underwater canyons.

CONTINENTAL SHELF

The shelf is mostly composed of mobile soft sediment beds of sand, silt and mud[63]. These mobile sediments provide habitat for a diverse range of marine worms and shellfish. The seabed-dwelling worms of the West Coast continental shelf are similar to those elsewhere around New Zealand and other places in the world[64]. However, Probert et al (2001) considered that certain environmental aspects of the West Coast (such as variable freshwater inflows, high sediment inputs, storm waves and episodic upwelling) may make it a favourable habitat for opportunistic species such as some marine worms and other types of invertebrates.

Some areas of the shelf comprise substrates of coarser materials. Rocky reefs occur in some places, but they are difficult to survey so there are only a few studies that have researched these deep reefs (e.g. greater than 30 metres depth). Stevenson (2003) presents maps of 'foul ground' areas in the Kahurangi to Haast area that are regarded, for the purpose of the NIWA trawl surveys, as unsuitable for bottom trawling due to the potential for nets to get snagged by seabed rocks, logs and other debris. While deep reefs and foul ground are relatively uncommon in the northern parts of the West Coast marine and coastal area[65], they are more common in the more dissected continental shelf landforms of South Westland[66]. There is some anecdotal information derived from fishers about the species that occur in some of these deep rocky reefs and foul ground sites (for example, there are reports of black coral in South Westland), but there is very little published material.

63 Probert and Swanson 1985
64 Probert et al 2001, p980
65 I McKenzie, pers comm 2006
66 e.g. Stevenson 2004

Figure 3.6: Deep nearshore substrate types.
Source: Stevenson 2004, RNZN (various dates), Mitchell 1987, Price 1983a&b, McDougal 1975 & 1982

Few specific sites on the continental shelf have been identified in the published literature as of particular significance. The main exceptions are:

- the 'Harvester Prospect', that was found in the 1980s and 1990s to contain significant concentrations of placer gold, but not in economic quantities;
- the Kahurangi Shoals, an area of coarse bed materials where the currents are modified by the seabed topography;
- an area of freshwater upwelling off Point Elizabeth, presumably originating from limestone structures related to the karst (limestone) areas of the Paparoa Syncline.

Fish assemblages associated with the West Coast continental shelf area feature species such as[67] flatfish, stargazer, school shark, spiny dogfish, barracouta, red cod, gurnard and rig. Towards the edge of the shelf, deeper water species become more prevalent, including: rattails, tarakihi, hoki and ghost sharks. Fish (and invertebrate) assemblages are discussed in more detail at the end of this section.

Tarakihi.
Photo: P Ryan, DOC collection.

CONTINENTAL SLOPE

The continental slope begins at the 'shelf break', at a depth of about 200 metres. Here, the seabed drops off more steeply into deeper waters towards the Challenger Plateau and to even greater depths of about 4000 m in the Tasman Basin. The shoreline was positioned at about the shelf break during periods of lower sea level in the Ice Ages. The continental slope extends to within the coastal marine area only south of about Heretaniwha Point. Depths of about 2000 metres are reached in some places within that area. The continental slope is dissected in several places by steep-sided canyons.

Like the continental shelf, the upper continental slope is mostly composed of soft sediments like sand, silt and mud. Studies of bottom-dwelling worms, shellfish, etc, in northern parts of the West Coast show a change in invertebrate assemblages with increasing depth across the continental shelf and slope[68]; however, these surveys did not extend into South Westland, where deep waters (greater than 200 metres) occur within the 12 nautical mile boundary that marks the extent of the West Coast coastal marine area.

Trawl surveys in the 200–400 metre depth range between Okarito and Haast River[69] give an indication of the fish assemblages of the upper parts of the continental slope. The most common species caught in these surveys were: ling, stargazer, hoki, ghost shark, red cod, tarakihi, spiny dogfish, arrow squid and barracouta. Compared to the continental shelf, some species such as ling, hoki, ghost shark and stargazer become more common in these greater depths, while others such as spiny dogfish and barracouta become less abundant; gurnard and rig are virtually absent. However, the trawl survey data (see elsewhere in this chapter) also shows that the catch rates for each species can be quite variable from year to year.

CANYONS

Submarine canyons in the West Coast coastal marine area occur from the Hokitika Canyon southwards. They extend well beyond the 12 nautical mile limit, the combined Hokitika-Cook Canyon system running for over 650 kilometres offshore[70]. The South Westland area between the Hokitika Canyon and Awarua Point includes the largest submarine canyon features on New Zealand's western coast, and one of the main concentrations of nearshore canyon ecosystems in New Zealand.

67 e.g. as indicated by the NIWA fishery trawl survey reports, such as Stevenson & Hanchet 2000
68 Probert et al 2001
69 Stratum #16 from Stevenson & Hanchet 2000
70 Cox2005

Canyons provide a great variety of seabed terrain, and their form tends to alter the current systems, in particular by channelling the upwelling of the Tasman Current onto the continental shelf. In physical terms, recent studies indicate that the Hokitika and Cook Canyons act as major 'sediment sinks', draining fine sediments off the continental shelf down into the deeper waters of the Tasman Basin[71]. This is probably also the case for the less studied canyons to the south.

The Hokitika Canyon is the largest of the West Coast canyons, encroaching to within about 8 kilometres from the coastline[72]. Other canyons to the south encroach much closer to the shore; these include the major features of the Cook, Moeraki, Haast, Arawata, Jackson and Cascade Canyons. Depths of up to 2000 m are thought to occur within 12 nautical miles offshore in the Cascade Canyon, and depth ranges of about 400–1000 m in the other canyons[73]. The Hokitika and Cook Canyons have been recently mapped in great detail by a joint NIWA-French expedition, which included geological and substrate surveys[74].

Some trawl surveys have been located along the margins of submarine canyons, and so the fish assemblages described later in this chapter could be expected to apply to areas of similar substrate at the heads of the canyons to depths of 400 metres. However, those surveys also indicated considerable areas of foul ground, and these substrate differences could be expected to produce corresponding differences in the biological communities that live there. There is no information from the West Coast inshore trawl surveys for depths greater than 400 metres (depths which occur in territorial waters within the canyons of South Westland). It is to be expected that the fish assemblages change with depth in these canyons. Some fish species, such as orange roughy, seal shark and other deep-sea sharks, rattails, and dories are known to occur in South Westland; furthermore, these species are known to become more common in New Zealand waters at these greater depths[75]. However, there is no specific published report on the fish assemblages of waters deeper than 400 m in the West Coast coastal marine area.

The association between canyons and spawning fish such as hoki, ling and hake is an indication of their biological richness and their suitability for the propagation of some marine species and the dispersal of their offspring by upwellings and other coastal current systems. In addition to these commercial species, large aggregations of non-commercial fish (e.g. lanternfish) are also know to occur in these canyon (and associated continental slope) areas of the West Coast. These fish and their spawn in turn provide a large food source for larger predators such as barracouta, fur seals and orca[76].

3.6.2 Invertebrate and Fish Species in the Deep Nearshore Domain

New Zealand's nearshore invertebrate and fish species have been documented in a number of studies for a variety of commercial and noncommercial purposes. However, detailed information on the distribution of species is limited.

SEABED INVERTEBRATES

Seabed invertebrates have been assessed in a number of studies[77]. The samples were mostly taken by the New Zealand Oceanographic Institute (NZOI) in the 1980s along transects out from Karamea, Westport, Greymouth and Whataroa, in depths of 30 to 1120 metres.

Shelf seabed invertebrate assemblages in the West Coast study area have been assessed by several authors. Grange (1990) identified two communities within that area, separated by depth, substrate type and location:

- a coastal and sandy bivalve community north of about Heretaniwha Point of mostly common New Zealand species; and

71 H Neil pers comm 2006
72 Probert and Swanson 1985
73 Carter 1981
74 H Neil pers comm 2006
75 e.g. see Anderson et al 1998
76 McDiarmid et al 2005, Livingston 2002
77 Probert et al 2001, Probert & Grove 1998, Probert & Anderson 1986, Probert 1986, Probert & Swanson 1985

- a deeper and muddy bivalve community south of there dominated by a different group of species and with a higher species diversity.

More detailed studies by Probert and Grove (1998) and others identified shelf biological communities between Wanganui Bluffs and Karamea. That study identified four community types, based on marine worms and shellfish that mostly lack common (non-scientific) names:

- an inner shelf community on silty sand (32–51 m depth);
- a mid to outer shelf community on sandy mud (87–297 m);
- an outer shelf community on sand at the northern end of the study area (195–248 m); and
- an upper slope community on sandy mud (477–1120 m).

The first two of these types included sample sites from within the West Coast coastal marine area. This pattern was largely confirmed by an assessment of marine worm distributions by Probert et al (2001). In addition, this latter study found that the community structure changes across the shelf and upper slope, and to a lesser extent with latitude. The study concluded that the distribution pattern of seabed worms appears to be mostly related to water depth and seabed clay content.

Probert (1986) found that pelagic phytoplankton (sea-surface plant microbes) are the main source of energy through the food chain for shelf invertebrates and bottom-feeding fish. River inputs provide a lot of freshwater and sediment, but relatively little in the way of nutrients.

FISH ASSEMBLAGES

The relative annual abundance of a variety of nearshore fish species that occupy the waters of the West Coast continental shelf and slope (in depths ranging from 20 to 400 metres) has been determined through periodic trawl surveys. Trawl surveys of the West Coast South Island and Tasman and Golden Bays were undertaken on five occasions from 1994 to 2003[78]. In all, 90 different species of fish have been recorded from within territorial waters of the West Coast region in these trawl surveys.

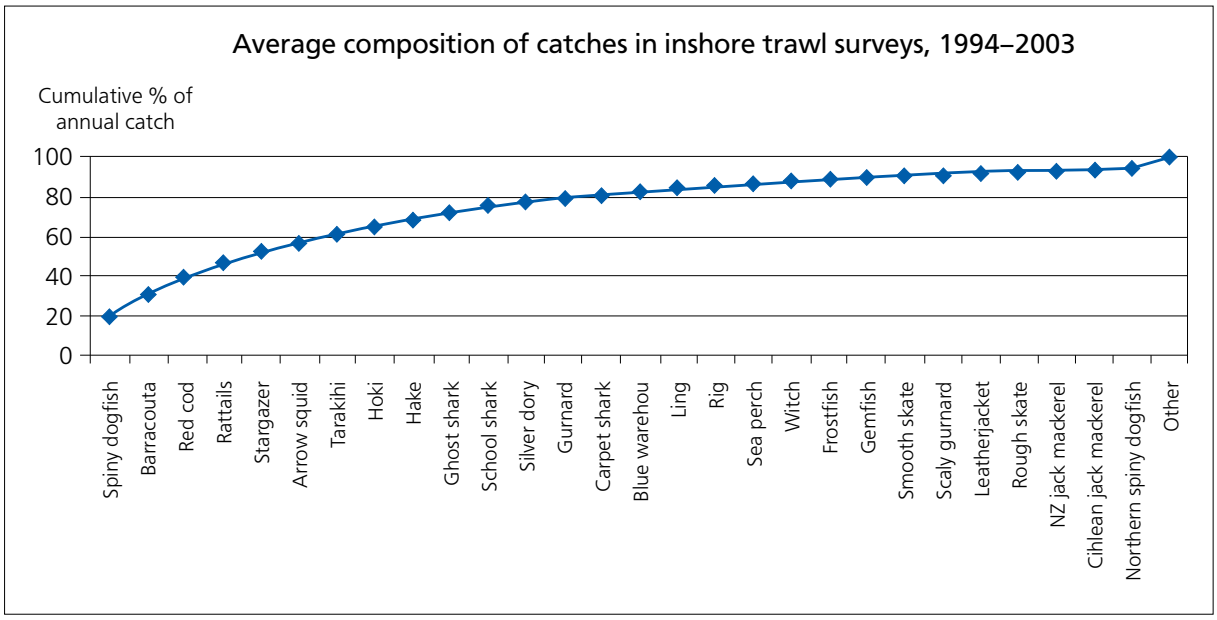
Stevenson and others assessed the distribution and abundance of fish in three depth strata throughout Marlborough, Nelson and the West Coast. The West Coast information was summarised and further analysed by Neale (2006c).

The results of these surveys for the whole survey area show that seven main species (spiny dogfish, barracouta, red cod, giant stargazer, arrow squid, tarakihi, and hoki) and one species group (rattails) comprise over 60% of the catch (see Figure 3.7 following page).

78 Neale (2006c), Stevenson 2004, Stevenson 2002, Stevenson & Hanchet 2000, Stevenson 1998, Drummond & Stevenson 1996, Drummond & Stevenson 1995

Figure 3.7. Common benthic fish species on the West Coast.

(Graph derived from 5 NIWA trawl survey reports. See Neale 2006c, Stevenson 2004, Stevenson 2002, Stevenson & Hanchet 2000, Stevenson 1998, Drummond & Stevenson 1996, Drummond & Stevenson 1995a)



Barracouta.
Photo: Mfish photo library.

However, a wide variety of species were caught during the NIWA surveys, with 21 species each comprising at least 1% of the catch. While the relative abundances of these species might vary between the Nelson and West Coast regions, available information indicates that this general pattern also applies to the West Coast region on its own.

Hurst et al (2000) summarised the known areas of importance for New Zealand coastal and continental shelf fish species, with particular reference to spawning, pupping or egg-laying, and juvenile populations. Their report selected 35 "commercially important" fish species that are found regularly in research trawls in depths of less than 200 metres. O'Driscoll et al (2003) undertook a similar exercise for 32 deepwater and pelagic fish species that are found regularly in trawl and longline fisheries in the 200 to 1500 metres depth range. Those two reports found the South Island West Coast included marine areas significant for the species listed in Table 3.1. Data from O'Driscoll et al (2003) indicates that deeper waters off parts of the West Coast (especially north of about the Cook and Hokitika Canyons) are areas where large aggregations of juveniles of a number of commercially important fish species occur – such as hoki, hake, ling, frostfish, orange roughy and lookdown dory.

Table 3.1. Abundances of fish species reproducing in West Coast marine areas.

Summarised from Hurst et al 2000 (inner & outer shelf species); O'Driscoll et al 2003 (deepwater & pelagic).

[NOTE: The 'outer shelf' and 'deep' classes in the table below are relevant to the West Coast Marine Protection Forum process only where these environments occur within the coastal marine area defined for this study].

KEY TO ABUNDANCES

	High/ Common
	Moderate/ Medium/ Occasional
	Low/Rare
+	Present, abundance unknown
	Absent/ Possible/ No data

(Months indicate main season)

Fish species	Survey abundance of spawning, pupping, or egg-laying adults	Survey abundance of juveniles	Approx normal depth range	Main area within West Coast
INNER SHELF	(common/ occasional)	(high/ moderate/ low)	(Inner/ Outer shelf)	
Red gurnard			I	
Blue mackerel			I	
Jack mackerel (T.nz)			I	
Kahawai			I	
INNER & OUTER SHELF				
Hake			I (& O)	
Barracouta			I & O	
Red cod			I & O	
Tarakihi			I & O	
Spiny dogfish			I & O	
Jack mackerel (T.declivis & T. s.m.)			O (&I)	
OUTER SHELF				
Blue warehou	(Aug/Sep)		O	
Gemfish			O	
Giant stargazer			O	
School shark			O	
Hapuku			O	
Arrow squid	+		O	
DEEP	Common/ Occasional/ Rare	High/ Medium/ Low	(Metres, from Anderson et al)	
Hoki	(Jun–Sep)		300–1000	Kahurangi – Moeraki Canyon
Hake	(Jun–Sep)		400–1000	Kahurangi – Hokitika
Ling	(Jul– Sep)		0–800	Kahurangi – Hokitika
Frostfish	(Mar–Oct)		0–400	Heaphy – Cook Canyon
Orange roughy	(Jun/Jul)		700+	Challenger Plateau, Cook Canyon
Silver warehou	(Jun–Oct)		100–500	Heaphy – Hokitika
Lookdown dory	(Jul/Aug)		300–800	Kahurangi – Cook Canyon
Rough skate	(Mar/Apr)		?	Kahurangi – Cook Canyon
Smooth skate	(Mar/Apr)		?	Karamea – Moeraki Canyon
Bluenose	(Jul–Oct)		200–800	Heaphy – Hokitika
White warehou	(Jul–Sep)		200–600	Heaphy – Hokitika
Ribaldo	(Jul/Aug)		500–1000	Heaphy – Hokitika
Alfonsino			300–500+	Heaphy
Silverside			100–600	Heaphy
Northern spiny dogfish			100–500	Foulwind – Paparoa
Moonfish		+	0–? (pelagic offshore)	Foulwind – Fiordland
Anchovy	+		0–200 (pelagic)	
Pilchards	+	+	0–100 (pelagic)	

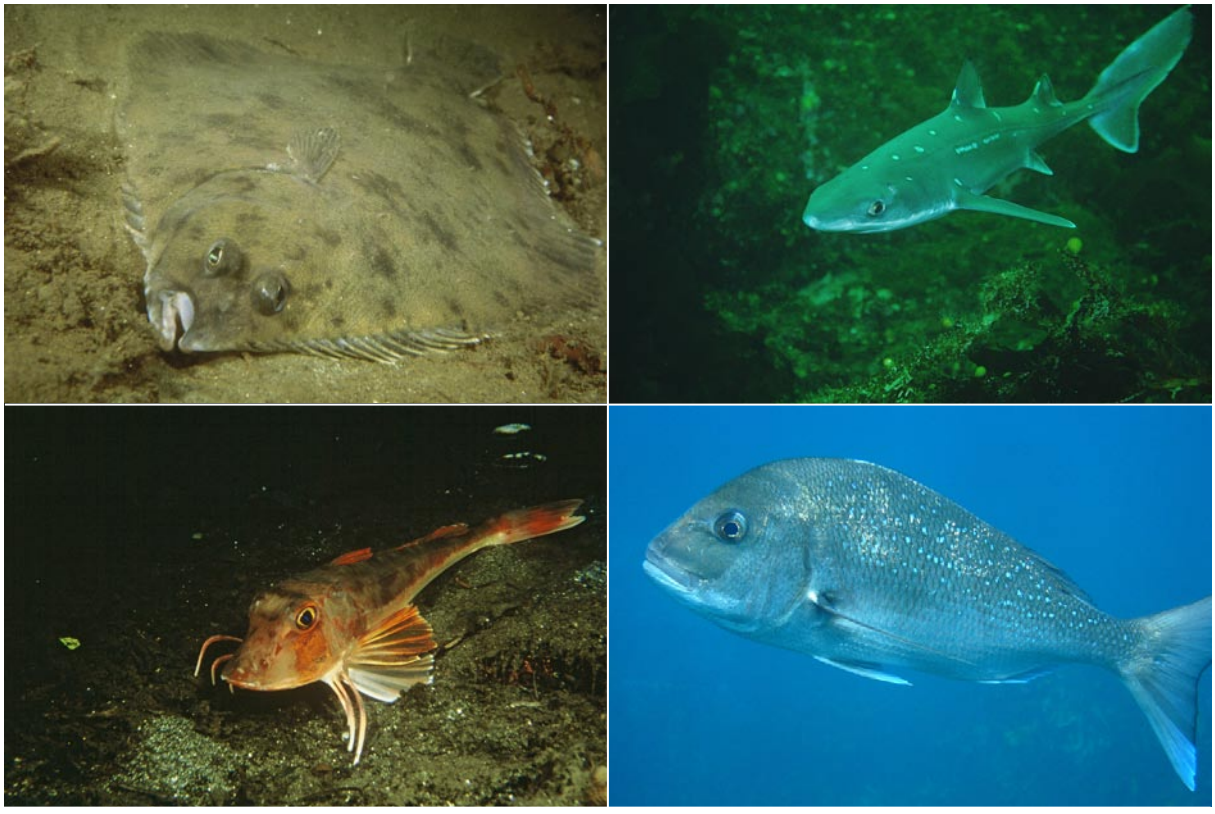
Giant stargazer. *Photo: S Wing, DOC collection.*

The West Coast was considered to be of low or unknown importance for the other commercial fish species listed by Hurst et al (2000) and O'Driscoll et al (2003) and indicated in the table above. Also note that these two reports did not consider all fish species, including some that are known to be common on the West Coast (e.g. some flatfish, many reef fish species and all non-commercial fish).

FISH SPAWNING

The winter months are when the most fish spawning activity occurs off the West Coast. The greatest amount of spawning by hoki, hake, ling and associated species occurs along the continental shelf edge and associated canyons from about the Heaphy Bluff to Hokitika. Similar areas off South Westland are known spawning grounds for some deepwater species, such as orange roughy.

The West Coast of the South Island (during August-September) is one of four known spawning areas in New Zealand for blue warehou. The South Island West Coast has a warehou fishery during August/September and again later in summer. The spawning seasons of hake, silver warehou, ling, gemfish, blue warehou, giant stargazer, barracouta, jack mackerel, tarakihi and red cod overlap with the hoki spawning season on the South Island West Coast[79].



Some of the 90 fish species recorded from NIWA trawl surveys in the deep nearshore domain:
Top row: Black flounder (patikimohoao). *Photo: W Farelly, DOC;*
Spiny dogfish (koinga). *Photo: S Wing, DOC collection*
Bottom row: Gurnard (kumukumu). *Photo: W Farelly, DOC collection;*
Snapper (tamure). *Photo: J Major, DOC collection.*

79 Livingston 2002

Hurst & Bagley (1984) surveyed for spawning barracouta in early September 1984, from Cape Foulwind to Cook Canyon, and found that:

"....catch rates of barracouta and some of the other main species (e.g. spiny dogfish, tarakihi, red cod, common warehou, stargazer) were significantly greater in the southern half of the survey area, between Hokitika Trench and Cook Canyon. Several species were spawning or about to spawn in the period of the survey, namely barracouta, common warehou, silver warehou, red cod, red gurnard and ling."

3.6.3 Existing Protection in the Deep Nearshore Domain

These New Zealand territorial waters are governed by general controls under a variety of legislation (e.g. the Fisheries, Resource Management, Wildlife, Foreshore and Seabed and Maritime Transport, Acts). Other than these general controls, there are no specific protection or management areas over the continental shelf, continental slope or underwater canyons within the West Coast coastal marine area.

3.6.4 Uses Associated with the Deep Nearshore Domain

The waters of the continental shelf, continental slope and underwater canyons are presently used mostly for fishing (including trawling, net and line fishing) and for shipping and navigation; most of these are commercial users but there are also some recreational users. Mining or other extraction operations on the seabed have not been undertaken to date, although there has been some mineral exploration (e.g. for hydrocarbons and gold) and associated geological studies[80].

Commercial fishing is a predominant use of the deep nearshore domain: stern trawler approaching Greymouth.
Photo: S Nimmo.

80 e.g. Corner 1989, Kingett & Associates 1987, Price 1985, Price 1983a, Price 1983b, Carter 1980, Alpine Geophysical Associates 1968

3.7 Ecosystems on the Margins of the West Coast Coastal Marine Area

Some ecosystems and habitats on dry land and in freshwater on the margin of the West Coast coastal marine area are briefly discussed below because they can have a physical and biological influence on the coastal and marine environment. Some of the main types include:

- islands and rock stacks;
- dune lands; and
- freshwater waterways and wetlands

3.7.1 Islands and Rock Stacks

Above the wash of the tide, islands and stacks often have a cap of vegetation with the amount of soil development depending mostly on the height and area of the island's surface. These off-shore sites provide resting and breeding places, free of predators and other types of disturbance, for wildlife which otherwise live in the marine zone, such as fur seals and burrowing seabirds. Islands also provide refuges for threatened plants (e.g. seal cress nau) and add greatly to the diversity of habitats and marine life along open coasts. For example, they can be surrounded by rocky reef areas that sometimes extend to considerable depths, and are less affected by wave action compared to the mainland coastlines.

Islands and rock stacks rise above the surrounding coastal marine area.
From top:
Open Bay Islands. *Photo: P. Ryan, DOC collection.*

Motukiekie Rocks. *Photo: D Neale, DOC.*

The main island groups off the West Coast are mapped in Figure 3.3. Of the 70 vegetated rock stacks and islets in the West Coast Tai Poutini Conservancy, Taumaka me Popotai (the Open Bay Islands) makes up most of the total area. Taumaka me Popotai (Open Bay Islands), a group of islands 4 km off the mouth of the Okuru River in South Westland (see map12, Haast, in Chapter 5), are regarded as the most important islands on the West Coast because of their habitat and wildlife features.

The cluster of islands at Motukiekie[81] support burrowing seabirds (which are not common on the West Coast) and threatened plants. Some islands such as Wall, Hanata, and Cascade Islands are places for such species as fur seals, threatened plants and reef invertebrates. Other island and stack clusters at Wekakura, Punakaiki, Moeraki and Jackson Head have not yet been well studied.

Taumaka me Popotai is private (Maori-owned) land, and is also a gazetted wildlife refuge and a Coastal Protection Area in the Regional Coastal Plan. Seal Island is a scenic reserve and, along with several other islands and stacks, is among the Outstanding Natural Features and Landscapes listed in the West Coast Regional Coastal Plan. A biosecurity plan produced by DOC[82] aims to protect the natural features of Taumaka me Popotai from weeds and animal pests.

3.7.2 Dune Lands

The best development of dune landscapes on the West Coast is north and south of the mouths of the Haast and Okuru Rivers, where shore-parallel dune ridges extend inland for 2–3 km. This section of coastline is extending seawards as sand continues to accumulate. These Haast-Okuru dunes also carry impressive sequences of undisturbed indigenous vegetation, from pioneer sand-binding plants to mature forest (with intervening swamp vegetation).

81 [as shown in Chapter 5, Segment 5 of this report]
82 Newton 2005

Burmeister Morass: forested sand dune and wetland complex. Arawhata River mouth in distance.
Photo: DL Homer.

Johnson (1992) surveyed the sand dune and beach vegetation of the West Coast as part of a national inventory carried out by DSIR Land Resources. The DSIR inventory showed that the relatively inaccessible coastline (backed by bush-clad hills) from Kahurangi Point to about Karamea has a predominantly rocky coast interspersed with dune systems which are botanically significant[83]. Here, *"Small beaches contain lenses of unmodified native vegetation and the larger dune systems have excellent mosaics of sand dune communities, including pingao, dune herbs and grassland, coastal broad-leaved forest, nikau forest, hard beech and northern rata forests, and some lagoon vegetation locally".*

Nikau palms on the coastline, south of the Heaphy River.
Photo: L. F. Molloy

The coastline from Hunts Beach to Sandy Beach (Makawhio River) and on to Maori Beach (Bruce Bay) consists of a wave-worked beach practically without vegetation and abuts a low scarp cut by storms into the alluvial deposits of the hinterland. Here, *"....there is almost no transition between the bare sand and gravel of the beach, and salt-damaged podocarp forest behind"....."Very different beaches occur between Tititira Head and Ship Creek where there is an indented coast backed by steep hills of Tertiary sedimentary and volcanic rocks. Here numerous sandy beaches (such as Monro, Moeraki, and Murphy Beaches) line small coves".*

Overall, Johnson rated the beaches at three sites – Saltwater Lagoon, Okarito Beach, and Ohinemaka – as having the best unmodified indigenous duneland vegetation in Westland. *"Despite modifications by grazing, fire and weeds, these sites are valuable biologically, the more so because of their settings within a diversity of adjacent landforms and vegetation".* Two other beaches in South Westland – Cole Creek and Ship Creek to Waita River – *"are of interest partly because of their dune-to-forest sequences, but also because they have examples of native coastal vegetation easy of access from the highway north of Haast"*[84]. Cascade River and Barn Bay (which Johnson included as part of a 'Fiordland' area) were rated very highly as *"very important for their diversity of dune communities and associated wetlands, in good condition."*

83 Johnson 1992
84 Johnson 1992, p216

Pingao on sand dunes at Ship Creek. *Photo: L.F. Molloy.*

Pingao (golden sand sedge) is the main dune-forming endemic coastal plant on the West Coast. Previously widespread throughout New Zealand, it has suffered from competition with weeds such as marram grass and gorse, as well as grazing by stock and other browsing mammals. It remains relatively common in some parts of the West Coast, especially to the north of the Heaphy River and south of Cascade Point. Ship Creek and Pahautane Beach are two very accessible sites where this plant still thrives.

3.7.3 Freshwater Waterways and Wetlands

Other wetland types also occur upstream of the coastal marine area, e.g. freshwater swamps, lakes and rivers.[85] These are often connected directly to the coastal marine area by a flowing channel that provides important physical linkages (e.g. the movement of fresh water, sediments and nutrients into the coastal marine area) and biological linkages (e.g. the migration of freshwater fish and their use of wetlands for spawning) between the land and sea environments.

3.8 Marine Pests And Other Introduced Organisms

A notable feature of the West Coast is the virtual absence of adventive (introduced) marine species, except in the estuarine domain where some adventive fish and plants have established. The invasive cord grass *Spartina* was found at the Oparara Estuary but ongoing monitoring indicates that it has now been eradicated. Three possible introduced marine species have been recorded, but recent research suggests that they are all native to New Zealand:

- The small seaweed ***Polysiphonia sertularioides*** is a possible adventive (introduced) species, but has been recorded on the West Coast only at Scott's Beach (Heaphy Track) and it is by no means a dominant component of the marine flora of that locality[86];
- The **red rock crab** occurs on intertidal rocky shores and subtidal reefs throughout the region, but it is possible that this species is a 'self introduced' New Zealand native (perhaps arriving attached to drifting flotsam from other countries); and
- The **blue mussel** has been suggested as a possible adventive species, but has been found from fossil records to be a New Zealand native[87].

It is a notable and rare occurrence for such a large marine region of New Zealand to be free of introduced marine species. Furthermore, two environmental factors work in favour of reducing the likelihood of introduced species becoming introduced and established in the West Coast marine area. They are:

1. the West Coast region lies at the 'upstream end' of New Zealand's coastal current systems; and
2. the relatively few human vectors (such as vessel traffic and marine farming) for introducing marine species to the West Coast

This all adds up to a high natural conservation value for the present West Coast marine environment.

However, there are a number of pest species that could be introduced to the West Coast by natural or human vectors. They include:

- the Japanese kelp *Undaria* (which is already established in numerous locations around New Zealand); and
- the North Pacific seastar *Asterias amurensis* (which is established in Tasmania and South Australia); and
- the clubbed tunicate sea squirt *Styela clava*.

85 e.g. see Partridge 2004
86 Neale & Nelson 1998
87 Gardner 2004

Current modelling by NIWA suggests that there is a very low risk of species establishing naturally from Australian populations, due to the long required drift times of at least four to six months, and up to two years[88]. Because of the factors outlined above, the West Coast is in an almost unique situation – of being able to prevent or strongly limit the natural or human-assisted spread of exotic marine species into the region. This is relevant not just for the biosecurity of the West Coast marine and coastal area, but also for that of regions 'downstream' – such as Fiordland. This 'upstream position' means that should a marine species become established in the West Coast, the likelihood of it spreading to other parts of the country by natural coastal currents will probably be higher than for other regions.

3.9 Absence Of Common New Zealand Species And Habitats

Some ecologically significant native species are notably absent or very uncommon on the West Coast, including a number of large kelp seaweeds (e.g. paddle kelp, flapjack, *Lessonia*).

There are also a number of significant marine habitats that are common elsewhere in New Zealand but absent or rare in the West Coast marine and coastal area – such as, sheltered rocky reefs, subtidal kelp forests, and rock-walled inlets.

3.10 Threatened Species

At least 61 marine, estuarine and coastal species recorded from the West Coast (and no doubt others that have not yet been recorded) have been given a threat classification by the Department of Conservation[89], based on specified criteria[90]. These are listed in Appendix 4 according to their primary habitat and their threat status listing.

3.11 Taonga Species

Taonga species are those native plants, birds and other animals which are of special cultural significance and importance to Ngai Tahu and are found within Ngai Tahu takiwa (which includes the entire West Coast coastal marine area of concern to the West Coast Marine Protection Forum). The marine, coastal and estuarine species listed in the Ngai Tahu Claims Settlement Act 1998 as taonga are listed in Appendix 5.

88 Stanton 1997

89 Hitchmough et al 2007

90 Molloy et al 2002

Waiatoto River mouth and forested dune lands. *Photo: D.L Homer, GNS*

CHAPTER 4

Human Uses of the West Coast Marine and Coastal Environment

4.1 Introduction

Chapters 2 and 3 have summarised the physical and biological character of the West Coast marine environment. This section summarises the different ways that people use the coastal marine environment, including information on:

- Maori customary uses and kaitiakitanga
- Fishing
- Other coastal and marine resource uses
- Recreation and tourism activities
- Biological and environmental sciences
- Use of adjacent lands

These uses are each addressed in separate sections, and the chapter concludes with a summary of the current marine and coastal protection and management area measures that exist on the West Coast.

Human occupation and use of the West Coast marine environment dates back hundreds of years. Over that time, people and communities have formed close connections that affect the character and use of that environment today. Evidence of these past activities also remains today as historic and archaeological sites. All of these past connections to the West Coast marine environment are clearly important to many people both on and off the West Coast. However, historic and archaeological sites are largely outside the scope of the MPA Policy.

4.1.1 MPA Policy and Treaty Obligations

The MPA Policy and Implementation Plan acknowledges and provides for the special relationship between the Crown and Maori, including kaitiakitanga, customary use and matauranga Maori. This relationship reflects the obligations that arise from the Treaty of Waitangi and the various commitments to tangata whenua that are included in marine management legislation. Where MPAs are being considered for a particular area, tangata whenua are to be involved at an early stage.

West Coast *Tai Poutini* lies within the Ngai Tahu whanui takiwa (tribal area). In order to give proper effect to this relationship, iwi representation on the West Coast Marine Protection Forum has included representatives of the two Ngai Tahu Tai Poutini runanga; Te Runanga o Ngati Waewae and Te Runanga o Makaawhio. In 2004, Te Runanga o Ngai Tahu were involved with an expert group of marine specialists to provide a strategic approach to progressing marine protection within the Ngai Tahu whanui takiwa.

A report[1] was prepared to collate, map and assess biological information and identify key characteristics of areas required to adequately protect representative examples of the full range of natural habitats and ecosystems of the takiwa. This report assisted the West Coast Marine Protection Forum in compiling information about the physical and biological characteristics of the West Coast marine environment.

The 2004 report did not address values of cultural significance to the tangata whenua of Tai Poutini. Te Runanga o Ngai Tahu subsequently undertook to gather information within the takiwa on this topic and this work is progressing. The objective of this research is to identify and record information about the way tangata whenua, in both historic and contemporary times, have used (and value) the coastal and marine area of Tai Poutini. When completed, this

1 Dept of Conservation 2004

information will assist tangata whenua to consider how these values could be protected within the framework of the MPA process.

This West Coast Marine and Coastal Environment Report does not address Maori Customary Fishing. The Kaimoana Customary Fishing Regulations are a fisheries management tool administered by the Ministry of Fisheries to cover non-commercial customary fishing. They do not remove the right of tangata whenua to catch their recreational limits under the Amateur Fishing Regulations; nor do they provide for commercial fishing.

The Kaimoana Regulations enable the establishment of mataitai reserves. These reserves provide a tool for tangata whenua to manage all non-commercial fishing in some of their traditional fishing grounds.

4.2 Ngai Tahu Customary Uses and Kaitiakitanga

On the West Coast, concerns of the tangata whenua include the protection of the mana associated with land and sea and the protection of taonga (treasures) such as pounamu, pingao and kaimoana.

The whole of the coastal area offered a bounty of mahinga kai resources. Mahinga kai can be literally translated as *"food-works"* and includes not only resources but the places where such resources were harvested. Mahinga kai resources include:

- a range of kaimoana (sea food);
- sea fishing, eeling and the harvesting of other freshwater fish in lagoons and rivers;
- marine mammals providing whale meat and seal pups;
- waterfowl, sea bird egg gathering and forest birds; and
- a variety of plant resources, including harakeke (flax), pingao and ti kouka (cabbage tree).

The coast was also a major highway and trade route, particularly in areas where travel by land was difficult. Travel on the sea between settlements and hapü (sub-tribal groups) was common, with a variety of different forms of waka (canoe), including southern waka hunua (double hulled canoe). Hence, numerous tauranga waka (places where waka were launched) appear up and down the coast and wherever there is a tauranga waka located there is likely to be a kainga (settlement), fishing ground, kaimoana resource with a sea trail that links to a land trail and/or a mahinga kai resource.

The traditional mobile lifestyle of the people led to their dependence on the resources of the coast. The tipuna had a huge knowledge of the coastal environment and weather patterns, passed from generation to generation. Their knowledge continues to be held by whanau and hapu and is regarded as a taonga.

Other key cultural values within the coastal marine area include;

- Wahi tapu/taonga (sacred sites/treasures) – such as urupa (burial sites);
- Pa/Kainga – such as Okahu Pa at Neils Beach and the Heaphy and Buller River mouth sites
- Tauranga Waka – places where waka were launched and landed, such as Jackson Bay/ Okahu and Tauranga Bay;
- Ara – trails such as those used when early Maori travelled to Anita Bay to gather precious tangiwai (a type of pounamu jade);
- Mahinga Maataitai – fishing grounds;
- Reefs and Islands – very important mahinga kai; also act as markers (or pou) providing directions to fishing grounds or trails; and
- Kai moana – all manner of species of fish, shell-fish and marine mammals.

The connection of Maori to the West Coast and the marine environment is described in more detail by numerous publications[2].

The ability to access and use mahinga kai sites and resources has a major impact on the ability of Poutini Ngai Tahu (people of West Coast (Tai Poutini) Ngai Tahu descent) to relate to each other and to provide for themselves culturally, economically and socially. Fundamentally, Poutini Ngai Tahu want to be able to continue to sustain themselves from mahinga kai resources. Examples of current customary use and access requirements include: the gathering of pïngao from coastal dunes for weaving and for tukutuku panels; harakeke for weaving; and tuna (eel) and whitebait harvesting.

Kaitiaki is derived from the verb 'tiaki' which means "to guard, protect, to keep, to watch and to wait for". To be a kaitiaki is an extremely important responsibility. To Poutini Ngai Tahu, Kaitiakitanga is not a passive custodianship, nor is it simply the exercise of traditional property rights. Instead, it entails an active exercise of power in a manner beneficial to the resource.

The Ngai Tahu Claims Settlement Act lists and gives recognition to a number of taonga species and significant sites (e.g. topuni, nohoanga) on the West Coast. Taonga species occurring within or adjacent to the coastal marine area are listed in Appendix 5, and particular sites are mentioned in the segments of Chapter 5.

4.3 Fishing

Fishing practices throughout the West Coast have changed a lot over the past 200 years. Fishing by Maori on the West Coast Tai Poutini before 1840 was mostly in estuaries (for whitebait, eels, kahawai and yellow-eyed mullet) and rocky shores (for mussels)[3]. There was also a limited amount of sea fishing for barracouta, rig and other marine fish. These fisheries are still used today by both traditional and recreational fishers – the West Coast whitebait fishery in particular is popular in the spring months with both residents and visitors.

Commercial fishing occurs throughout the West Coast. *Photo: S Nimmo.*

2 e.g. Anderson 1998, Waitangi Tribunal 1992, Beattie 1920, Hooker 1986, Madgwick 1992

3 Waitangi Tribunal 1992

Greymouth Harbour is one of several ports used by West Coast fishers
Photo: S Nimmo.

In early times, marine mammals were also regarded as part of the 'fishery'. Early Maori sealing occurred throughout New Zealand/Aotearoa prior to the arrival of pakeha explorers. Some of the earliest contacts between European and Maori were through the sealing and whaling industries in south-western New Zealand that peaked in the early 1800s[4], but depletion of these animals led to the decline of these activities. Today, all marine mammals in New Zealand waters are legally protected.

Rapid development of commercial fishing occurred throughout the 1960s and 1970s, including increased development of boat-based inshore and deepwater fisheries on the West Coast[5]. Controls on fishing activity during this time consisted mostly of input controls, like limits on the number of licences issued to fish a particular species or on the size of vessel able to be used. In 1986 the Quota Management System was introduced as a tool for managing New Zealand's fisheries resources. The Quota Management System manages the 'output' – that is, the total amount of fish harvested.

In the late 1960s and 1970s, a largely unregulated foreign fishery existed outside the three mile territorial limit targeting high value species such as snapper[6]. New Zealand gained control of this fishing activity with the declaration of the 200 mile Exclusive Economic Zone (EEZ) in 1978.

Over the years, commercial and recreational fishing on the West Coast have contributed to the regional and national economy. While there are few specific references to historic trends in West Coast fishing, it is apparent that freshwater fisheries have been affected by habitat changes[7] and that marine fish stocks and fishing activity have changed over time[8].

The rest of this section contains information on current fishing practices within the West Coast Forum area. The focus of this section is on identifying where fishers fish and the fishing methods used, as this information is required to inform decisions about Marine Protected Areas. This section looks mostly at broad regional fishing patterns, while more detailed or site-specific information that is available is mostly included in Chapter 5. The quality and amount of information available differs for each fishing sector. The commercial and recreational fishing information is mainly derived from Ministry of Fisheries' catch information systems and research reports. Ministry catch information is generally not of a fine-scale and it is hoped that fishers operating in the area and other knowledgeable people will contribute finer-scale data to improve the Forum's MPA recommendation process. One opportunity for this is through the submission process explained in Chapter 1 of this report.

Some customary fishing information is included in Section 4.2.1. As noted in Section 4.1, it is hoped that customary fishers and tangata whenua will contribute more information on such fishing through the West Coast Marine Protection Forum process.

4 Starke 1986, Molloy 1985, Begg & Begg 1979
5 Stevens 2000
6 e.g. see Johnson and Haworth 2004
7 e.g. McDowall 1984
8 e.g. Booth et al 2005

4.3.1 Commercial Fishing

INTRODUCTION

Commercial fishers catch a wide range of species in waters off the West Coast. These include deepwater species like hoki and ling, pelagic species like skipjack, albacore and southern bluefin tuna, and inshore species like bluenose, snapper and tarakihi.

Commercial fishers are required by law to report the amount of each species they catch, what fishing method they use and how much effort is spent fishing. They are also required to report where they catch fish.

For most fishing activity, where fishing occurs is reported by Fisheries Management Area (FMA) and Statistical Reporting Areas (see Figure 4.1). As can be seen in the figure, the reporting areas are large, encompassing marine waters that extend well beyond the 12 mile territorial limit. As a consequence, it is difficult to provide detailed information about fishing activity within the coastal marine area (highlighted) of concern to the West Coast Marine Protection Forum.

The West Coast Forum region lies within Fisheries Management Area 7 (FMA 7 extends from the Clarence River on the east coast of the South Island, around the top of the South Island, down to Awarua Point on the West Coast, and out to the 200 mile limit). The West Coast coastal marine area of concern to the Forum lies within four statistical reporting areas – 032 (part), 033, 034 and 035 (see Figure 4.1).

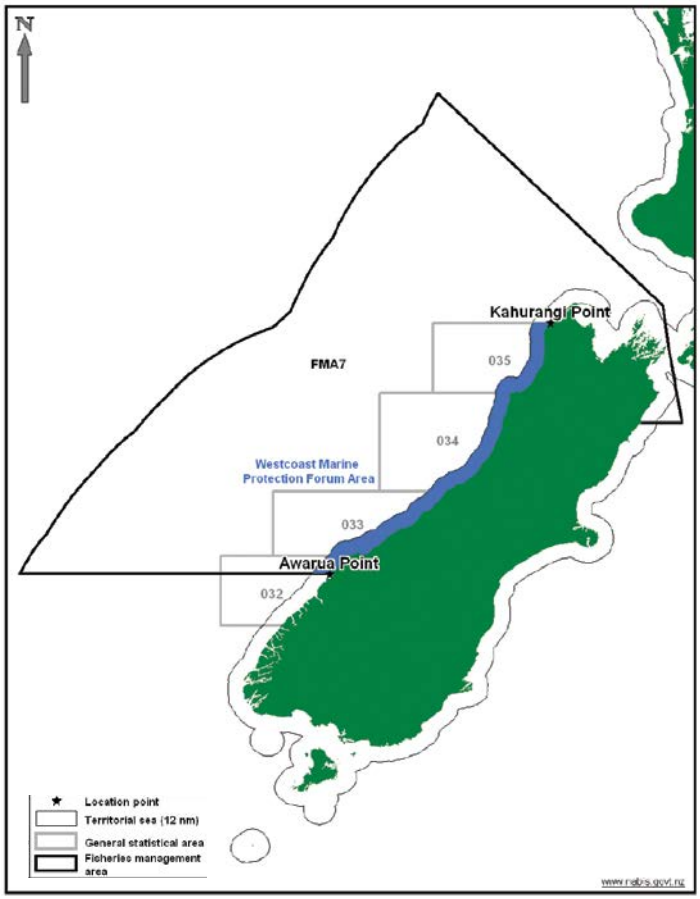


Figure 4.1: MFish Statistical reporting Areas, MFish Fisheries Management Area (FMA) 7 boundaries and the West Coast Marine Protection Forum boundaries.

WHERE COMMERCIAL FISHERS FISH

Commercial fishing occurs throughout the West Coast coastal marine area[9]. A wide range of species is caught, but it is the fish being targeted that determines where fishers go fishing. This is not to say that other species caught when targeting a particular species are not wanted. Non-target species are an expected, managed and valuable part of commercial fishing practice, particularly in finfish fisheries, which are rarely discrete. However, non target species are not the main driver for where commercial fishers go fishing.

The information provided below is on species distributed and targeted primarily in water less than 200 metres deep. It is important to note, however, that a number of species more frequently found in deeper waters (e.g. hoki, groper and ling and pelagic species like tuna) are targeted and caught in waters of less than 200 m depth. Commercial fishers are the best source of information on such targeting and their information will be valuable in providing a complete picture of fishing in the region.

According to Ministry of Fisheries catch information, the following species commonly found in waters shallower than 200 metres are targeted by commercial fishers off the West Coast: barracouta, blue cod, bluenose, 'flatfish'[10], frostfish, gurnard, jack mackerel, kahawai, paddle crab, red cod, school shark, rig, stargazer, silver warehou, tarakihi, trevally and warehou.

9 Booth et al 2005

10 For the purposes of reporting commercial catch the following species are included in 'flatfish': black flounder, brill, NZ sole, sole, greenback flounder, lemon sole, sand flounder, turbot, witch and yellow belly flounder.

Table 4.1 indicates the estimated average annual catch for FMA 7 that is taken within each of the three Statistical Reporting Areas, 033-035 (032 is not included because only a small part of it lies within the West Coast region). Commercial fishers can provide more information on how fishing effort for a particular species or group of species is distributed within each reporting area.

Table 4.1:
Estimated average annual catch of species distributed and targeted (mostly in waters of 200 m depth or less) in Statistical Reporting Areas 033, 034 and 035 in the fishing years 2000 to 2005 and proportion of estimated catch that is in targeted fishing trips.*
(Note: Estimated catch in tonnes is rounded to the first decimal point)

Species	033 Estimated average annual catch (in tonnes)	034 Estimated average annual catch (in tonnes)	035 Estimated average annual catch (in tonnes)	Proportion of catch that is targeted** (%)	Total estimated average annual catch (033 – 035) (in tonnes)
Barracouta	218.9	1692.7	791.9	71	2703.5
Blue cod	0.4	0.3	1.2	*	1.9
Bluenose	19.4	23.6	2.3	44	45.3
Flatfish***	228.1	993.7	309.0	79	1530.8
Frostfish	0.2	623.4	283.1	*	906.7
Gurnard	108.4	206.3	64.6	*	379.3
Jack Mackerel	15.1	528.6	704.0	3	1247.7
Kahawai	0.7	1.1	2.2	0	4.0
Red cod	389.7	524.0	127.8	53	1041.5
School shark	18.2	42.3	27.1	35	87.6
Skipjack tuna	0.3	0.7	163.8	*	164.8
Rig	18.6	36.9	5.8	61	61.3
Stargazer	161.0	263.1	27.2	16	451.3
Silver warehou	11.4	602.4	570.3	22	1184.1
Tarakihi	166.5	210.9	63.1	39	440.5
Trevally	<0.1	1.1	7.2	*	8.3
Warehou	162.6	394.1	118.0	37	674.7
Rock Lobster****				100	100.0

This catch information is based on the estimated catch from each statistical area, not just the catch from targeted trips.

* Commercial catch information can only be included if it meets MFish release criteria, because of commercial sensitivity. If commercial catch information did not meet the release criteria, the species has not been included in the table.

** Based on estimated catch for 2004-05 fishing year.

*** 'Flatfish' includes the following species: black flounder, brill, NZ sole, sole, greenback flounder, lemon sole, sand flounder, turbot, witch and yellow belly flounder.

**** Rock lobster has different statistical areas (928, 929,930 and 931) and also a different fishing year (1 April to 31 March), so the estimated catch has been combined for all statistical areas and then averaged.

The species listed in Table 4.1 are caught not only within the boundary of the West Coast coastal marine area. They may be caught in deeper waters as well, just as there are some deep sea species (such as hoki) that are sometimes caught within the West Coast coastal marine area. It is also important to note that the statistical areas are all different sizes and this fact needs to be taken into account when comparing the amounts of catch between statistical areas. The scale at which the Ministry of Fisheries records information prevents fine scale analysis, so the information in Table 4.1 is only a general overview of where different fish stocks are caught. More detailed information if provided by commercial fishers, will provide a more accurate description of where commercial fishing effort is focused on the West Coast.

WHAT FISHING METHODS ARE USED

Commercial fishers use a wide range of methods to catch fish in West Coast marine waters. The methods include trawling (net-towing along or near the seabed or in midwater), trolling (towing hooked fishing lines through the water at a slow to moderate speed), potting (setting of mesh pots containing bait onto the seabed), handlining, bottom longlining, drop/dahn lining (several methods of setting fishing lines that often have a number of baited hooks or lures), and set netting (stationary nets placed for a period of time at the sea surface or on the seabed). More detailed explanations of these methods are given in the box (on the next page) or can be found in fishing publications or websites such as www.seafic.co.nz or www.starfish.govt.nz.

Table 4.2:

The average proportion of the West Coast catch caught using different methods for each of the target species, for the fishing year 2004-05.

Catch for each species (calculated as a percentage for each fishing method)			
		Percentage of total estimated catch	Methods used when targeting
Barracouta	Bottom Trawl Midwater trawl	55.5 44.5	Yes Yes
Bluenose	Bottom Longlining Midwater trawl Bottom Trawl	71.4 24.9 3.6	Yes No No
Flatfish	Bottom Trawl	100	Yes
Frostfish	Midwater trawl	100	Yes
Gurnard	Bottom Trawl	100	Yes
Jack Mackerel	Mid water trawl	100	Yes
Red cod	Bottom trawl Mid water trawl Cod Pot Set Net	99 0.6 0-0.4 0-0.4	Yes No No No
Rig	Set net Bottom trawl Midwater trawl	64.0 34.9 1.1	Yes No No
Rock lobster	Rock lobster pots	100	Yes
School shark	Bottom long lining Set net Bottom trawl Dahn Lines Trolling Midwater trawl	29 43 27 0-1 0-1 0-1	Yes Yes No No No No
Stargazer	Bottom trawl Midwater trawl Bottom longline	99.8 0-0.2 0-0.2	Yes No No
Tarakihi	Bottom Trawl Bottom Longlining	99.2 0.4	Yes No
Trevally	Bottom trawl Set Net Bottom longline Mid water trawl	85 14 0-1 0-1	Yes No No No
Warehou	Bottom Trawl Midwater trawl Set net	98.0 1.9 0.1	Yes No No

Trawling (general)

Trawl nets are generally conical or funnel shaped with an area at the trawl opening called the fishing circle, and then tapering down to the closed area at the end called the cod-end. The fishing circle is kept open by the hydrodynamic spreading forces of trawl doors, the floats on the headline section and the weighted groundrope. The groundrope configuration can have various designs depending on the seabed type when benthic trawling, or whether being used off the seabed when midwater trawling.

The fish are herded into the trawl by the fish's sensory responses to the wires that lead down from the vessels to the trawl doors, from the trawl doors to the trawl net and the enclosing meshes that lead the fish towards the cod-end.

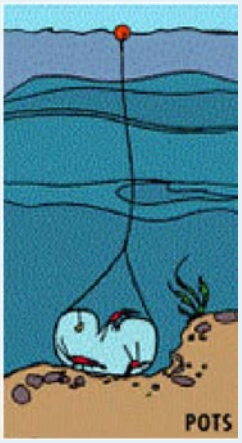
Trawl nets can be used for a number of water depth applications such as benthic and midwater trawling or in combination with more than one net in multi-rigged trawl operations by one vessel or in respect of pair trawling where one net is towed between two vessels.

Trolling

Trolling involves the use of lures or baited hooks and lines attached to outrigger booms on either side of a vessel and towed at relatively slow speeds depending on the species targeted. Once hooked, the fish is retrieved by pulling it onto the deck of the vessel.

The trolling lines also have weights attached. Different weights are used on each line so that the lines fall to different depths.

Pots and Traps



Pots are set up as traps, with bait secured inside the pots to normally attract rock lobsters or blue cod. The traps are constructed so that once the fish or crustacean has entered through a specially designed entrance, it is unable to exit again. Generally, there is a single non-escape entrance, located on the top or side of the pot and escapement gaps on the sides to allow for the release of undersized species.

Pots' shapes vary depending on the species targeted. They are normally made of a durable frame covered in a mesh configuration. Fishers release pots from boats on the end of a rope long enough to reach the bottom. The pots are weighted to ensure they settle on the sea floor the correct way up. The position of the pot is marked with floats so they can easily be recovered.

Handlining

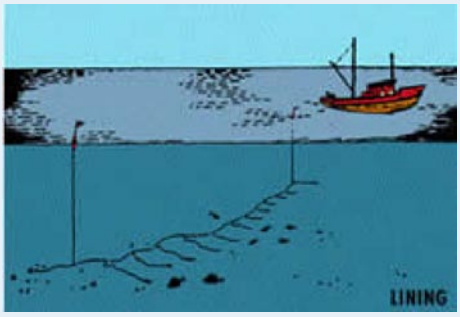
Handlining is fishing with lines and hooks from a stationary or moving boat.

Handlining is also a highly selective fishery in terms of fish quality, species and size. Because hauling is slow, mechanised (electrical or hydraulic) systems have been developed to allow more lines to be worked by a smaller crew.

Bottom LongLining

Longlines consist of a backbone line with 'snoods' (short lengths of line with a hook) attached. The method of longlining has become highly mechanised, with the snoods being automatically baited and clipped to the backbone as the line is set out over the stern of the vessel.

Bottom longlining (also called 'trot lining') is when the line is set along the sea floor. They are held in position by anchors at each end, and there are surface marker buoys to show the location of the line.



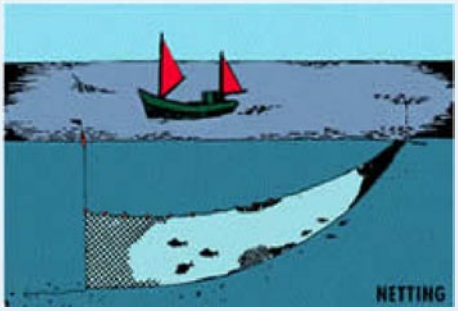
Drop/Dahn Lines

Drop/dahn lining (also called vertical lining) is a method suited for rocky areas and areas with vertical type terrain. Instead of horizontal bottom lines, vertical lines with snoods attached are used. Lines are secured by a weight and marked with a dahn buoy.

Set Net

Set netting (also called gill netting) involves setting a section of net which traps or entangles fish by their gills. As they try to back out, their gills are caught in the mesh.

The set net is deployed on the seabed with the top of the net buoyed by a float line whilst the bottom of the net is held down by a line of weights. The combined action of the floats and weights keeps the net stretched out vertically and meshes open.



Adapted from Ministry of Fisheries information

Notes about the data in Table 4.2:

Some methods, such as trawling or longlining, may occur both inside and outside the West Coast coastal marine area, so the information is only indicative of the proportion of catches within the three statistical areas. The data cannot be extrapolated to indicate the exact percentage of catch by method from within the area of interest to the Forum.

Ranges have been provided when there are fewer than three people using this method, due to the MFish release criteria and commercial sensitivity around catch information. If there were only two methods and one method had less than three participants this species has not been included in the table.

EELING

Commercial eeling is carried out in estuaries and river mouth areas within the coastal marine area, as well as in freshwater catchment areas, using fyke nets. The Tai Poutini Tuna Eel Management Plan[11] lists Okarito Lagoon as the most substantial water body in the West Coast coastal marine area that is open to commercial eel fishing. The plan also lists some 'significant water bodies' within the coastal marine area that are closed to commercial eel fishing on account of their protected or private land status. These are:

- Five Mile Lagoon;
- Lake Windermere;
- Waitangiroto Nature Reserve;
- Totara Lagoon Wildlife Management Reserve;
- Saltwater Lagoon Scenic Reserve;
- Porarari River;
- Heaphy River; and
- Arahura River (privately owned by Mawhera Incorporation)

MARINE FARMS

No marine farms presently exist on the West Coast, at least in part because of the high energy nature of the coastline. Consents have been issued by the West Coast Regional Council and the Ministry of Fisheries for a 45 hectare mussel farm at Jackson Bay/Okahu.

4.3.2 Recreational Fishing and Freshwater Fisheries

Most recreational fishing activity is managed by the Ministry of Fisheries under the Fisheries Act 1996, including marine fish and eels. Fishing for other native freshwater fish species (e.g. whitebait) is managed by the Department of Conservation. Sports fisheries (of some acclimatised or introduced fish) are managed by the West Coast Fish and Game Council.

MARINE RECREATIONAL FISHING

There is not a lot of published information available on recreational fishing on the West Coast. However, many people are recreational fishers and they hold a lot of anecdotal information about this activity. In order to improve the Forum's MPA recommendation process, it is hoped that fishers operating in the area and other knowledgeable people will contribute more detailed information on where recreational fishing occurs, for what species, and using what methods. One opportunity for this is through the submission process explained in Chapter 1 of this report.

A marine recreational fishing study was recently commissioned for the purpose of better informing the West Coast Marine Protection Forum[12]. The study is providing information on the species targeted and caught, methods used and locations fished by recreational fishers

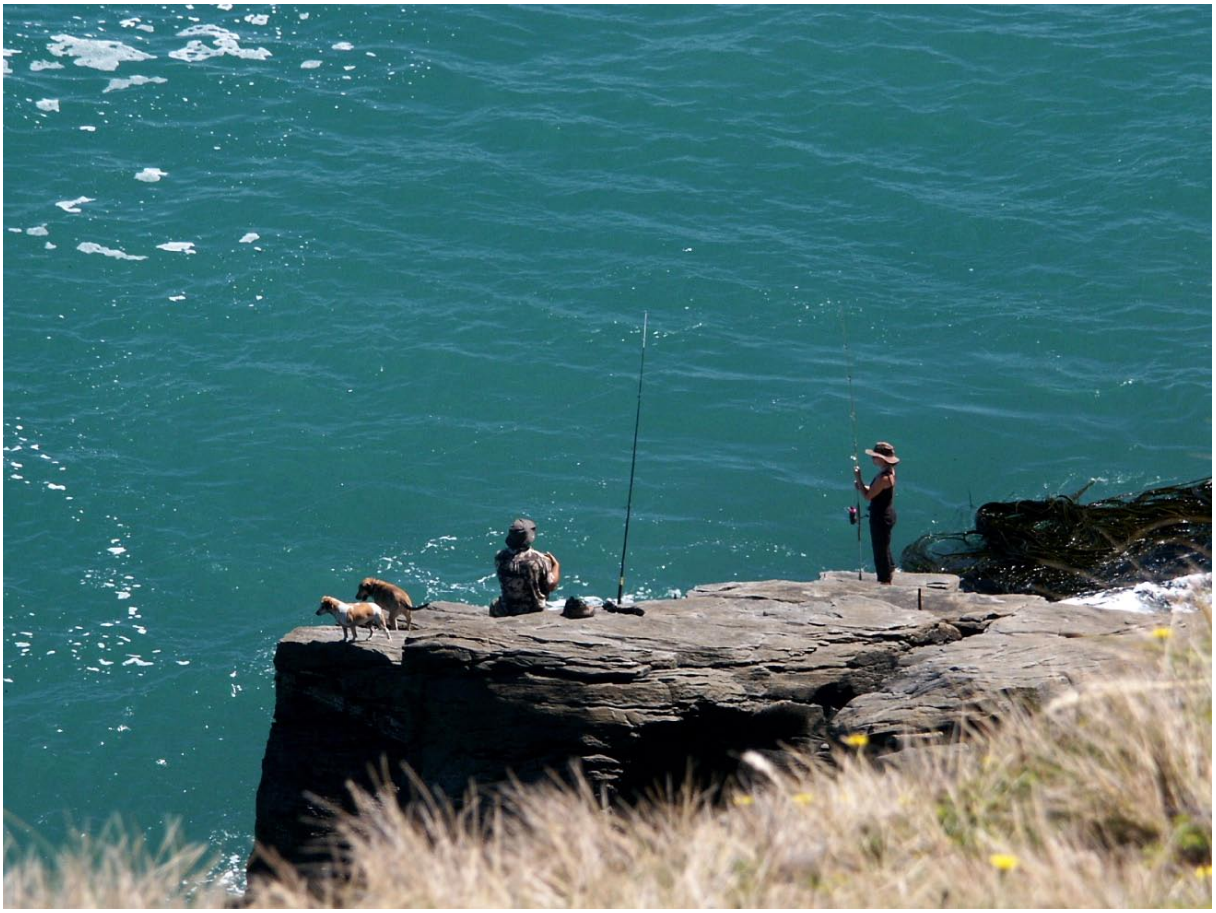
11 Tai Poutini Tuna 1999

12 NIWA in prep

between Kahurangi Point and Awarua Point. The study uses information from aerial surveys, questionnaires, and past telephone and diary surveys. Some of the initial results of this study are included in the summary below.

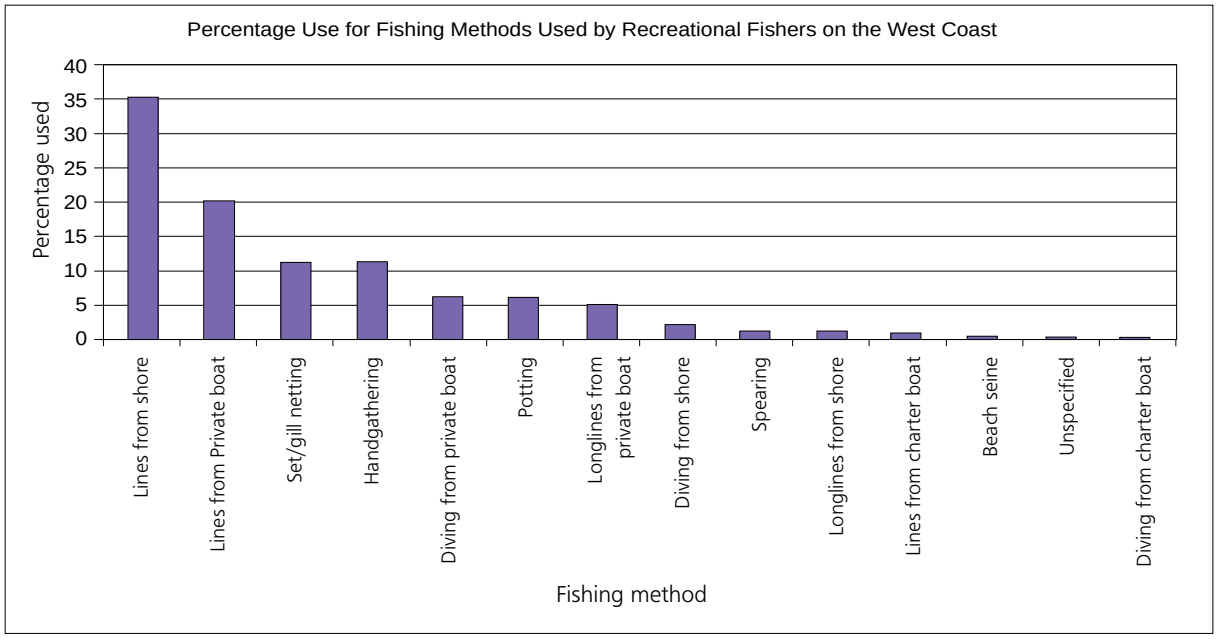
According to information collected in the questionnaires, the species most frequently targeted by recreational fishers on the West Coast are blue cod, rig, snapper, kahawai, rock lobster, elephant fish and school shark. These species are also the most frequently caught. Past telephone and diary surveys have identified the same set of species as important to recreational fishers on the West Coast.

Recreational fishers on the West Coast also use many different fishing methods (see Figure 4.2 opposite). Information collected in questionnaires, aerial surveys and telephone and diary surveys identify rod or line fishing from shore, followed by rod and line fishing from boats as the most common methods used. Telephone and diary surveys and questionnaires also identify set/gill netting as being frequently used (aerial surveys did not appear to sample netting or hand gathering methods well). Other methods used (but less frequently) include diving, potting, longlining, spearing, and beach seining. Dredging was also identified but it is likely this method occurs in the part of FMA 7 that does not lie within the West Coast coastal marine area of interest to the Forum.



Recreational fishers rod fishing.
Photos: S Nimmo.

Figure 4.2
Percentage of different recreational fishing methods used on the West Coast identified in the 2006 questionnaires. (Graph derived from data in NIWA (in prep).)



No absolute estimates of fishing effort are available as the information collected in the study is not representative of an average day's fishing. However, aerial surveys provide information on the relative intensity throughout the West Coast coastal marine area, for recreational boat fishing and surfcasting. Figures 4.3 to 4.8 (for zones 1–6, from north to south) show the distribution and methods observed during the aerial surveys. The aerial surveys indicate that the greatest densities of recreational fishers occur close to population centres, such as Westport, Greymouth and Hokitika. Boat-based fishing was most frequently observed near Westport and Cape Foulwind, but was also common around Jackson Head and Cascade Point. Surfcasting was relatively common throughout most of the survey area, except between Okuru and Awarua Point (refer Figure 4.8). The location of recreational fishing events is often linked to access sites (e.g. roads, river mouths, port areas and boat ramps) and coastal settlements that are mapped and described in Chapter 5. The more remote areas are generally used less by recreational fishers.

Recreational fishing occurs in all types of coastal and marine environments within the West Coast. In river mouths, estuaries, and lagoons people fish using rods and set nets for fish such as kahawai, yellow-eyed mullet and sports fish. They also gather shellfish such as cockles and pipis, mostly from the larger tidal flat estuaries. On the intertidal and shallow subtidal areas of the open coast, fishers do line fishing (e.g. using boat rods, surfcasters and set lines) and set netting from rocky shores, beaches and boats to catch fish such as red cod, kahawai, elephant fish, blue cod, tarakihi and snapper. At rocky shore and reef sites, mussels, paua and kina are gathered by hand, and rock lobsters are caught by several methods. Further offshore in the deep subtidal areas and beyond, recreational boats are sometimes taken to catch deeper water species such as groper, ling and tuna.

It appears that most recreational fishing on the West Coast is done informally by individuals, but clubs, charter boats and competitions also provide opportunities for recreational fishers. An unknown number of recreational commercial charter boats operate on the West Coast, mostly out of the three main ports of Westport, Greymouth and Jackson Bay. These trips are sometimes combined with commercial sightseeing or dolphin watching. Several fishing and diving clubs are based on the West Coast or visit from elsewhere, and several recreational fishing competitions and events occur each year throughout the region.

Figure 4.3. Aerial surveys, Zone 1: Kahurangi Point to Little Wanganui Head.

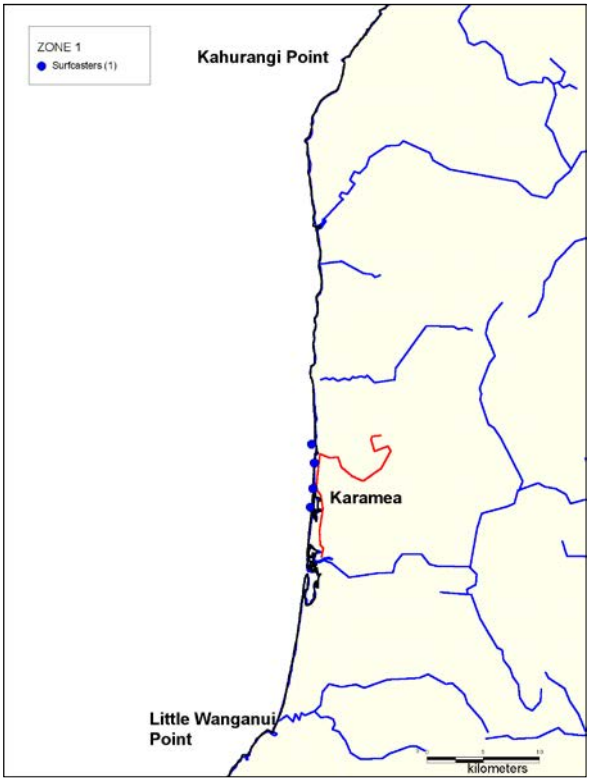


Figure 4.4. Aerial surveys, Zone 2: Little Wanganui Point to Kaipakati Point.

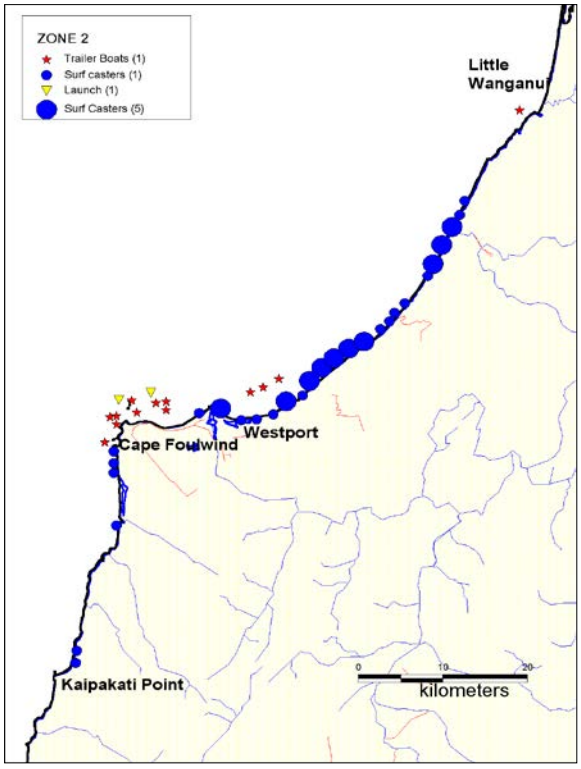


Figure 4.5. Aerial surveys, Zone 3: Kaipakati Point to Hokitika.

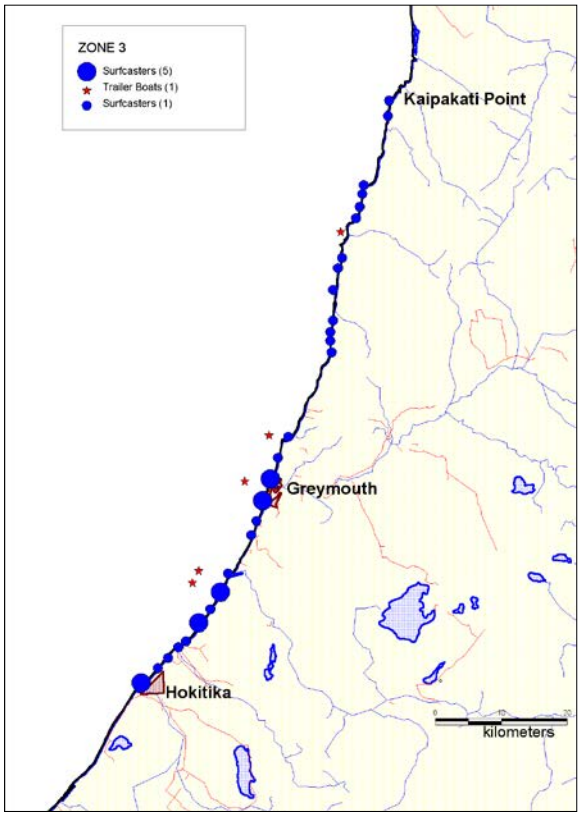
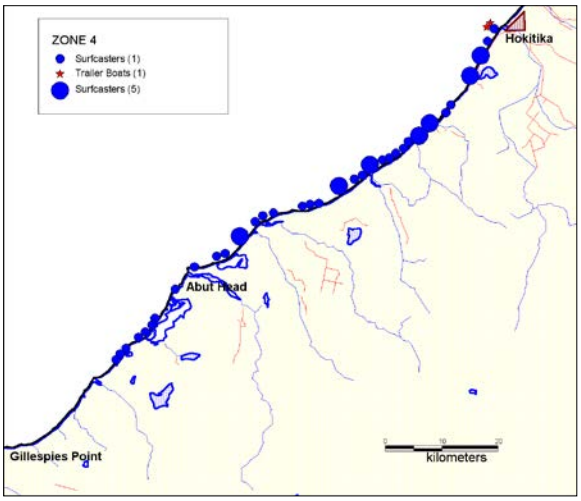


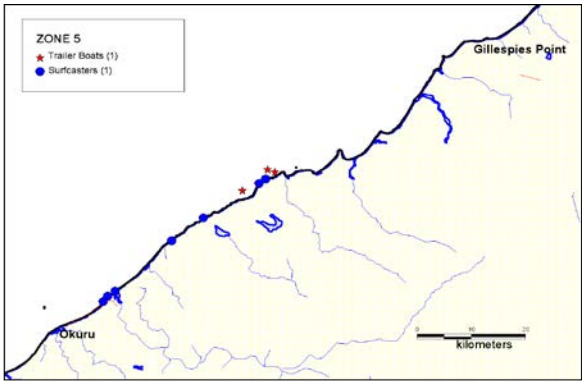
Figure 4.6. Aerial surveys, Zone 4: Hokitika to Gillespies Point.



Figures 4.3 to 4.8: Recreational fishing activities recorded by 2006 NIWA aerial surveys (NIWA in prep)

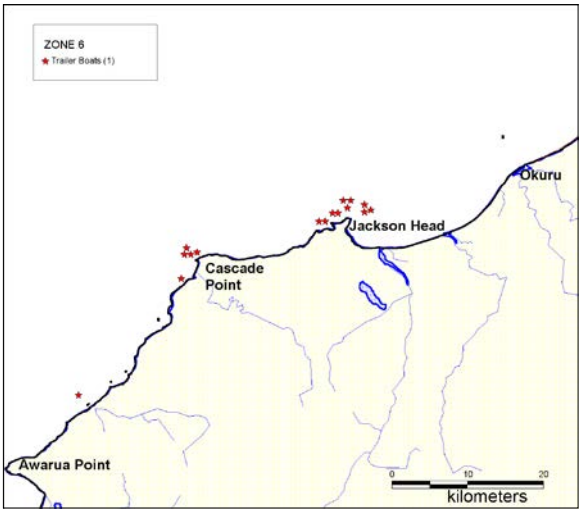
Types of fishing activity and the numbers observed are indicated in key.

Figure 4.7. Aerial surveys, Zone 5: Gillespies Point to Okuru.



Types of fishing activity and the numbers observed are indicated in key.

Figure 4.8. Aerial surveys, Zone 6: Okuru to Awarua Point.



FRESHWATER FISHING

Some fish caught within the coastal marine area are more commonly regarded as freshwater fish, and these include whitebait, eels and sports fish (e.g. brown trout, rainbow trout, quinnat salmon and perch). All of these fish spend some part of their lives in fresh water, but they can also be found in estuarine or marine waters.

Whitebaiting is a major recreational and commercial activity in springtime around the tidal reaches of West Coast river mouths and estuaries. Fishers target the young of five native Galaxias freshwater fish species returning in shoals from the sea, and the fish are caught using a variety of fine-meshed nets, screens and structures. The West Coast season runs from 1st September to 14th November, and the region supports probably the largest whitebait fishery in New Zealand[13]. A fully consultative public process is required under the Whitebait Fishing (West Coast) Regulations 1994 before any change can be made to the management of the fishery.

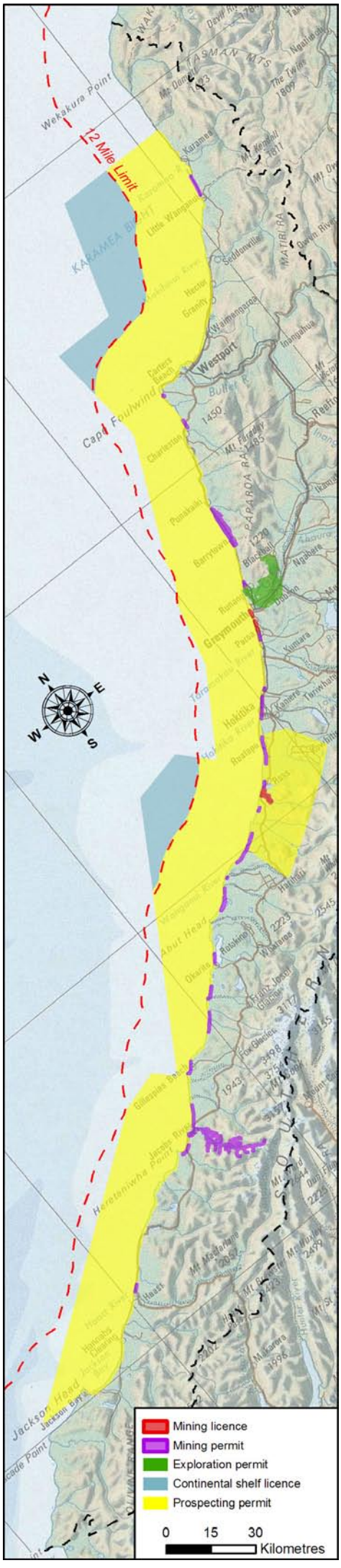
SPORTS FISHING

In the West Coast coastal marine area, sports fish include brown trout, rainbow trout, quinnat salmon and perch[14]. Much of the fishing for these species occurs upstream of the coastal marine area, but some rodfishing occurs at river mouths and in estuaries. Fishing sometimes targets these acclimatised species or they are caught incidentally by kahawai fishers, but they must be taken in accordance with the regulations (e.g. not on a baited line or in a setnet). From January until April sea-run salmon can be expected around most major river mouths south of the Taramakau[15].

EELING

Recreational eeling is done in estuaries and river mouth areas within the coastal marine area, as well as in freshwater catchment areas, using line fishing and other hand-gathering methods. There is little published information available about this type of recreational fishing on the West Coast.

13 McDowall 1984
14 McDowall 1994, Fish and Game New Zealand 2006
15 Fish and Game New Zealand 2006



Whitebaiting is a major activity in the tidal reaches of West Coast waterways: whitebaiters at Rapahoe. *Photo: S Nimmo.*

4.4 Other Coastal and Marine Resource Uses

4.4.1 Mineral, Aggregate and Driftwood Extraction

To be able to prospect or mine in the West Coast coastal marine area, a minerals permit and a resource consent are required from the Ministry of Commerce and West Coast Regional Council. Just under a quarter of the West Coast's coastline is currently subject to mining permits which cover the beaches and/or dunes. The extent of these permits is mapped in Figure 4.9.

To date, mining and other extractive activities have been for:

- gold (including blacksand goldmining);
- hydrocarbons;
- aggregate (mixed sand and gravel, for concrete and construction);
- decorative gravel and stones;
- sand;
- pounamu; and
- driftwood.

The general distribution and main areas of coastal (and some offshore marine) mineral deposits on the West Coast are mostly known as a result of past exploration and mining. These general areas give some (but not a full) indication of where future mining interests might lie, and so are broadly described here.

GOLD AND BLACKSAND DEPOSITS

Gold deposits on the West Coast continental shelf have been the target of several offshore sampling programmes (e.g. Price 1983, Utting 1989, Lew and Corner 1990). These sampling programmes found that while modern silts and clays cover most of the shelf (smothering any evidence of possible underlying gold), gold-bearing gravels were found over an area of 67 km^2 off Hokitika. Consents for a marine gold exploration proposal are presently held for most of the West Coast's coastal marine area by Seafield Resources Ltd.

Historically, the coastal parts of the West Coast were important gold mining sites. According to Braithwaite and Piranjo (1993):
"Blacksand placers of late Quaternary age have been extensively worked for gold at many locations along the 320 km of coastline from Karamea to south of Hokitika...

Figure 4.9: Prospecting and mining permits and licences extengin into or over the coastal marine area.
Source: unpublished DOC data.

The main coastal areas worked for gold were:

- Mokihinui Beach and Fairdown;
- Charleston;
- St Kilda;
- Brighton;
- Barrytown flats and terraces; and
- Darkies Terrace and North Beach [Cobden],

as well as other terraces inland.

South of Ross the interglacial shorelines were mainly located west of the present day position and most of the deposits are modern beach placers, the major ones being:

- Saltwater Beach;
- Okarito Lagoon;
- Five Mile Beach; and
- Gillespies Beach[16].

ILMENITE SANDS

There has also been periodic prospecting interest in titanium-bearing ilmenite sands in the northern and central parts of the West Coast, such as Karamea North, Birchfield, Fairdown, Carters Beach, Nine Mile Beach, Barrytown and Hokitika South [17].

AGGREGATE, GRAVEL AND STONES

A number of businesses extract sediment materials such as gravel, aggregate for concrete and decorative stones from beach foreshores and river mouths. These activities are controlled primarily through resource consents issued by the West Coast Regional Council.

Commercial operations such as this one at Blaketown take sediment materials from some intertidal beaches. *Photo: T Hume, NIWA.*

16 Braithwaite & Piranjo 1993 p.59
17 Braithwaite & Piranjo 1993 p.69

The Hokitika sewage ponds outfall is an example of treated waste disposal in the coastal marine area. *Photo: D Neale, DOC.*

HYDROCARBONS

Offshore exploration for hydrocarbons has been undertaken in the Karamea area[18].

POUNAMU AND AOTEA STONE

The pounamu resource is owned and managed by Te Runanga o Ngai Tahu[19]. Pounamu originates from several West Coast catchments such as the Arahura, Hokitika and Cascade Rivers. Some coastlines in the vicinity of these catchments are identified in the Pounamu Management Plan as areas open to public fossicking for pounamu. The related resource of aotea stone originates from the vicinity of the Makawhio and Mahitahi Rivers.

DRIFTWOOD

Driftwood is taken from most beaches for personal or commercial use (e.g. firewood or art materials). The materials are typically taken from the foreshore or from river mouth areas, but sometimes from the upper shore or from the vicinity of coastal wetlands.

4.4.2 Waste Disposal

Disposal of solid and liquid waste onto coastal land and waters occurs on parts of the West Coast. Point discharges are shown in the segment maps of chapter 5. Sewage disposal plants have permission from the West Coast Regional Council to discharge raw sewage and partially treated effluent at a number of coastal settlements. Currently, all sewage effluent discharges from the main townships of Greymouth, Westport and Hokitika are being upgraded. A number of existing or closed rubbish dumps encroach onto or leach into coastal waters (e.g. Westport).

Waste disposal from vessels is a prohibited activity within the territorial limit.

18 Kingett and Associates 1998
19 Te Runanga o Nga Tahu 1998

4.4.3 Coastal Erosion and Flooding Response

High rainfall, dynamic rivers, an abundant sediment supply, and high energy seas all contribute to erosion and flooding hazards on beaches and rivers throughout the West Coast. These hazards can affect coastal developments such as land, buildings and roads, as well as removing natural buffers such as sand dunes and coastal forest. Such impacts may be exacerbated by the effects of climate change, particularly if this leads to a rise in sea level and increased storm surges.

The management of hazards, and their mitigation through protection measures, planning and monitoring, is governed by local authorities enacting the Resource Management Act (1991). To mitigate the effects of coastal erosion and flooding on coastal settlements, some structures have been put in place within the coastal marine environment.

Areas recently experiencing erosion and flooding hazards on beaches include: Karamea, Granity, Westport, Woodpecker Bay, Punakaiki, Rapahoe, Greymouth, Hokitika, Okarito and Bruce Bay.

Responses to coastal erosion and flooding hazards have included:

- the planting of dunes with exotic plants like marram and gorse, or native plants like pingao and flax;
- the construction of rock walls and protective bunds;
- the occasional artificial opening or widening of river or creek mouths and estuary channels; and
- planning provisions like setback zones and coastal hazard areas to control the development of coastal land and reduce the risk of coastal hazards.

Rockworks have been placed in response to sea and river erosion at several places along the coast, including Bruce Bay (above) and Punakaiki (below).
Photo: D Neale, DOC.

Ports like Greymouth Harbour are important to shipping and navigation operations throughout the region.
Photo: S Nimmo.

On the open coast, coastal protection works are the main type of structure. Coastal protection works are usually built as rock revetments, but can also comprise concrete walls and gravel bunds, or less formal modes of protection such as truck tyres, sandbags and other dumped materials. Chapter 5 identifies areas where coastal structures have been put into place in response to erosion and flooding hazards.

4.4.4 Ports and Navigation

The river mouth ports of Westport and Greymouth are important commercial gateways for these towns, providing facilities which cater mostly for fishing vessels and the transport as cargo of local raw materials (eg, coal and cement). The ports also provide facilities for recreational pursuits such as surfing, boating, fishing and sightseeing. The river mouth ports of Westport and Greymouth are two of only a few river mouth ports remaining in New Zealand.

Jackson Bay/Okahu has harbour facilities which include a wharf, boat ramp and moorings. These are used by commercial fishers and increasingly by recreational trailer boats and tourist boats. The wharf and surrounding area is also used by sightseers and recreational fishers. A number of boat launching facilities also occur in other locations, such as the Little Wanganui, Okari, Moeraki and Okuru Rivers, but each is used for only small numbers of recreational vessels or commercial fishers.

The Westport Harbour and bar are frequently dredged, with spoil being dumped at a site to the northeast of the Buller River mouth. The Greymouth Harbour wharf areas are dredged on a less frequent basis, with the spoil being dumped in the vicinity of the Grey River mouth. The facilities of both of these ports are mostly situated upstream from the designated coastal marine area of their respective rivers.

Shipping and navigation occur throughout the coastal marine area. Shipping, navigation and harbour facilities come under the management of Buller Port Services within Westport Harbour limits (enclosed by a line extending between Ngakawau River and Cape Foulwind) and the Greymouth Harbour Supervisor within Greymouth Harbour limits (extending two nautical miles radius out from the river mouth).

The exposed nature of the West Coast presents challenges for shipping and navigation. The relative shelter afforded by some landform features (e.g. some headlands, embayments, small islands and rock stacks) are well known to many local fishers as anchorages or refuges in stormy sea conditions (identified anchorage sites are listed in Chapter 5). River bars and channels are navigable in the right conditions by experienced skippers of smaller commercial or recreational vessels. Greater varieties of vessels use the three main West Coast ports, or arrive from ports elsewhere such as Nelson and Bluff.

Whitebait stands are one of the more common structures in the West Coast marine and coastal environment, such as these in the Okuru River estuary. *Photo: P. Gerbeaux, DOC collection*

4.4.5 Marine and Coastal Structures

Because of the high-energy nature of the open coast, most structures in the coastal marine area are in estuaries and river mouths. They include

- boat-ramps and launching sites;
- whitebait stands (present between late August - mid November);
- jetties;
- pipes (including waste disposal structures);
- flood and erosion works (discussed above);
- ports, (as discussed above); and
- bridges.

The locations of these structures are indicated in the maps in Chapter 5.

Operating areas and area-based controls are specified and implemented under various conditions of consent, and these are discussed individually in more detail in Chapter 5. As well as the existing ports on the West Coast approvals have been given for operations at:

- the Solid Energy Ltd coal export facility near Granity;
- the Okuru Enterprises Ltd water export facility near Jackson Bay.

4.5 Recreation and Tourism Activities

Recreational fishing has been discussed in detail above in section 4.3.2 of this chapter. This section focuses on other recreational uses of the West Coast coastal marine area, as well as commercial tourism operations. Although the MPA policy does not provide for the protection of non-extractive recreational activities or values, identifying these uses of the marine environment will provide the forum with some more background information.

Recreational uses are very diverse and widely spread, but some of the most common activities are:

- boating (motorised and human-powered), canoeing and kayaking;
- surfing and swimming;
- coastal wetland recreation;
- gamebird shooting;
- beachwalking and fossicking;
- motor biking and four-wheel driving; and
- community events.

Access to the coastal and marine environment often influences where people will go and what activities they engage in. At some of these coastal sites, efforts have been made (especially by the Department of Conservation, as well as councils and community groups) to provide improved visitor access, facilities, information and interpretation, through better planning and day-to-day management.

BOATING, CANOEING AND KAYAKING

In the sea, recreational boats and tourist vessels operate at a variety of sites and for a variety of purposes, including fishing (see Section 4.3.2), access, sightseeing, and marine mammal watching. Vessels range from kayaks, dinghies and small runabouts used by private individuals to larger crewed vessels that are hired out for tourist charters. Tourist ships occasionally travel the West Coast and berth at the main harbours.

Boat ramps and other launching sites are very important to boating activity on the West Coast. The locations of these launching sites are closely related to the distribution of recreational boat traffic in the region, mostly because recreational vessels often have a limited travel range. Recreational and tourist vessels operate in both the enclosed waters of the estuarine domain (river mouths, lagoons and estuaries), and in the areas of open sea that are generally accessed by launching off the beach or crossing a river bar. While there is no published information about the levels of recreational boating in the region, some of the main boat launching sites are at Westport Harbour, Greymouth Harbour and Jackson Bay/Okahu.

Boat-based marine mammal watching operates through permits issued under the Marine Mammals Protection Regulations 1992 by the Department of Conservation. These tours typically focus on the viewing of Hector's dolphins and fur seals, but also view other marine wildlife as opportunities arise. These operations are usually combined with other activities such as fishing charters and sightseeing.

SURFING AND SWIMMING

Surfing, swimming and similar shoreline recreation is widely dispersed through the region, but tends to be most common near settlements and at sites where safe and superior sea conditions prevail. Some of the most popular swimming and surfing beaches are at Westport, Tauranga Bay, Punakaiki, Rapahoe, Greymouth, Hokitika, Bruce Bay and Neils Beach. National and regional surfing competitions are sometimes held at such places as Tauranga Bay.

Coastal recreation and tourism activities come in many forms. *Photos: S. Nimmo*

ESTUARINE RECREATION

Within coastal estuaries and river mouths, recreational activities can include fishing and shellfish gathering, scenic and recreational boating, canoeing and kayaking (see above), gamebird shooting and birdwatching. Seasonal game bird shooting is popular on numerous coastal wetlands, targeting such wildfowl as ducks and black swans.

OTHER SHORELINE AND LAND-BASED ACTIVITIES

Shore-based recreation and tourism activities include wildlife viewing, scenic viewing, shore exploration and walking, vehicle use and community events. Recreation and tourism sites that provide access to the coastal environment, and have been developed for users, include:

- the Heaphy Track between Kohaihai and the Heaphy River mouth;
- Cape Foulwind;
- the beaches at Westport, Greymouth and Hokitika;
- the Paparoa coastline;
- Waitangiroto heron colony and Okarito Lagoon;
- Knights Point to Ship Creek;
- Hapuka Estuary; and
- Jackson Bay/Okahu.

Viewing of marine wildlife is a popular activity at some shore locations, and includes both recreational viewing and guided tours. Species that are the object of such activities include New Zealand fur seal, Hector's dolphin, tawaki (Fiordland crested penguin), Westland petrel, blue penguin, waders and shore birds, kotuku and spoonbills. Wildlife viewing mostly occurs at specific localities where the animals congregate to breed, rest or feed.

Scenic viewing, shore exploration and walking occurs throughout the West Coast for a variety of reasons. These can include educational visits to rocky shores by school parties; tourists and local residents visiting the beach for relaxation or exercise, or just appreciating the coastline as part of the wider scenic vista; or fossicking for pounamu and other beach 'treasures'. Commercial tourism operations include guided visits to popular coastal points of interest, such as Cape Foulwind, Charleston, Punakaiki, Ship Creek and Jackson Bay/Okahu.

Motorbikes, four-wheel drives and other vehicles are widely used in the coastal marine area. They enable ready access to some of the more remote sites, but are sometimes restricted by natural barriers such as rivers and headlands. While serving some recreational or commercial purposes, vehicles can also disturb other people, or natural ecosystem features such as sand dunes, mudflats and wildlife.

Several community-based recreation events are held in the coastal marine area. They include fishing and surfing competitions (see earlier sections of this report), and beach-based events such as Hokitika's Driftwood & Sand Beach Sculpture event and the Sand Dunes Classic golf tournament. Many of these events occur annually, typically in the summer months.

4.6 Biological and Environmental Sciences

The coastal and marine environment is also used for scientific studies that may remove species from ecosystems or involve structures being placed into the coastal marine environment. These studies contribute to the body of information available on the West Coast coastal marine area.

There are a number of on-going projects on the West Coast in which universities or other scientific research agencies undertake research, survey and monitoring of the coastal and marine environment. These include:

- intertidal rocky reef monitoring, including the study of larval settlement and growth of shellfish (University of Canterbury and Oregon State University);

- sea level monitoring at permanent stations at Charleston and Jackson Bay/Okahu (NIWA);
- fur seal monitoring at Wekakura Point, Cape Foulwind and Taumaka (DOC);
- Hector's dolphin studies (DOC and several universities);
- trawl surveys conducted to monitor fish stocks and research trophic linkages (NIWA).

Other site-specific scientific studies are undertaken periodically for environmental impact assessments.

Divers on survey in South Westland. *Photo: H Kettles, DOC.*

4.7 Use of Adjacent Lands

The West Coast Marine Protection Forum is focusing on the protection of the coastal and marine environment. However, the uses of neighbouring land provides some useful information on whether or when land based activities may or may not be affecting the marine environment. Neighbouring land use will not necessarily denote or indicate where recommendations for marine protected areas may eventually be made.

The very dynamic topographical and climatic environment (outlined in Chapter 2) has constrained human settlement and land development throughout the West Coast. Environmental factors which have determined this distinctive geography of human settlement include:

- the narrowness of the coastal lowlands, backed by high mountains;
- the preponderance of glaciated landforms, indigenous forests and wetlands;
- the limited distribution of free-draining and fertile soils;
- the large number of rivers crossing the coastal lowlands to the Tasman Sea;
- frequent high-intensity rain storms, leading to flooded rivers; and
- the lack of sheltered harbours along the 600 km-long coastline.

Both Maori and European settlers established themselves close to the coast, on dunelands or on river terraces. Port settlements at the mouths of major rivers have grown into coastal towns such as Westport, Greymouth and Hokitika.

Today, land uses adjacent to the coastal and marine environment include:

- Coastal settlements;
- Farming (e.g. stock grazing);
- Land development; and
- Mining.

West Coast coastal settlements vary from large towns like Greymouth to individual and small group residences in remoter areas like Miko and Nikau. In general, areas near the larger settlements and/or access points tend to be used more often by more people, compared to remote areas. Consequently, some of the greatest levels and varieties of commercial, social and recreational use are near the settlements of Westport, Greymouth and Hokitika.

Baches near Fox River mouth (top) and vehicle access along estuary margins (bottom) are examples of land uses adjacent to the coastal marine area. *Photo: D Neale, DOC.*

Accessibility (particularly legal public access) is an important determinant in where many activities occur. So, the proximity of State Highways 6 and 67, and other public roads to the coastline is an important factor, as is distribution of public coastal land giving free public access (particularly walking or vehicular access along marginal strips beside rivers and streams near the coastline).

Much of the coastal strip on the West Coast has been modified by land development and human activities (especially through historic farming, forestry and 'black-sanding' goldmining). This is particularly the case where prograded dune surfaces and lowland river flats abut the coastline – such as around Karamea, the Mohikinui River to Charleston, parts of the Paparoa coast and the Barrytown Flats, Rapahoe to the Waitaha River, some of the remote beaches and dune landscapes between Wanganui Bluff and Heretaniwha Point, and the coastal strip and river mouths of the Haast plain. This flat, well-drained coastal land is some of the best in the region for farming and, in the northern and central parts of the West Coast it generally lies closer to the main roads and towns. The development of pasture and the associated spread of weeds have altered the coastal vegetation greatly, to the extent that there are now few examples of original foredune vegetation left.

Grazing and trampling by stock can have a number of undesirable influences, including the reduction of palatable coastal indigenous vegetation, pugging and reduction of soil physical stability, and the pollution of spawning sites for inanga. Stock grazing of the coastal strip is prevalent in the Haast, Waitaha-Taramakau, Cape Foulwind, and Karamea localities.

4.8 Current Coastal and Marine Protection and Management Area Measures

Several types of management controls are in place over defined parts of the West Coast coastal marine area as well as on the adjacent lands. These include:

- coastal management areas of the West Coast Regional Coastal Plan,
- areas listed in the Ngai Tahu Settlement Act 1998, and
- conservation lands administered by the Department of Conservation.

These areas are shown in the segment maps in Chapter 5.

4.8.1 Crown Conservation Lands that Extend into the Coastal Marine Area.

Conservation areas that mostly protect the land (e.g. national parks and reserves) sometimes include small parts of the coastal marine area, often as a result of coastal erosion and river mouth changes. However, this section of the report concentrates on identifying only those conservation areas that are 'properly' within the West Coast coastal marine area (in terms of their size, integrity, location and/or purpose), based on the best available information.

Parts of the coastal marine area that are wholly or mostly within Crown conservation lands are listed below, grouped according to the estuarine and marine environmental domains identified in Chapters 2 and 3. It is important to note that this list has not been assessed against the 'protection standard' proposed by the MPA Policy, and so does not necessarily represent a list of marine protected areas.

TIDAL FLAT ESTUARIES:

Saltwater Lagoon and some saltmarsh areas within Okarito Lagoon Wildlife Management Reserve.

TIDAL LAGOONS:

Totara Lagoon, Te Rahotaiepa Lagoon, Waitangiroto River, Five Mile Lagoon and Ohinemaka River.

RIVER MOUTHS:

Taramakau, Hokitika, Wanganui, Poerua, Waiho, Cook, Karangarua, Paringa, Whakapohai, Waita, Haast, Waiatoto, Arawhata, Cascade and Hope Rivers.

INTERTIDAL (OPEN COAST), SHALLOW SUBTIDAL (OPEN COAST), AND DEEP NEARSHORE:

No substantial areas within conservation lands.

Jackson Head and Jackson Bay/Okahu looking north east towards mouth of Arawhata River and Haast coastal plain. *Photo: D.L. Homer GNS*

CHAPTER 5

West Coast Marine and Coastal Localities: a Detailed Description of 14 Segments

5.0 Introduction

This chapter summarises information about the West Coast region at a more detailed scale than the information presented in Chapters 2–4. The West Coast region is divided into 14 'segments', numbered from north (Kahurangi) to south (Hope). The boundaries of each segment have been selected for convenience of mapping (allowing a little overlap between maps). The segments have been so chosen to ease the display of information about the coastal and marine environment: the locations and their boundaries do not represent any attempt to identify priorities for protection or MPA boundaries.

Each segment comprises a written description and illustrations about the natural and human environment under a series of standard headings. To provide spatial information on the localities, a base map and a series of smaller maps accompany each text/photo segment.

Note: The maps are not to be used for navigational purposes.

5.0.1 Map Information Sources

A. BASE MAPS

The 14 large base maps show some of the main information about each segment, such as place names, topography (both on land and in the sea) and seabed sediments. They cover the full length of the West Coast shoreline at a scale of 1:125,000, and extend offshore to show some or all of the 12 nautical mile territorial limit (see Figure 5.1). In some cases, where the full extent of the territorial sea is not included on the maps, sediment and bathymetric (depth) information can be found in the regional maps shown in Chapter 2.

The legend on each base map explains several of the main symbols. Mapped symbols that are not included in the legend (e.g. forest cover, coastal rocks) correspond to map legends from the main sources – NZMS Topographical (land) maps and RNZN Hydrographic (marine) charts[1].

Land information includes topographic data (contour shading), place names, rivers, land cover (forest, shrubland, grassland), roads and settlements from the Land Information New Zealand (LINZ) Topo database, and public conservation land from the Department of Conservation Geographic Information System (DOC GIS).

Informal place names of localities that have locally known names not approved by the NZ Geographic Board are shown in single quotation marks (e.g. 'Halfway Rock')

12 nautical mile limit is from the Department's conservancy boundary on the GIS database.

Upstream limits of Coastal Marine Area have been obtained from the West Coast Regional Council (WCRC). These 'cross river boundaries' are as defined in the West Coast Regional Coastal Plan[2], and are formalised in an agreement between The West Coast Regional Council, the Minister of Conservation and the relevant District Council.

Seabed information:

- Bathymetry is from RNZN hydrographic charts. This chart series was chosen because it contains the most detailed depth information available about the shallow subtidal zone (less than about 50 metres depth). More detailed information for the deeper areas (deeper than about 100 metres) is available from such charts as the NZ Oceanographic Institute Coastal Series Charts (scale 1:200 000)[3], and the NIWA charts reproduced in Chapter 2. Notably, the

1 RNZN 1987
2 West Coast Regional Council 2000
3 Carter 1981, Norris 1979, Eade 1972, Norris & van der Linden 1972

Figure 5.1: Index of segment maps

NIWA charts provide much greater detail of the continental slope and submarine canyons, and they should be referred to when considering these deeper areas.

- Sediment data has been obtained from four main sources:
  (a) Price 1983a, b (mapped at a scale of 1:50 000) in the area from Kongahu Point to Waitaha River,
  (b) Mitchell 1987 (north of Kongahu Pt, mapped at a scale of 1:200 000),
  (c) McDougall 1975 and 1982, (offshore beyond about 5–10 nautical miles, north of Moeraki Canyon, mapped at 1: 1 000 000),
  (d) RNZN 1984 (spot information south of Moeraki Canyon).

Sediment data is unavailable for the shallow subtidal zone south of the Waitaha River and for most of the coastal marine area south of about Knight's Point. A reef area noted by Price (1983a) in the vicinity of Gibson's Reef (Cape Foulwind) has not been included because local information[4] indicates that its position is incorrectly shown, and because West Coast subtidal reefs are more completely mapped in the accompanying "4-maps" (see below). The source references use slightly different terms for the various sediment categories, even though all are based on the 'Wentworth' size classification. So, to ensure consistent interpretation across the whole region for the purposes of these segment maps, the categories have been grouped into five sediment texture classes.

B. SEGMENT "4-MAPS"

In addition to the base maps, a page of four smaller maps is included for each segment. These provide a summary in map form of a large amount of other information available, especially within the immediate coastal strip.

Habitats and Ecosystems

- Islands: from the West Coast Islands Inventory by Neale (2006e). This inventory is a compiled folder of information about the vegetated rock stacks and islands off the West Coast *Tai Poutini* Conservancy. It includes unpublished survey reports of some specific islands/stacks, ranging from a paragraph to several pages, and sometimes including more detailed maps of each island.
- Tidal wetlands: the maps characterise each of the waterways listed in Schedule 1 of the West Coast Regional Coastal Plan, as one of three main types (river mouths, tidal flat estuaries, and tidal lagoons; as defined in Chapter 2 of this report), based on classifications in Johnson & Gerbeaux 2004, Neale 2006a, and DOC inventories of West Coast wetlands. The maps do not specifically identify the very numerous small waterways that are not included in the regional coastal plan schedule.
- Beach types: the maps show the extent of intertidal sediment beaches on the West Coast, and broadly characterise each part of the coastline as one of three main beach types (sand, sand and gravel, cobble ridge; as discussed in Chapter 2)[5]. This mapping is done at a broad scale in the order of tens of kilometres, but the detail will be improved with the NIWA "NZ Coast" beach classification project that is presently being completed[6].
- Intertidal and shallow rocky reef: the maps show the estimated extent of rocky marine substrates, derived from work by Neale (2006f) that includes an analysis of nautical charts and 1:15 000 air photos, and knowledge gained from coastal survey work completed since 1987. The maps are considered to provide a reasonable approximation of reef extent to depths of about 20 metres below sea level, mapped at a scale of 1:50, 000. It should be noted that some areas mapped as rocky reef will include patchy reef-sand areas, and that mapping accuracy is reduced where reefs may be obscured in air photos by deep or murky water.

4 I McKenzie pers comm 2006
5 Neale unpublished DOC data
6 T Hume pers comm 2006

Animals and Plants

- Fur seal colonies are derived from the West Coast fur seal colony inventory by Neale and Best (1999). This inventory is a compiled folder of information about the seal colonies in the West Coast Tai Poutini Conservancy. It includes unpublished survey reports of some specific sites, ranging from a paragraph to several pages, and sometimes including more detailed maps of each site.
- Birds: seabird, shorebird and wetland bird sites are derived from Department of Conservation and Wildlife Service records, local observations and surveys, and a range of other published and unpublished records held by the Department's West Coast Tai Poutini Conservancy. Information about tawaki (Fiordland crested penguin) is mostly from McLean et al 1997.
- Fish and shellfish: information on shellfish beds is derived mostly from field surveys by D. Neale (DOC Hokitika) and others since 1987. The locations of some shellfish beds are deduced indirectly from persistent shell deposits on beaches.
- Plants: Coastal cress distribution is documented in Norton and De Lange (1999). Coastal herbfields have been mapped by Neale (DOC, unpublished data). Saltmarsh distributions are derived from field surveys by D. Neale (DOC Hokitika) and others since 1987[7].

People and Use

- Coastal Permits (approved) have been obtained from the West Coast Regional Council (WCRC) Consents Manager[8], as well as rivers with whitebait stands as listed in Schedule 2 of the Whitebait Fishing (West Coast) Regulations 1994.
- Coastal Permits (unrecorded) are resource uses and activities occurring in the coastal marine area that are not listed in the WCRC database. The information for these has been obtained from local knowledge and observations during field surveys and site inspections. The legal status of such uses and activities is generally undetermined in this report, but will likely include some that are unauthorised, and others that are 'permitted activities' under the Regional Coastal Plan that are not required to have a coastal permit.
- Mineral tenements: information is from the Department's database of authorisations under the Crown Minerals Act, and the maps include only those extending into the coastal marine area.
- Public access: this is derived from information collated by Neale (2006d) from personal observations, DOC field staff, and others. Base data was mapped at a scale of 1: 50, 000, initially compiled for the conservancy's marine mammal stranding response plan. Boat access routes mark known regular launching sites and routes.

Existing Protection and Management Areas

1. Regional Coastal Plan Areas have been obtained from the West Coast Regional Council (WCRC) GIS computer database, and show those areas defined in Schedules 2 (Coastal Management Areas) and 3 (Cross Boundary Areas) of the West Coast Regional Coastal Plan[9].
2. Public conservation land maps the extent and status of lands administered by the Department of Conservation. The maps do not distinguish between land inside and outside the coastal marine area.
3. Other management areas: closed whitebaiting areas are those areas closed to whitebaiting under the Whitebait Fishing (West Coast) Regulations 1994. Topuni sites, nohoanga sites and Statutory Acknowledgement Areas are as defined by the Ngai Tahu Claims Settlement Act 1998.

7 e.g. Neale 1998a , Rogers et al 1996, Neale et al 1993

8 C Dall, pers comm 2006

9 West Coast Regional Council 2000

5.1 Kahurangi

(Kahurangi Point – Kohaihai Bluff, 40 km)

5.1.1 Summary

The Kahurangi segment has a mostly rocky coastline adjoining forested slopes of Kahurangi National Park. The seabed is mostly of a uniform shelf grading out to fine sediments, but with a variety of inshore beaches and rocky reefs and the Kahurangi Shoals in the north. The area generally supports marine life that is typical of such habitats in the Buller district, but with some more northern influences. Access to and use of this remote and relatively unmodified area is mostly by commercial fishing vessels, helicopters and trampers on the coastal section of the Heaphy Track.

Notable features include: its relatively unmodified coastal forest and dune communities, coastal wildlife, wilderness landscapes, protected catchments, diverse marine habitats, cultural and archaeological heritage and variety of recreational and commercial uses.

Existing protection includes all the land bordering this segment of coastline lying within Kahurangi National Park. Topuni sites are identified at Kahurangi and Otukoro Iti. Specified areas are listed under the Regional Coastal Plan.

5.1.2 Natural Features

COASTAL LAND AND ISLANDS

The Kahurangi segment includes some of the least modified sections of coastal land in the Buller-NW Nelson region, due largely to poor accessibility, rugged topography, and consequent low level of human habitation. The land comprises largely intact nationally significant[10] natural ecosystem sequences from the crests of the Tasman Mountains to the Tasman Sea, virtually all protected within Kahurangi National Park.

Wekakura Point to Whakapoai Point. *Photo: T Hume, NIWA*

10 Morse 1981

From top: Rocks Point and Big Bay

Kahurangi Point to Kahurangi River
Photo: T Hume, NIWA

This coastal land has been recognised as a 'key biodiversity area in Kahurangi National Park'[11], and the natural quality of the sand dune and beach vegetation of the Kahurangi – Oparara coastline has been rated higher than any other coastline between Farewell Spit and Saltwater Lagoon (South Westland)[12]. The coastline tends to be rockier north of Wekakura Point, although a broad sandy beach immediately south from Kahurangi Point includes high dunes and large blowouts. The threatened coastal dune plants sand tussock and pingao occur in this area north of the Heaphy River. Coastal cress[13] and shore spurge occur south of the Heaphy River, which is also the southernmost reach of the native dune plant *Spinifex* on the West Coast. The coastline is largely free of weeds with gorse and marram grass being controlled in some coastal sites to counter their northward spread.

Eight small vegetated rock stacks occur close to shore (one at Seal Bay, one north of Toropuihi Creek, three at Wekakura Point and three south of Whakapoai Point) but they have not been biologically surveyed[14].

Sites of geological interest include a fossil site at Kohaihai Bluff and a fluorite mineral site of national importance at Whakapoai Point[15].

COASTAL WETLANDS AND WATERWAYS

The Heaphy River is the main river entering this coastal segment, but numerous smaller streams also flow out to sea. The Heaphy River mouth wetland is the only coastal wetland in the locality and is of local ecological importance[16]. The coastal streams between Karamea and Takaka (Golden Bay) have collectively been recognised as a 'key biodiversity area in Kahurangi National Park'[17], due to their diverse native fish assemblages.

11 Dyson 2001
12 Johnson 1992
13 Garnock-Jones & Norton 1995, F Overmars, pers comm 1992
14 Neale 2006e
15 Hayward & Kenny 1999
16 Partridge 2004, Dept of Conservation, unpublished wetland inventory
17 Dyson 2001

Kahurangi Point to Rocks Point in the distance.
Photo: T Hume, NIWA

SEASHORE AND MARINE AREAS

This coastal segment contains some of the most extensive inshore rocky reefs in the northern region of the West Coast of the South Island, with the main concentration north of Wekakura Point. The reefs are interspersed by sandy beaches and boulder shores, especially south of Wekakura Point in depths less than 20 metres. Offshore, the seabed slopes gradually out towards the Challenger Plateau at a gradient of less than two degrees within the territorial limit, reaching a depth of about 125 metres at the territorial limit. Seabed sediments mostly grade from coarse sand and pebble beaches to medium-fine sands and muddy sediments out to the territorial limit. An area of deeper rocky reef is reported to occur offshore of Rocks Point[18].

Big Bay to Steep Point in the distance
Photo: DOC

18 I McKenzie, pers comm. 2006

Nikau palms and boulder coastline, Heaphy Track
Photo: L.F Molloy

The rocky reef is interrupted by a coarser sandy gravel area at the Kahurangi Shoals. This shallower seabed experiences a significant upwelling of nutrient-rich water from the Tasman/ Westland Currents[19], resulting in high concentrations of zooplankton extending into western Cook Strait[20].

Coastal currents vary in direction and strength depending on sea and weather conditions. Hydrographic charts[21] give an indication of an average 0.2 knot northward current off Rocks Point and a 0.3 knot southward current off Heaphy River.

COASTAL AND MARINE WILDLIFE

New Zealand fur seals breed in colonies concentrated on three areas, with over 1200 females having been counted in previous years at these places: an unnamed embayment two kilometres south of Kahurangi River, Otukoro Iti and Wekakura Point – Toropuihi Creek[22]. Fur seal pup production has been monitored annually at the Wekakura Point colony since 1992 and during this period between 500 and 1100 pups have been born each year, with an overall trend of decline [23].

Hector's dolphins occur off this coastline in moderate to low densities[24] and humpback whales, right whales, orca, common dolphins and dusky dolphins have been reported in inshore waters.

White fronted terns breed on some offshore stacks[25].

MARINE FISH AND OTHER SPECIES

This coastal segment like the whole western coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, potting and set netting.

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate.

Coastal reef fish[26] and seaweeds[27] surveyed at Wekakura Point are typical of this area but exhibit increased species diversity than other areas due to more abundant reef habitats and the additional influence of northern coastal reef fish (such as magpie morwong and orange clinid) and seaweeds (such as agar weed).

19 Shirtcliffe & Moore 1990
20 Bradford-Grieve et al 1993, Foster & Battaerd 1985, James & Wilkinson 1988
21 RNZN 1985
22 S Courtney, pers comm 1988
23 H. Best, pers comm 2006
24 Dawson 2001
25 S Courtney, pers comm 1988
26 Neale 2006b
27 Neale & Nelson 1998

Heaphy River mouth
Photo: L.F. Molloy

An experimental blackfoot paua harvest programme was undertaken in the mid 1990s[28] between Kahurangi Point and Wekakura Point, to provide stock assessment information for the Paua 6 fishery. At that time it was found the paua stock level was not large, although paua beds were found in many areas within the survey area.

5.1.3 Cultural and Archaeological Heritage

The area is known from archaeological sites and traditions to have been occupied by early Maori, including an archaeological site at the Heaphy River mouth[29]. The first European visitors were sealing gangs in the early 1800s, followed by explorers in the 1840s, and gold seekers in the 1860s[30]. Kahurangi Point (the northwestern landmark of the Ngai Tahu tribal takiwa) and Otukoro Iti (an early settlement where a significant battle occurred with Ngati Rarua in the 1820s) are recognised as topuni; sites of special importance to Ngai Tahu[31].

Otukoroiti Point and Kahurangi Point in the far distance from near Rocks Point

Sand dune blowouts south of Kahurangi Point
Photos: DOC

28 McShane et al 1993, 1994, 1995
29 e.g. McFadgen & Goff 2003
30 e.g. Hooker 1990
31 Ngai Tahu Claims Settlement Act 1998

Kahurangi River mouth
Photo: DOC collection

5.1.4 Recreation and Tourism

The coastline between the Heaphy and Kohaihai Rivers is mostly used by trampers on the coastal section of the Heaphy Track (one of New Zealand's designated 'Great Walks'). The area north of Heaphy River is largely unvisited and difficult to access, though occasional parties also walk the difficult coastal route from Kahurangi to Heaphy, or access the area by boat or helicopter. It has been noted as the only piece of 'wilderness'[32] coastline in central and northern New Zealand. Groome (1990) considered the recreational values of the Heaphy Track to be of international importance and Grindell (1984) listed the Heaphy as a river of national scenic importance. The natural landscape, the wild character, and the track and hut facilities all contribute to this.

The coastline is difficult for recreational fishers to access, but some probably visit by helicopter or by boat out of Nelson, Westhaven and Westport; they use a variety of fishing methods including SCUBA and line fishing. Recreational divers, rodfishers and whitebaiters also access the area from land along the Heaphy Track, fishing especially in the vicinity of Scott's Beach, Crayfish Point and the Heaphy River mouth.

5.1.5 Commercial Use

This segment, like the rest of the inshore western coast of the South Island, is fished by commercial fishers using a variety of methods and by vessels that operate out of Nelson, Motueka, Westhaven and Westport. Commercial fish species are listed in section 4.3.1. As well as fishing on the inner continental shelf, some rock lobster fishing occurs on the rocky reefs in this region. An experimental harvest of paua was undertaken in the early 1990s[33].

Offshore hydrocarbon exploration has also been undertaken in this area[34].

32 'Wilderness' as used by the Recreational Opportunities Spectrum (ROS) classification, described in Dyson 2001
33 McShane et al 1995
34 Kingett & Associates 1987

5.1.6 Other Public Uses and Facilities

Kahurangi Point is at the northern-most boundary of the West Coast Marine Protection Forum area. It also marks the jurisdiction boundary for a number of other agencies, such as the West Coast Regional Council, Department of Conservation West Coast Tai Poutini Conservancy, Buller District Council and West Coast Fish and Game; it is the takiwa boundary of Te Runanga o Ngai Tahu.

This area is relatively remote and has few coastal landing and access points but is on occasion accessed by helicopter. Big Bay is the most suitable inshore anchorage on this exposed segment[35], but small vessels can also enter the Heaphy River mouth in good conditions. Vehicles (including bicycles) and dogs are prohibited from the coastal area, with a few specific exceptions.[36]

Kohaihai Bluff from Scott's Beach
Photo: DOC

Other than facilities associated with the Heaphy Track (e.g., Heaphy Huts, Katipo Creek Shelter), there is no public accommodation or settlement in the area.

There are no Resource Management Act coastal permits issued for this segment[37].

5.1.7 Existing Protection and Management Areas

Most of the coastal land above MHWS is protected within Kahurangi National Park in accordance with the park management plan[38]. A small area of private land occurs on the coastal flat south of the Heaphy River. The Tasman Wilderness Area within Kahurangi National Park covers much of the hill country in this segment south of the Heaphy River (but excluding the coastal strip). Substantial areas of forest are under possum control by the Department of Conservation and coastal weed control is also a priority.

The beach north of Kotaipapa Point
Photo: DOC

35 RNZN 1987
36 Dyson 2001
37 www.wcrc.govt.nz "Maps on the Web", June 2006
38 Dyson 2001

North end of Scotts Beach
Photo: DOC

Kahurangi Point and Otukoro Iti are topuni sites under the Ngai Tahu Claims Settlement Act 1998. There is an historic reserve designation over land owned by Ngai Tahu at Otukoro Iti.

Whitebaiting is not permitted in non-tidal areas, nor upstream of 'back pegs' on the Heaphy River[39].

The Heaphy River is a water body closed to commercial eel fishing (based on its protected land status)[40].

The Kahurangi segment lies within Fisheries Statistical Area FSA 35, which is part of the Ministry of Fisheries Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Buller District.

The operative West Coast Regional Coastal Plan recognises:

- Culturally Significant Areas: CSA1 Kahurangi Point, CSA2 Otukoroiti Point, CSA3 Heaphy River.
- Coastal Recreation Area: CRA1 Heaphy Track.
- Outstanding Natural Features and Landscapes: ONFL1 Kahurangi – Kohaihai.
- Marine Mammal and Bird Sites: MMB1 Toropuihi – Wekakura Point.

39 Whitebait Fishing (West Coast) Regulations 1994
40 Tai Poutini Tuna 1999

5.2 Karamea

(Kohaihai River – Gentle Annie Point, 47 km)

5.2.1 Summary

The Karamea segment includes the Karamea coastal sand plain and tidal estuaries in the north and coastal hill country in the south. The Oparara, Karamea and Little Wanganui Rivers flow out to sea in this segment. The seabed is mostly of a uniform shelf grading out to fine sediments but with inshore rocky reefs in the south and a variety of beach types. Marine life is typical of northern West Coast habitats but with the addition of some more northern influences. Access to and use of this area is greatest in the Karamea plains area. Dairy farming and residential development are predominant uses of the coastal sand plain.

Notable features of this segment include: its accessibility from Karamea and SH 67, extensive coastal wetlands, relatively unmodified and remote coastal forest in the north and south, coastal wildlife, natural landscapes and protected catchments, diverse marine habitats, cultural and historic heritage and a variety of recreational uses.

Existing protection include: small areas of conservation lands associated with coastal wetlands and other parts of the Karamea sand plain. Virtually all the forested hill country lies within Kahurangi National Park. There are several areas closed to whitebaiting, and specified areas under the Regional Coastal Plan.

5.2.2 Natural Features

COASTAL LAND AND ISLANDS

The Karamea segment coastal landscape can be divided into two main parts, with a boundary at the Little Wanganui River mouth. To the north, the coastline consists entirely of sandy beaches, backed mostly by estuaries, broad river plains, coastal wetlands and low-lying sand dunes. To the south the coastline is predominantly rocky, with some coarse sand and cobble beaches backed by very steep gullied hillslopes with small streams running down to the coast.

Little Wanganui beach
Photo: T Hume, NIWA

Most of the Karamea coastal sand plain and river flats have been modified by farming and other land development. Coastal sand plain forest remnants are small, but natural vegetation cover has been retained on much of the coastal hillslopes. Between Kohaihai and Oparara the coastal hills are much closer to the coastline, rising above a narrow coastal plain of fixed dunes and a sandy beach with a steeper profile. The Oparara Estuary and the Karamea/Otumahana Estuary are prominent wetland features in this coastal segment. The Karamea settlement and Kongahu Swamp both lie a little further inland on the broad coastal and alluvial plain. Dairy farming is the main land use on the coastal plain.

Between the Little Wanganui River mouth and Kongahu Point, the coastal hillslopes are composed of erodible mudstone and sandstone with large landslips reaching down to the shore. South of Kongahu Point the narrow coastal strip consists of more stable Paparoa granite.

Johnson (1992) ranked the Kahurangi – Oparara coast as the most botanically-significant coastal dune vegetation system between Farewell Spit and Saltwater Lagoon Pouerua. However, although the dune form is still largely intact, marram grass and other weed species are present. Dune blowouts are common along the beach between Oparara and Little Wanganui (partly intensified by stock grazing and farm development) and are mostly edged with introduced

North towards Kohaihai Point
Photo: T Hume, NIWA

plant species such as marram grass and pasture grasses. The threatened red katipo spider has been recorded in significant numbers at Karamea Beach[41]. The threatened coastal cress *Lepidium flexicaule* occurs in significant abundance at the seal colony site on Kongahu Point[42].

The coastline from Little Wanganui River to Gentle Annie Point is listed in the Regional Coastal Plan[43] as an outstanding natural feature and landscape. It is described as a "highly natural section of coast adjoining a large area of land administered by the Department of Conservation. [It has] high amenity, landscape and scenic values enhanced by natural coastal landforms." Indigenous forests in the Karamea Bluffs area are under a sustained possum control programme.

Sites of geological interest include a fossil site of regional importance at Little Wanganui Head (notable for its large fossil brachiopods) and geological structures at Gentle Annie Point[44]. Coastal erosion including slumping caused by the Murchison earthquake, is a feature of this southern part of the Karamea coastal segment (see Henderson 1937).

COASTAL WETLANDS AND WATERWAYS

The largest waterways are the Kohaihai, Oparara, Karamea and Little Wanganui Rivers and Falls Creek. The Karamea River has an estimated annual suspended sediment discharge of 0.15 million tonnes[45].

The Karamea plain is an important area for coastal wetlands. The main ones are described below:

Karamea Aerodrome Lagoon is a freshwater wetland of moderate wildlife value[46], and is used at high tide by birds feeding on the Karamea River estuary.

Karamea-Otumahana Estuary (400 ha) and Oparara Estuary (110 ha) are considered wetlands of national importance[47] because of their high wildlife value (especially a high diversity of birds, particularly waterfowl and some migratory waders). These estuaries are fed by the Oparara and Karamea Rivers respectively, and are surrounded mostly by grazed pasture. The Karamea-Otumahana Estuary is one of the largest and more diverse estuarine habitats in the West Coast region. It comprises sand and mud flats with extensive areas of saltmarsh dominated by sea rush, saltmarsh ribbonwood and jointed rush. Large shellfish beds of cockles, pipi and other bivalve species occupy extensive areas of the estuary's mudflats and tidal channels.

A very high diversity of about 40 bird species occur here, including shorebirds, waterfowl and wetland birds[48]. The estuaries provide spawning and rearing habitat for indigenous fish species, including giant kokopu and inanga[49]. The southern lagoon draining Kongahu Swamp is a particularly important whitebait spawning area[50]. Marginal saltmarsh vegetation provides good cover for wildlife and the barrier beaches and dunes provide high tide roosts for birds. White-fronted terns nest on the north spit of the Karamea River estuary and black-backed gulls and red-billed gulls nest on the north spit of the Oparara Estuary. The Otumahana Estuary

41 Patrick 2002
42 Neale & Geritzlehner 2006
43 WCRC 2000
44 Hayward & Kenny 1999
45 Hicks & Shankar 2003
46 Davis 1987, Morse 1981, DOC unpublished wetland inventory
47 Partridge 2004, Cromarty & Scott 1995, Neale et al 1992, Davis 1987, Morse 1981
48 Cromarty & Scott 1995
49 Davis 1987
50 Kelly 1988

is the southern known limit on New Zealand's west coast for the bubble shell[51] (a snail) and the glasswort (a saltmarsh plant)[52]. The Oparara Estuary has not been studied in as much detail, but it also has extensive sand flats and its proximity to the larger Karamea-Otumahana Estuary is important to its natural values, by adding to the total area expanse of these habitats available to plants and animals on the Karamea plain.

Inanga spawning sites have been recorded in Granite and Blackwater Creeks at the south end of the Otumahana Estuary, in Baker Creek at the north end of the Karamea Estuary, and in the Oparara River and an unnamed tributary of the Oparara Estuary[53]. Small patches of the exotic cord grass (*Spartina* sp.)have been controlled in Karamea estuary since the 1980s.

Kongahu Swamp and Little Wanganui River mouth are considered wetlands of moderate-to-high wildlife interest because they support some threatened wildlife species, and provide habitat for indigenous fish, including spawning sites for inanga[54]. Kongahu Swamp lies just outside the coastal marine area. It is a large freshwater peat swamp of flax, *Carex*, and kahikatea on the coastal plain; it drains northwards into the Otumahana Estuary and provides habitat for brown mudfish, giant kokopu and inanga. Prior to drainage works and on-going land development for dairy farming since the 1980s, Kongahu Swamp was the most extensive wetland of its kind in the northwest of the South Island. It was then regarded as a nationally important wetland habitat[55] but this is now unlikely given the environmental changes. The adjacent whitebaiting closed area provides some protection for the whitebait population.

From top:
The coastline north from Six Mile Creek
One of the earthquake slips on the coastline between Little Wanganui Head and Kongahu Point.
Photos: T Hume, NIWA

The Little Wanganui River rises in Kahurangi National Park and crosses the southern end of the Karamea coastal sand plain, flowing quietly over a shingle bed[56]. The proximity of the tidal sandflat roosts at the river mouth to the intertidal reef at Little Wanganui Head makes it a habitat for coastal birds like variable oystercatchers.

51 B. Marshall pers comm 1992
52 D. Norton pers comm 1992
53 Taylor et al 1992
54 Partridge 2004, Davis 1987, Morse 1981
55 DOC unpublished wetland inventory, Davis 1987; Morse 1981,
56 Kelly 1988

From left: Little Wanganui River; Karamea- Otumahana Estuary
Photos: T Hume, NIWA

SEASHORE AND MARINE AREAS

The Karamea coastal segment contains the most extensive continuous sand beaches on the West Coast, stretching from Kohaihai to Little Wanganui.

Intertidal rock platforms and shallow reefs occur at several sites south of Little Wanganui River, with the largest at Gentle Annie Point and others at Little Wanganui Head, Falls Creek and Kongahu Point. Coastal bluffs of erodible sedimentary rock occur between Little Wanganui Head and Kongahu Point. Rocky shores are relatively common in this section. These platforms and reefs are typical of northern West Coast rocky coastal habitats, being significantly influenced by sedimentation and dominated by mussels, other filter-feeding invertebrates and robust seaweeds. In most cases the coastal reefs appear to bottom out to sand very close to shore at depths of around 10 metres or less. There is no documented evidence of deep reefs within territorial waters in this segment, but there is reportedly a large area of foul ground further out, about 40 km offshore[57].

Karamea River mouth, Otumahana Estuary and adjacent coastal areas.
Photo: T Hume, NIWA

Offshore, the seabed slopes gradually out across the Karamea Bight towards the Challenger Plateau at a gradient of less than one degree, reaching a depth of about 100 metres at the territorial limit. Seabed sediments grade from sandy and cobble beaches to muddy sediments offshore.

Coastal currents vary with sea and weather conditions, but the hydrographic chart indicates an average 0.3 knot southward current off the Oparara River mouth and a 1.0 knot northward current off Gentle Annie Point.

COASTAL AND MARINE WILDLIFE

Wetland and wading birds occur in the estuaries and wetlands, especially the Karamea-Otumahana Estuary, but few detailed records of their occurrence are available.

A seal rookery at Kongahu Point appears to have increased in size over recent years, with about 30 pups reported in 2006.

Hector's dolphins occur in the inshore waters in moderate to low densities,[58] and several whale and dolphin species as well as vagrant New Zealand fur seals have been recorded in inshore waters or beachcast.

57 Stevenson 2004
58 Dawson 2001

MARINE FISH AND OTHER SPECIES

This coastal segment like the whole western coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, potting and set netting.

Inshore trawl fisheries are multi-species and are primarly based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[59].

Intertidal shore platforms and reefs in this area (e.g. Little Wanganui Head, Falls Creek, Kongahu Point, Grenadier Rocks, Gentle Annie Point) have extensive mussel beds and a variety of other marine species. The Gentle Annie Point mussel bed appears to support a moderate diversity of fish species that is typical of the Buller area. This locality is the southern known limit on New Zealand's west coast for an agar weed, *Pterocladia lucida*[60]. Shells of the endemic toheroa are sometimes found on the beach near Kongahu (specimens collected in 1992 are held in the Te Papa collection), suggesting this species should be in the locality but live specimens are yet to be found.

The coastline south from Kohaihai Bluff
Photo: T Hume, NIWA

5.2.3 Historical and Archaeological Heritage

There is extensive evidence of early Maori occupation at numerous coastal archaeological sites on the Karamea sand plain, but beach ecresion following the Murchison earthquake has destroyed some of these sites[61].

5.2.4 Recreation and Tourism

Recreational fishing occurs throughout the Karamea segment and includes surfcasting and rod fishing (at any accessible location), set netting (especially at accessible points south of Otumahana Estuary), cockle gathering (especially in Otumahana Estuary), and whitebaiting (most coastal rivers and streams, including from whitebait stands in the Karamea and Little Wanganui Rivers). Waterfowl shooting and recreational boating occurs in the Oparara and Karamea-Otumahana Estuaries.

Uses of the area south of Little Wanganui relate mostly to recreational walking and fishing activities and to the baches at Falls Creek and Kongahu Point. Much of this coastline is quite difficult for recreational users to access, but some visit for SCUBA-diving and line fishing, travelling by boat out of the main rivers in the area (e.g. Little Wanganui) or Westport. Recreational fishers also access the area by walking along the coastline from Little Wanganui and Mokihinui. Mussel gathering is possible in the vicinity of the beds at Gentle Annie Point, Little Wanganui Head and Falls Creek. Diving and potting (e.g. for rock lobsters) is most likely in the deeper and more complex reefs around Kongahu Point.

59 Stevenson & Hanchet 2000
60 W. Nelson pers comm 1998
61 Hooker 1990

Scenery and landscape appreciation are relevant at a number of locations – such as the estuaries, the road corridor, and sites in the vicinity of Karamea and other small settlements. The Kohaihai roadend picnic area at the southern entrance to the Heaphy Track is of regional recreational significance and receives high public use[62]. Other access points along the coast are used for beachwalking and other coastal recreational activities. Other recreation and tourism facilities include a small fishing/launching wharf near the Little Wanganui River mouth, a camping ground adjoining the Otumahana Estuary and a golf course on the beach frontage to the north of Karamea.

5.2.5 Commercial Use

Much of the coastal sand plain and estuary margins as well as some of the lower hill country south from Little Wanganui Head have been developed for dairying and sheep farming.

This segment, as for the rest of the inshore western coast of the South Island, is fished by commercial fishers using a variety of methods and by vessels that operate out of Nelson, Motueka, Westhaven and Westport. As well as fishing on the inner continental shelf, some rock lobster fishing occurs on the rocky reefs in this region.

A blacksand gold mining licence covers the beach between Karamea and Little Wanganui. The coastal marine area out to the territorial limit is part of a marine gold exploration proposal presently being sought by Seafield Resources Ltd.

A dairy factory at Karamea that is presently closed for operation has an effluent discharge pipe on the Karamea beach.

5.2.6 Other Public Uses and Facilities

Public access (including vehicle access) to and along the coastal marine area occurs at several sites along the Karamea plain, including Kohaihai River mouth, Oparara Estuary, Flagstaff (out from Karamea), Otumahana Estuary and Little Wanganui River mouth. Most of these access points run out from State Highway 67 as far as Karamea township, and then from a gravelled road that continues northward along the coast to the start of the Heaphy Track at Kohaihai.

Shore platform at Gentle Annie Point, north to Kongahu Point in the distance. *Photo: D Neale, DOC.*

62 Groome 1990

Access south of Little Wanganui River is limited to a gravel road (de Malmanches Rd) at the southern end of this segment and walking tracks and coastal routes in the north and south. Access across waterways and along the coast is possible along the full length, but restricted by the tide at several points, especially between Falls Creek and Kongahu Point and at major river mouths.

The main settlement is at Karamea, but smaller settlements and private dwellings occur at Little Wanganui and Falls Creek. Single houses and baches occur at numerous locations along the Karamea plain, as well as a bach at Kongahu Point. Sewage ponds for the Little Wanganui settlement are located just upstream of the coastal marine area at Glasseye Creek. In response to upstream flooding concerns, some channel excavation has occurred in Granite Creek and the southern reaches of Otumahana Estuary.

North of Kongahu Point
Photo: D Neale, DOC.

An airstrip is located near the coast just north of Karamea.

Canterbury University periodically use the mussel bed at Gentle Annie Point for research into larval settlement of mussels and other marine species.

There are Resource Management Act coastal permits issued in this segment[63] for:

- river outlet opening (Kohaihai River);
- river protection works and whitebait stands (Karamea and Little Wanganui Rivers);
- channel clearance and road realignment (Otumahana Estuary);
- vehicle access (Kongahu Beach);
- treated sewage discharge (Glasseye Creek).

5.2.7 Existing Protection and Management Areas

On the Karamea sand plain most of the immediate coastal strip of land above MHWS is private land and/or legal road, but small portions of land within and adjacent to Karamea and Oparara estuaries (including a large area of saltmarsh within the coastal marine area of Otumahana Estuary), Kongahu Swamp and Little Wanganui River mouth are conservation lands administered by the Department of Conservation.

Some of the coastal hillslopes in the northern portion of this segment are part of Kahurangi National Park, fronted by formed legal road and/or private land.

South of Little Wanganui, much of the coast is in conservation lands administered by the Department of Conservation, but significant areas of private land exist north from Falls Creek, north of Kongahu Point, and around Gentle Annie Point. The Hiwinui Scenic Reserve (12.9 ha) extends along the coast for about two kilometres south from Falls Creek[64], and the Karamea Bluff Ecological Area extends from north of Kongahu Point to about Gentle Annie Point.

The area lies within Fisheries Statistical Area FSA 35, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Buller District.

63 www.wcrc.govt.nz "Maps on the Web", June 2006
64 Kelly 1974

Looking south from Kongahu Point, to Gentle Annie Point in the distance.
Photo: D Neale, DOC.

Several waterways in this segment are closed to whitebaiting:[65]

- Baker Creek (a tributary of the Karamea River estuary)
- The area of about 2.5 acres known as Kongahu Swamp located north of Granite Creek to the east of the main road approximately 6.5 km south of Karamea.
- Blackwater Creek (to within 200 m of the tide gate at Kongahu Swamp).

Whitebaiting is not permitted in non-tidal areas nor upstream of 'back pegs' on the Kohaihai, Oparara, Karamea and Little Wanganui Rivers and Granite Creek.

The operative West Coast Regional Coastal Plan recognises:

- Coastal Protection Areas; CPA1 Oparara Estuary, CPA2 Karamea-Otumahana Estuary, CPA3 Little Wanganui Head and River.
- Culturally Significant Areas; CSA4 Kohaihai.
- Outstanding Natural Features and Landscapes; ONFL2 Little Wanganui to Gentle Annie Point.
- Marine Mammal and Bird Site; MMB2 Kongahu Point.
- Coastal Hazard Areas; CHA1 Oparara River to Little Wanganui River.

65 Whitebait Fishing (West Coast) Regulations 1994

5.3 Buller Bay

(Mokihinui River mouth – 'Penguin Beach', 56 km)

5.3.1 Summary

From the northern end of the Buller Bay segment south to about Waimangaroa, the coastal hills and the escarpments of the Denniston and Stockton Plateaux reach close to the coastline, save for a narrow coastal plain. Further south the coastal plain broadens significantly to form the northern margins of the Foulwind Plain. Coastal land in this segment is mostly modified by settlements, farming and other land development, especially on the coastal flats and the Cape Foulwind headland; natural vegetation cover is retained on many coastal hillsides.

The Mokihinui and Buller Rivers, as well as a number of smaller rivers and streams, flow out to sea and some are associated with coastal wetlands. The seabed is mostly of a uniform shelf grading out to fine sediments, but with inshore rocky reefs in some places and a variety of beach types. The area supports marine life that is typical of such habitats in the northern West Coast. Access to and use of this coastal/marine segment is widespread; it is one of the more densely populated parts of the West Coast. Dairy farming and residential development are predominant land uses, especially on the coastal sand plain.

Notable features of this segment include: its higher resident population, its accessibility from Westport, SH 67 and other roads, Westport Harbour, remnant coastal sandplain wetlands and forests, coastal wildlife, natural landscapes and protected catchments, diverse marine habitats, cultural and historic heritage, and recreational uses.

Existing protection includes: areas of conservation land associated with coastal wetlands and other parts of the Foulwind sand plain and more extensive protected areas in the coastal and inland hill country. There are also several areas closed to whitebaiting and specified areas under the Regional Coastal Plan.

The Cape Foulwind area and Tauranga Bay with Okari Lagoon and the Charleston coast further to the south
Photo: T Hume, NIWA

5.3.2 Natural Features

COASTAL LAND AND ISLANDS

Most of the hillslopes in the north of this segment are forested. In contrast coastal sand plain forest remnants are small. Johnson (1992) rated the coastal and beach vegetation from Granity to Jones Creek as significant, particularly noting the persistence of matai/totara forest on ancient beach ridges. The cobble beaches in this area are suitable habitat for native skinks, with several sightings reported [66].

Coastal erosion is a problem in some places; for instance, erosion at Carters Beach is currently of major concern as it may threaten the Westport airfield. In contrast, from about Orowaiti to Carters Beach, the construction of harbour training works at the Buller River mouth since 1870 has resulted in the beach building out seawards by up to a kilometre or more. This new land has been developed into residential areas of Westport township, harbour facilities and recreational areas; these construction works have also formed new tidal wetlands and caused an eastward migration of the Orowaiti River mouth.

66 Dept of Conservation unpublished reptile sighting database

Top: Westport and the Buller River mouth area.
Bottom: Orowaiti Lagoon mouth and North Beach.
Photo: T Hume, NIWA

Cape Foulwind, the granite and limestone headland at the northwest corner of the Foulwind Plain, is a distinctive coastal feature of the Buller Bay segment. The headland's landscape has been altered by land development over the years but regeneration of native vegetation is being enhanced in some areas by active planting and exclusion of grazing stock.

Wall Island is one of the largest island habitats in the northern West Coast and along with the immediately adjoining headland of Tauranga Bay, it supports the threatened seal cress[67] and breeding sites for NZ fur seals and burrowing seabirds (fairy prions and muttonbirds). The Three Steeples and associated rock stacks are prominent coastal landmarks lying off Cape Foulwind. The three main islets are topped by a sparse cover of taupata; their cliffs above high tide level are bare rock.

Sites of geological interest include: the sedimentary geology, igneous geology and marine terrace and tombolo landforms around Cape Foulwind and Tauranga Bay and the igneous geology of Torea Rocks[68].

COASTAL WETLANDS AND WATERWAYS

The largest waterways are the Buller and Mokihinui Rivers, with estimated annual suspended sediment discharges of 2.7 and 0.29 million tonnes respectively[69]. Smaller rivers discharging to sea include the Ngakawau, Waimangaroa, Whareatea and Orowaiti.

Orowaiti Lagoon is the largest tidal wetland in the Buller Bay segment. It contains a variety of estuarine habitats including saltmarsh, mudflats, sand flats and channels. However, the lagoon is seriously polluted by sewage and farm waste that pose a human health risk to the lagoon's shellfish beds. Buller River mouth tidal wetlands are outside the coastal marine area but include Bradshaw's Creek and areas locally known as 'Lost Lagoon' and 'the Floating Basin'. These wetlands in combination provide an extensive area of natural habitat for aquatic plants (e.g. saltmarsh herbs and rushes), birds (e.g. bitterns, crakes, waterfowl) and fish (e.g. giant kokopu, inanga).

Birchfield swamp and other coastal wetlands lie mostly outside the coastal marine area, but are typically associated with river mouths and add to the diversity of aquatic habitats in the area.

SEASHORE AND MARINE AREAS

The Buller Bay segment contains a wide variety of seashore types.

Beaches north of about Waimangaroa have a steep intertidal cobble beach ridge dropping down to a flat sandy base extending beyond the low tide level. These are the most extensive mobile cobble beach system on the West Coast. While they support very little intertidal marine life, they mostly remain in an unmodified state. Between Waimangaroa and Fairdown the cobble beaches begin to grade into the pure sand beaches that are a feature of the shoreline from Westport to Cape Foulwind.

67 Neale 2006e
68 Hayward & Kenny 1999
69 Hicks & Shankar 2003

Granity township is positioned along a cobble ridge beach.
Photo: T Hume, NIWA

North Beach, Carters Beach and Okari Beach are the most extensive pure sand beach system along the West Coast. They appear to support one of the richest sand beach faunas in the region, including surf clams (e.g. *Dosinia, Spisula, Mactra* and *Tellina*), paddle crabs and coastal fish species.[70]

The physical dynamics of the Buller River mouth has been extensively studied because of its commercial relevance to harbour operations[71]. The coastal geomorphology of other parts of Buller Bay has been studied mainly in relation to coastal hazards and resource consent proposals[72].

The Ngakawau River, with Hector to the north (left) and Ngakawau to the south.
Photo: T Hume, NIWA

Rocky reefs are a prominent feature of the Cape Foulwind and Three Steeples area, and patchy reefs also occur in intertidal and shallow waters in the vicinity of Nikau and Granity. The Three Steeples area includes some deep reefs (20+ m) which are an uncommon feature in the northern West Coast[73] and contribute to the diversity of coastal geomorphology in this segment. A fully submerged formation locally known as Gibson's Reef occurs about two kilometres east of the Steeples[74]. The Buller River mouth training works also form a type of artificial rocky reef extending to depths of a few metres in a relatively brackish environment.

The rocky shores and reefs around Cape Foulwind are good examples of northern West Coast rocky coastal habitats, being significantly influenced by wave exposure and sedimentation (typically turbid waters and sand scour). This creates a distinctive environment for species that are adapted to such dynamic conditions – filter-feeding invertebrates (e.g. mussels and bryozoans), robust seaweeds (e.g. bull kelp, coralline algae) and grazing molluscs (e.g. limpets, paua). The coastal reef fish[75], seaweeds[76] and estuarine communities[77] are typical of the northern West Coast. Both mainland species of bull kelp are abundant in the Cape Foulwind area.

70 e.g. see Neale 2007

71 Kirk, Hastie & Lumsden 1985, 1986, 1987; Hastie, Kirk & Lumsden 1986; Simpson & Fyson 1971, Furkert 1947

72 Ramsay 2006, Apperly 1997; Wright & Foster 1996; Hicks 1996; Reid et al 1996; Kingett Mitchell & Associates 1996; Stanton 1971, 1996; Kingett & Associates 1994; Neale 1989; McMillan 1983; Gower 1982; Valentine & Macky 1984; Mangin 1973; van der Linden & Norris 1973; Nevins 1938

73 Shears in prep

74 Norris 1978

75 Neale 2006b, Shears in prep

76 Harvey et al 2005, Neale & Nelson 1998

77 Rogers et al 1996

The reefs further offshore around the Steeples are less affected by sand scour, and they cover a greater depth range and provide more habitat diversity. This is reflected in greater species diversity than for the shallower mainland reefs at Cape Foulwind and elsewhere in the northern West Coast. This diversity is most apparent for coastal reef fish[78] and seaweeds (including a notably high diversity of crustose coralline algae)[79]. To a lesser extent this pattern of greater species diversity is also true for the shore at Wall Island.

Mokihinui (Waimarie) settlement is positioned on the banks of the Mokihinui River. *Photo: D Neale, DOC.*

Intertidal rock platforms are relatively scarce in the Buller area, with the shoreline being more commonly dominated by large boulders among sloping or broken bedrock. Some of the most extensive intertidal reefs occur at Wall Island and at 'Penguin Beach' to the south of Tauranga Bay, where biologically rich mussel beds can be found. Intertidal habitats with dense cover of marine life occur particularly at Nikau, Wall Island and Penguin Beach.

Offshore, the seabed slopes gradually out across the Buller Bay towards the Challenger Plateau at a gradient of less than two degrees within the territorial limit, reaching a depth of about 100-150 m at the territorial limit. Seabed sediments grade from coarse sand beaches to muddy sediments offshore. Coastal currents vary with sea and weather conditions, and the hydrographic chart indicates an east-west bidirectional tidal current off the Buller River mouth.

COASTAL AND MARINE WILDLIFE

New Zealand fur seals breed in rookery areas concentrated on Black Reef, the Tauranga Bay headland, and Wall Island. Fur seal pup production has been monitored at the Tauranga Bay colony since 1991, during which time between 150 and 450 pups have been born each year, with research indicating an overall trend of decline[80]. An additional estimated 100-300 pups are born each year on Black Reef and Wall Island[81].

Wall Island and the seal colony walkway, with Cape Foulwind to the north. *Photo: D Neale, DOC.*

78 Roberts et al 2005
79 Harvey et al 2005
80 H. Best, pers comm 2006
81 Neale & Best 1999

Hector's dolphins occur throughout this segment in some of the highest densities recorded for this species[82]. They have been studied in this locality by Secchi (in press) and Clement (2006). Other marine mammals reported include blue whale, right whale, beaked whales, pilot whale, common dolphin and dusky dolphin and orca (which are thought to feed around seal colonies at the Steeples).

Burrowing seabirds (probably sooty shearwaters and/or fairy prions) nest on Wall Island[83], and sooty shearwaters nest near the Tauranga Bay seal colony. Spotted shags roost on the inside of the western Buller River breakwater and also on the Three Steeples.

Native skinks have been reported among shoreline rocks in the area known as 'The Gap'[84].

Orowaiti Lagoon and the coastal wetlands flowing into the Buller River mouth support a variety of waders, waterfowl and shorebirds including threatened species such as marsh crake and bittern.

From top:
Cape Foulwind, with Kawau Point in the middle distance and Buller River mouth beyond.
Carters Beach settlement and sandy beach in the foreground.
Photos: D Neale, DOC.

MARINE FISH AND OTHER SPECIES

The Buller Bay marine segment, like the rest of the western coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[85].

Rock lobsters occur especially around the Three Steeples and Cape Foulwind areas.

Surveys of coastal reef fish[86], seaweeds[87] and shallow reef communities[88] have found an abundance of species adapted to the prevailing turbid and exposed conditions of the area. A moderate diversity of 27 coastal reef fish species have been recorded in this segment which is boosted to some degree by the reefs at the Steeples[89]. The Steeples and Gibson's Reef are locally known for their relative abundance of rock lobster[90], while paua are reported to be more common on the mainland reefs around Cape Foulwind[91].

82 Dawson 2001
83 Neale 2006e
84 J. Green pers comm 1999
85 Stevenson & Hanchet 2000
86 Roberts et al 2005
87 Harvey et al 2005, Neale & Nelson 1997
88 Shears in prep
89 Roberts et al 2005
90 B. Wals, pers comm 2005
91 R. Bromley pers comm 2006

View from Cape Foulwind walkway
Photo: DOC

Shellfish beds occur in parts of the Orowaiti Lagoon[92], with cockles and pipi being especially common in the lower reaches. The lagoon is the southern known limit of an estuarine clam, *Mactra tristis*, and this shellfish forms moderately large beds in the middle reaches.

5.3.3 Cultural and Archaeological Heritage

The area is known to have been occupied by Maori with numerous archaeological sites[93] including a very early settlement site at Bradshaw's Creek. European historic sites include harbour remains, tramways, shipwrecks, rock quarries and the Cape Foulwind lighthouse area. Mineral resources (e.g. gold, coal, limestone), timber, fishing, farming, tourism and conservation all feature highly in the social history of Westport and the surrounding coastal areas[94].

5.3.4 Recreation and Tourism

The Steeples and Gibson's Reef areas are the most important recreational diving and fishing sites in the Westport area[95] and probably in the whole of the northern West Coast. They are fished mostly for rock lobster and finfish such as blue cod, gurnard, sharks and snapper. Boat fishing also occurs in other parts of this segment.

Recreational set netting occurs on many of the beaches especially from Mokihinui to North Beach. In the Granity area, nets are often attached to stakes driven into the seabed. Most nets are set straight off the beach at low tides or in river mouths, with some set from boats launching out of the rivers.

Mussel gathering occurs especially at Nikau and in places around the Cape Foulwind area (e.g. Omau, Wall Island, Penguin Beach).

Paua are gathered at sites around the Cape Foulwind area. Cockles and pipi are abundant in Orowaiti Lagoon (especially in the lower reaches), but the extent of gathering is not documented. Whitebaiting occurs in most of the rivers in this segment. Whitebait stands occur on the Mokihinui and Orowaiti Rivers and the Buller River is particularly popular for scooping. Other recreational fishing activities (such as surfcasting and rod fishing) also occur in this segment but tend to be more dispersed.

The attractive coastal landscape, seal colony, surf beach and other features of Tauranga Bay and the Cape Foulwind Walkway provide opportunities for a wide range of recreational activities.

Other recreational activities occur throughout this segment, especially in localities close to settlements and access points. These include beach walking, motorcycling and driving, birdwatching, surfing, swimming, boating and jetskiing. Public boatramps are located on the lower Buller River at the Fishing Basin, and at Marrs Beach near the western Buller River breakwater. Boats can also be launched at places on the Mokihinui, Ngakawau and other rivers.

Coastal reserves and formed recreation areas include: the Mokihinui (Waimarie) Domain, Hector Rest Area, Les Warren Park, Carters Beach Domain, Cape Foulwind Walkway and Tauranga Bay carpark. Tourist businesses on the coast include: the Mokihinui Domain Camping Ground, Big Fish Hotel at Granity, the Seal Colony Top 10 Holiday Park at Carters Beach, and the Bayhouse Café at Tauranga Bay.

92 Rogers et al 1996
93 e.g. Hooker 1990
94 MacDonald 1973
95 B. Walsh pers comm 2005

Siltstone cliffs at Kawau Point, with Cape Foulwind beyond.
Photo: D Neale, DOC.

5.3.5 Commercial Use

The Westport Harbour in the Buller River is the West Coast's largest shipping port. It is managed on behalf of the Buller District Council by Buller Port Services Ltd, a wholly-owned subsidiary of Holcim (NZ) Ltd[96]. Cement is the main product shipped out of the port but gravel aggregates, coal and other cargo are also handled. Ballast water is discharged by coastal shipping prior to entering the harbour, berthing and loading cargo[97]. Commercial fishing wharves, fish processors and related facilities, transport companies, railway operations and other industries use the harbour infrastructure. A major portion of the port's infrastructure lies upstream of the coastal marine area.

The Buller Bay marine segment is fished by commercial fishers using a variety of fishing methods, including lobster potting, set netting and albacore trolling, with the most common method being bottom trawl[98]. The inshore trawl fishery in the Karamea Bight is based principally on flatfish (mostly sole, turbot and sand flounder), gurnard and red cod at a range of depths. The area is productive and can be fished in southwesterly conditions. A common trawl for local vessels is to fish from the Westport bar, parallel to the coast as far as the Mokihinui River[99].

96 www.westportharbour.co.nz
97 S. Brown pers comm 2006
98 Booth et al 2005
99 Boyd Fisheries Consultants Ltd 1996

Vessels mostly operate out of Westport, but also Greymouth and Nelson. In 2000, about 13 inshore fishing vessels were domiciled in Westport – eight trawlers, two rock lobster boats, one set netter and two season-only albacore tuna trawlers[100]. Vessels from further afield sometimes visit or base themselves in Westport especially in the albacore tuna and hoki fishing seasons. During the summer season the fleet can increase by 60 or more vessels depending on the movements of migratory albacore. Some commercial potting for rock lobster occurs on reefs around the Steeples.

There have been numerous proposals over the years for the development of harbour facilities in the area, the largest of these not to have been implemented being deepwater facilities extending from Cape Foulwind to the Steeples[101], another to the south of Granity[102], and the reclamation of Lost Lagoon[103]. The last two of these proposals have current resource consents.

Dredging is undertaken by Buller Port Services (mostly using the 55 m bucket dredge Kawatiri) in the Buller River, Fishing Basin and the river bar. Dredge spoil is dumped at a site about 1.5 nautical miles from North Beach. Commercial extraction of gravel aggregates occurs in the Buller River above the bridge, and assists reducing gravel build-up in the harbour area. Smaller amounts are extracted by local contractors from other rivers in the area.

Mining occurs locally in two areas of this coastal segment – a small blacksanding (beach gold) operation is authorised on the Tauranga Bay beach and limestone is mined by Holcim (NZ) Ltd at quarries near Cape Foulwind for processing at the nearby cement factory.

Dairy farming is a feature of the coastal flats in rural areas throughout this segment. The Westport Aerodrome is located on the coastal strip at the eastern end of Carters Beach, providing facilities for both commercial flights and private operators.

'Lost Lagoon', a tidal flat estuary on the east bank of the Buller River.
Photo: D Neale, DOC.

100 Stevens 2000
101 Coode 1880
102 Kingett & Associates 1994
103 Buller Port Services 1994

Torea Rocks, with Lovers Rock in the foreground and Chair Rock beyond.
Photo: D Neale, DOC.

5.3.6 Other Public Uses and Facilities

Access to this area is made for a variety of uses at numerous points along the coast. Public access can be gained to any part of the coastline from a series of roads and tracks leading to the beach, and the only significant impediments to travel along the coast are from the larger streams and rivers. State Highway 67 bridges many of the waterways a short distance upstream from the coastal marine area.

Residential areas occur along most of this segment, including Waimarie, Hector, Ngakawau, Granity, Westport, Carters Beach, Omau, and Tauranga Bay; other settlements such as Waimangaroa and Birchfield occur a short distance back from the coast.

Untreated sewage and stormwater are discharged directly to the lower Buller River. A new treatment plant is under construction.

Shore protection works have been constructed at several places including Waimarie and Granity School and in river mouth areas including Mokihinui River, Ngakawau River and Orowaiti Lagoon. The Orowaiti River and Lagoon serve as a flood overflow channel for the Buller River.

The Westport refuse station is located at a site adjoining the Orowaiti Lagoon.

Pied stilts on mudsnail flats at Orowaiti Lagoon.
Photo: D Neale, DOC.

There are Resource Management Act coastal permits issued in this segment[104] for:

- stone, pebble and sand removal (several locations)
- whitebait stands (Mokihinui River and Orowaiti Lagoon)
- stream outlet opening (Jones Creek)
- a coal export jetty facility (near Granity)
- river and coastal protection works (Granity School, Waimangaroa River and Orowaiti Lagoon)
- dredging and spoil dumping (off Buller River mouth).

5.3.7 Existing Protection and Management Areas

Coastal areas of conservation land are generally small in this segment but notable sites occur in the vicinity of Orowaiti Lagoon and North Beach (including a 20 hectare area of saltmarsh within the Orowaiti Estuary Scenic Reserve), Bradshaws Creek (Buller River Wildlife Refuge), Carters Beach Recreation Reserve, Cape Foulwind and Tauranga Bay and on the hillslopes of the Denniston and Stockton Plateaux.

104 www.wcrc.govt.nz "Maps on the Web", June 2006

Bradshaws (Martins) Creek (a tributary of the Buller River) is closed to whitebaiting. Whitebaiting is also not permitted in non-tidal areas nor upstream of 'back pegs' on the Mokihinui, Orowaiti and Buller Rivers.

The area lies almost entirely within Fisheries Statistical Area FSA 35 (north from Cape Foulwind) and FSA 34 south of there, which are part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Buller District.

The Westport Harbour limits (mostly for the purposes of controlling navigation and shipping infrastructure matters under the maritime Transport and Harbours Acts) extend from Ngakawau to Cape Foulwind (see map).

The operative West Coast Regional Coastal Plan recognises:

- Coastal Protection Area; CPA4 Orowaiti Lagoon.
- Coastal Development Areas; CDA1 Buller River mouth, CDA4 Ngakawau.
- Culturally Significant Areas; CSA5 Whareatea, CSA6 Omau Bay, CSA7 Tauranga Bay.
- Coastal Recreation Areas; CRA2 North Beach, CRA3 Lower Buller River, CRA4 Carters Beach, CRA5 Tauranga Bay.
- Outstanding Natural Features and Landscapes; ONFL3 Cape Foulwind
- Marine Mammal and Bird Site; MMB3 Three Steeples and Black Reef, MMB 4 Wall Island and adjacent coast, MMB5 north end of Nine Mile Beach.
- Coastal Hazard Areas; CHA2 Gentle Annie to Miko, CHA3 Dean Stream to Orowaiti River, CHA4 Tauranga Bay.

One of the Three Steeples rock stacks off Cape Foulwind. *Photo: D Neale, DOC.*

5.4 Charleston

('Penguin Beach' – Morrisey Creek, 24 km)

5.4.1 Summary

The Charleston segment includes the southern portion of the Foulwind sand plain and tidal wetlands in the north, and coastal hill country in the south. The Totara and Waitakere or Nile Rivers are the main rivers flowing out to sea in this segment. The seabed is mostly of a uniform shelf grading out to fine sediments but with inshore rocky reefs in the south and a variety of beach types. The area supports marine life that is typical of the northern West Coast. Access to and use of this segment is greatest in the Nine Mile/Okari, Totara/Nile and Charleston areas. Dairy farming and residential development are predominant uses of the coastal land, while the immediate coastal strip in the south of the segment is largely undeveloped.

Notable features include: coastal accessibility to some settlements by road, extensive coastal wetlands, relatively unmodified and remote coastal forest in the south, coastal wildlife, protected catchments, diverse marine habitats, cultural and historic heritage and a variety of recreational uses.

Existing protection includes: areas of conservation land around Okari Lagoon and other coastal wetlands; more extensive protected areas in the coastal hill country south of the Nile River, including Charleston Recreation Reserve and Paparoa National Park. There are also specified areas under the Regional Coastal Plan.

5.4.2 Natural Features

COASTAL LAND AND ISLANDS

Nine Mile Beach north of Okari Lagoon has one of the more extensive and well developed dune landforms in the northern West Coast. These dunelands have mostly been developed into farmland with few areas of native vegetation left. Sand dune communities within conservation land also occur along the beachfront of Okari Lagoon but they are dominated by gorse and marram.

Farmed dunes along the sandy Nine Mile Beach.
Photo: D Neale, DOC.

Along the rocky coast in the south of this segment, several small embayments occur – at Little Beach and along the Charleston coast (Joyce, Constant and Doctor Bays). South of these bays the coastal escarpment rises to 100-200 metres and is mostly covered in indigenous scrub and forest, with uplands of pakihi shrubland and forest.

Sites of geological interest include the granite minerals at Constant Bay[105] and the exposed crystalline rocks near the Nile River mouth and Charleston. These formations are among the oldest rocks in New Zealand, dating back to the Precambrian period.[106] The curious 'twin bay' formation of Joyce and Constant Bays is a result of the stratified geology of the area.

Small populations of the threatened coastal cress (*Lepidium flexicaule*) occur on the rocky coasts at Joyce Bay and near Deep Creek. The threatened Charleston gentian occurs on several coastal rocky headlands near that town.

105 Hayward & Kenny 1999
106 Thornton 1985

Joyce and Constant Bays, with Charleston settlement on the right.
Photo: D Neale, DOC.

COASTAL WETLANDS AND WATERWAYS

The Okari Lagoon (400 ha) is the largest wetland in the Charleston segment. Though historically very dynamic, its present form is a tidal sand and mudflat estuary bounded by a narrow band of saltmarsh vegetation and large areas of developed farmland and sand dunes. It receives water and sediment from the Tasman Sea and the Okari River at its northern end and to a lesser extent, from surface runoff and minor tributaries[107]. Although the estuary's margins and its 6950 ha catchment are mostly in private ownership and have been modified (by drainage, nutrient runoff, shore protection works and introduced species), the wetland itself retains a very natural, indigenous character.

The Charleston coast, from near the Nile River mouth to south of Deep Creek. Charleston can be seen on the left.
Photo: D Neale, DOC.

The Totara River mouth flowed north through the Okari Lagoon until about 1970, but now discharges directly out to sea through a mouth shared with the Little Totara River. The Nile River mouth flows slowly through a bedrock channel to Little Beach. It is lined by the gravelled Beach Road and residential buildings but retains large areas of native vegetation on its margins.

SEASHORE AND MARINE AREAS

A shore platform at the Okari Lagoon mouth is one of the few bedrock landforms in sheltered coastal waters of the West Coast region. It appears to be a relict landform that is now barely affected by the levels of wave action that created it, having probably been formed prior to the seaward advance of the beach in this locality.

Nine Mile Beach is one of the longest sand beach systems on the West Coast. It supports shallow subtidal surf clam beds and other species that are typical of such habitats.

Inshore reefs characterise the inshore area south from Parsons Hill and while intertidal surveys indicate broad similarities to other northern West Coast reefs[108], no subtidal reef surveys have yet been undertaken. Access to the reef areas is generally difficult; there are few offshore reefs to provide shelter and depth away from the coastline, and the sea is frequently turbid and rough. The Charleston Bays area has a variety of coastal rocky reef habitats that appear to increase this locality's habitat diversity.

107 Neale 1998a
108 D. Neale, unpublished DOC data

Offshore, the seabed slopes gradually out across the inner shelf towards the Challenger Plateau at a gradient of less than two degrees within the territorial limit, reaching a depth of about 150 metres at the territorial sea limit. Seabed sediments grade from cobble and coarse sand beaches to muddy sediments offshore.

The exposed 'Cod Rocks' area just north of Joyce Bay, Charleston.
Photos: D Neale, DOC.

COASTAL AND MARINE WILDLIFE

A variety of coastal and wetland birds utilise the estuarine flats and other habitats of the Okari Lagoon including terns, oystercatchers, gulls and waders[109].

Relatively high numbers of blue penguins have been reported in the Nile River mouth area, and the 51 burrows counted here makes it possibly the greatest known concentration of blue penguins between the Mokihinui and Taramakau Rivers[110].

A New Zealand fur seal rookery on the coast south of Deep Creek produces up to 380 pups per year[111].

Sooty shearwaters are reported to nest near Hampton's Rock[112], and spotted shags roost on the heads north of Joyce Bay[113].

MARINE FISH AND OTHER SPECIES

The Charleston marine segment, like the rest of the western coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

109 Neale 1998a
110 Blyth et al 2006
111 Bradshaw 1999, Neale & Best 1999, Neale 1999a
112 J. Green pers comm 2005
113 Neale 1996b

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[114].

As well as a significant trawl fishery along this coastal segment other commercial fishing methods are used such as trolling for albacore and set netting for rig and school shark.

Surveys of coastal fish, seaweeds and intertidal reef communities at several sites (e.g. Parsons Hill, Little Beach and Charleston) indicate that the reef communities in this segment are generally typical of the northern West Coast[115].

5.4.3 Cultural and Archaeological Heritage

Archaeological sites of national significance (including occupation and food-gathering sites) occur between the Buller and Okari Rivers[116] and the Okari Lagoon has a significant place in Maori history[117.] South of Okari the foredunes have been modified by historic goldmining, and Charleston (including the old harbour area at Constant Bay) retains historic features dating back to the 1860s gold rushes.

5.4.4 Recreation and Tourism

Recreational fishing occurs at points throughout this segment, especially where there is access close to State Highway 6 and other roadways. A variety of recreational fishing activities are undertaken, including surfcasting from rocks and beaches, boat fishing, hand gathering and netting. Whitebaiting occurs mainly in Okari Lagoon, Totara River and Nile River. Extensive beds of cockles, pipi and other shellfish in Okari Lagoon are probably used for food gathering. Mussel gathering occurs in the vicinity of road access points near Charleston.

Recreational boats access the sea and lagoons from launching sites that include Okari River roadend, Joyce Bay and Nile River, as well as from sites outside the segment itself (such as Fox River mouth, Woodpecker Bay and Westport Harbour).

From top:
Constant Bay at low tide.
Looking north from Needle Point.
Bouldery coast looking north towards the Tiropahi River mouth (obscured) and Needle Point.
Photos: D Neale, DOC.

114 Stevenson & Hanchet 2000
115 Roberts et al 2005, Neale & Nelson 1998
116 Hooker 1990
117 Ngai Tahu Claims Settlement Act 1998



From left:
Nile River mouth and Little Beach.
The northern portion of Okari Lagoon and sandy beach.
Sandy coast and farmland at Rahui.
Photos: D Neale, DOC.

The coastal landscape around Constant Bay and other accessible areas provide opportunities for a wide range of recreational activities. A walking track from Constant Bay leads to coastal cliffs at Doctor Bay that are one of the most popular and accessible rock climbing areas on the West Coast. Other walking routes to the coastline provide access for fishing, beach walking, birdwatching and exploring.

5.4.5 Commercial Use

Farming is a predominant use of the pastured dunes and coastal sandplains along Nine Mile Beach.

This marine segment, as for the rest of the inshore west coast of the South Island, is fished by commercial fishers using a variety of fishing methods including set net, longline and trolling with the most common method being bottom trawl[118]. Vessels in this area mostly operate out of Westport and Greymouth, but also from Nelson or other ports.

A beach gold mining permit exists between Parsons Hill and Totara River.

5.4.6 Other Public Uses and Facilities

Public access can be gained along the Nine Mile Beach Road from Tauranga Bay, from Beach Road north of the Nile River, and from Constant Bay and Joyce Bay, as well as several less obvious walking routes to the coast. Private land and/or difficult terrain restrict public access to some areas, especially south of Doctor Bay. Access is also possible at low tide to the southern part of this segment along the coast from Whitehorse Creek; while travel can be difficult in places, it is possible to walk north along the coastline from there to Charleston.

Bouldery coast south of Tiropahi River. Woodpecker Bay in the distance.
Photo: D Neale, DOC.

Residential housing is mostly concentrated in the Charleston – Beach Road area, with single residences also scattered in the Okari – Nine Mile Beach area.

A scientific monitoring station at Constant Bay comprises a small shed and instrument cable, part of a nationwide network managed by NIWA to provide information on tides and other water level changes.

There are Resource Management Act coastal permits issued in this segment[119] for:

- a mooring (Okari Lagoon)
- beach erosion control (Little Beach)
- blacksand goldmining (Nine Mile Beach)
- a sea level monitoring station (Constant Bay).

5.4.7 Existing Protection and Management Areas

Conservation land around Okari Lagoon occurs mostly along the foredune area including the Okari Spit Scenic Reserve (24 ha). A QEII covenant covers a small area of wetland on the landward margin of the lagoon.

118 Booth et al 2005

119 www.wcrc.govt.nz "Maps on the Web", June 2006

Tiropahi River mouth (left) and forested coastal slopes
Photo: D Neale, DOC.

Small areas of conservation land occur in the vicinity of the Charleston coastline.

Most of the coastal land from Doctor Bay south to Morrisey Creek is conservation land, including the Four Mile Scenic Reserve (459 ha) and part of Paparoa National Park.

Whitebaiting is not permitted in non-tidal areas, nor upstream of 'back pegs' on the Okari and Nile Rivers[120].

Okari Lagoon is a Ngai Tahu Statutory Acknowledgement Area.

The area lies within Fisheries Statistical Area FSA 34, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Buller District.

The operative West Coast Regional Coastal Plan recognises:

- Coastal Protection Area; CPA5 Okari Lagoon
- Outstanding Natural Features and Landscapes; ONFL 4 Parsons Hill to Razorback Point
- Marine Mammal and Bird Site; MMB5 north end of Nine Mile Beach, MMB6 Charleston, MMB7 south of Deep Creek
- Coastal Hazard Areas; CHA5 Nine Mile Beach and Little Beach.

Totara River, with the Little Totara River flowing in from the right.
Photo: D Neale, DOC.

120 Whitebait Fishing (West Coast) Regulations 1994

5.5 Paparoa

(Morrisey Creek – Point Elizabeth, 52 km)

5.5.1 Summary

The coastline of the Paparoa segment lies along the western margin of the Paparoa Range, broken only by the coastal lowlands of Barrytown Flat. Several rivers of various sizes flow out to sea from heavily forested catchments. The seabed is mostly of a uniform shelf grading out to fine sediments but with inshore rocky reefs and a variety of beach types. The area supports marine life that is typical of such habitats in the northern West Coast. Access to and use of the coast is possible throughout most of this segment. Tourism, residential development and farming are predominant uses of the coastal strip. Most of the coastline is backed by national park which retains a natural character.

Notable features include: accessibility from settlements and roads throughout, unmodified forest and coastal habitats, coastal wildlife, highly scenic natural landscapes, protected catchments, diverse marine habitats, cultural and historic heritage and recreational uses.

Existing protection includes: Paparoa National Park, scenic reserves and other conservation land. Some waterways are closed to whitebaiting and there are several specified areas under the Regional Coastal Plan.

5.5.2 Natural Features

COASTAL LAND AND ISLANDS

The coastline of the Paparoa segment lies along the western margin of the Paparoa Range and is strongly influenced by the complex geology of the locality. The coastline is mostly dominated by tertiary sedimentary rocks (e.g. sandstones and limestone), and mostly unmodified karst (limestone-related) formations of the Paparoa Syncline are a significant natural and geological feature of the Paparoa National Park. Much of the coastline is rugged and scenic, with many cliffs, headlands and small bays. This is particularly so in the north from the Fox River mouth to Razorback Point and in the south from Seventeen Mile Bluff to Nine Mile Creek/Kotorepi.

Rocky coasts at Fourteen Mile (above) and Sixteen Mile (below).
Photos: D Neale, DOC.

Between these two blocks of coastal hill country lies the 15 kilometre-long Barrytown Flat. The flat consists of groups of low beach ridges of marine sands and gravels among swampy ground, overlain along its eastern (inland) edge by a sloping surface of river gravels and landslip deposits at the foot of the Paparoa Range[121]. The major use of the flat is for farming and only a small proportion of the area has been protected from livestock. Nevertheless, a diversity of indigenous vegetation pockets remain on the Barrytown Flat: several rata-podocarp forest remnants (Nikau Scenic Reserve, 20 ha; 'Coates' Bush', 45 ha; 'Noble's Bush', 30 ha; and 'Weir's Bush', 10 ha), as well as some wetland areas (Maher Swamp, 200 ha; Canoe Creek Lagoon). Three ecologically important plants – totara, nikau and northern rata – flourish here despite being almost at their southern limits on the West Coast.

The Paparoa segment contains the southern recorded limits on the West Coast for at least 12 coastal plant species, including the native iceplant at Ten Mile and the threatened coastal cress *Lepidium flexicaule* at Point Elizabeth.[122] Pahautane Beach is one of the few areas of foredune habitat on the West Coast where the native dune plant pingao is dominant and marram grass is absent.

121 Bioresearches Ltd 1986

122 F. Overmars et al, unpublished DOC data

Above: Seventeen Mile Bluff
Below: Point Elizabeth, with Rapahoe at the far left.
Photos: D Neale, DOC.

Overall, this segment has a diverse and scientifically important geological history. Sites of particular geological interest include the 'pancake rocks and blowholes' karst landforms at Dolomite Point[123], seacliff landforms at Perpendicular Point, fossil sites at Woodpecker Bay, Perpendicular Point and Point Elizabeth, a mineral site at Whitehorse Creek, sedimentary rocks at Fox River mouth, Nine Mile and Twelve Mile and geological folding structures at Fourteen Mile, Sixteen Mile and Seventeen Mile[124].

Motukiekie Rocks form a cluster of vegetated rock stacks (along with another near Ten Mile Creek) at which the threatened seal cress is found as well as burrowing seabirds and fur seals; Seal Island shares a similar range of natural features[125]. Rock stacks in the vicinity of Point Elizabeth also support a colony of fur seals, but their ecology is less well known. Small stacks occur elsewhere in this segment, including at Dolomite Point and Woodpecker Bay.

Threatened coastal cresses (*Lepidium flexicaule* and seal cress *L.naufragorum*) are found at Seal Island, Perpendicular Point, Dolomite Point, Motukiekie Rocks and Point Elizabeth.

COASTAL WETLANDS AND WATERWAYS

The six main rivers and numerous smaller creeks which enter the sea within this segment have a variety of river mouth formations. The Fox, Pororari and Punakaiki Rivers drain mostly from the sedimentary limestone catchments of the Paparoa Syncline and emerge at the coast in semi-tidal river mouth lagoons that are often influenced (and very occasionally blocked) by the movements of beach sediments. The river mouth margins of these three rivers are partly modified by land and housing developments.

Three creeks to the south of the Barrytown Flat – Ten Mile Creek (Waianiwaniwa), Nine Mile Creek/Kotorepi and Seven Mile Creek (Waimatuku) – drain from partly forested 'coal measure' catchments. Of these only Seven Mile Creek/Waimatuku has a slow-flowing lagoon wetland at its mouth that is influenced by beach sediment movements, whereas the other two flow more steeply onto the beach and out to sea.

Many of the thirteen named creeks on the Barrytown Flat (the largest being Canoe Creek) have been highly modified by drainage and farm development[126]. There are several pond and lagoon areas, some in the south being the result of past goldmining activities. The largest 'natural' water body is the Canoe Creek Lagoon at the mouths of Collins and Devery's Creeks. Canoe Creek Lagoon has been rated as moderate-high wildlife value as a good food supply for a variety of waterfowl and waders, and Maher Swamp has been rated as being of moderate wildlife value as a good feeding and loafing area for wetland species[127]. Nikau Scenic Reserve has some wetland features within its coastal forest habitat adjacent to Hibernia Creek.

123 Coates & Laird 1988
124 Hayward & Kenny 1999
125 Neale 2006e
126 Bioresearches Ltd 1986
127 Morse 1981

Coastal farmland on the Barrytown Flats, with Barrytown in the distance.
Photo: D Neale, DOC.

SEASHORE AND MARINE AREAS

Overall the Paparoa segment has a rocky character, with intertidal rocky shores and shallow reefs. The form of the rocky shorelines in this segment varies considerably and includes: intertidal bedrock platforms and ramps, vertical cliffs, sea caves, boulder shores and complexes of these types. The rocky shore biological communities – including reef fish, seaweeds and benthic invertebrates – are typical of the northern West Coast; however, their overall extent, diversity and accessibility is notable relative to many other parts of that same area. The intertidal reef at Fourteen Mile Bluff is one of only two recorded sites for the recently discovered mottled clingfish. While it is considered likely that this fish occurs in some other places, the extensive surveys that have been done have not recorded it at any other sites[128].

Big Rock, Point Elizabeth
Photo: D Neale, DOC.

Numerous embayments and beach sections occur within sections of rocky coast, the largest continuous stretches of these being at Barrytown Flat, Rapahoe and Woodpecker Bay. The beaches comprise a mixture of coarse sand, gravel and cobbles. Barrytown Beach consists mostly of gravelly sediments[129], and is locally known for its decorative stones (including pounamu) that appear to be more resilient to the grinding action of the sea as they drift up the coast from the larger river catchments in the south[130].

Nautical charts mark a freshwater spring upwelling at 40 metres depth about five nautical miles north-west of Point Elizabeth[131], probably arising from the limestone formations found along this coastline.

Offshore the seabed slopes gradually out across the inner shelf towards the Challenger Plateau at a gradient of less than two degrees within the territorial limit, reaching a depth of about 150 metres at the territorial limit[132]. Seabed sediments grade from coarse beaches of sand, gravel, pebbles and boulders to sandy mud offshore.

128 Roberts et al 2005
129 Jones 1994
130 Neale 1990
131 RNZN 1958
132 RNZN 2002b

Dolomite Point blowhole
Photo: DOC.

Limestone cliffs at Dolomite Point.
Photo: L.F Molloy

COASTAL AND MARINE WILDLIFE

The most significant coastal wildlife feature in this segment is the Westland petrel colony in the coastal hills behind the Barrytown Flat, where several thousand of these birds nest in burrows. It is the only known breeding site in the world for this species with a total population of possibly 20 000 birds and one of only two major mainland petrel colonies in New Zealand[133].

Fur seals haul out at several sites including Seal Island and Motukiekie Rocks; several pups are often born each year at a small colony on Big Rock (Point Elizabeth)[134]. Hector's dolphins are widespread throughout this segment and can often be seen (especially in the summer months) from several viewpoints such as Dolomite Point, Pororari beach and Seal Island.

Blue penguins nest in coastal forests, caverns and other suitable locations throughout the segment. Fairy prions and possibly other burrowing seabirds nest on some of the offshore rock stacks, including the Motukiekie Rocks and Seal Island[135]. Spotted shags nest on the rocky shelves of Perpendicular Point and in smaller numbers south of Nine Mile Bluff and roost on several offshore rocks. Several dozen white fronted terns are often seen roosting on rock stacks at Dolomite Point[136].

MARINE FISH AND OTHER SPECIES

The Paparoa coastal segment like the rest of the western coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[137].

As well as a significant trawl fishery along this coastal segment other commercial fishing methods are used such as trolling for albacore and set netting for rig and school shark.

A relatively low diversity of 20 coastal reef fish species have been recorded in this segment, which is a typical feature of the northern West Coast[138].

5.5.3 Cultural and Archaeological Heritage

Archaeological sites occur in this segment mostly in association with caves and rock overhangs[139]. The gold rush towns of St Kilda and Brighton (near Fox River/ Woodpecker Bay) were adjacent to the shoreline and the partly sheltered harbour behind Seal Island, but have been mostly lost to coastal erosion. Old gold workings are common along the coastline on raised marine benches.

133 Marchant & Higgins 1998; Baker & Coleman 1977; Best & Owen 1976
134 Neale 2006e
135 Neale 2006e
136 Neale 2006e
137 Stevenson & Hanchet 1999
138 Roberts et al 2005
139 Hooker 1990

From left:
Dolomite Point
Fox River mouth.
Photos: D Neale, DOC.

5.5.4 Recreation and Tourism

Recreational fishing occurs at points throughout this coastline, especially where there is access from State Highway 6 and other roadways. A variety of recreational fishing activities are undertaken, including surfcasting from rocks and beaches, boat fishing, hand gathering and netting. Bobbing for crayfish is done at some places such as Seal Island and whitebaiting occurs, especially in the Fox, Pororari and Punakaiki Rivers and Seven Mile Creek/Waimatuku.

Recreational boats access this segment from launching sites at Fox River mouth and Woodpecker Bay, as well as sites outside the segment (such as the Westport and Greymouth Harbours). Point Elizabeth is notable as the closest diving site to Greymouth, and is often accessed by boats for crayfishing and other fishing activities when conditions allow.

Mussel gathering occurs especially in the vicinity of easy access points like Woodpecker Bay, Seal Island, Truman Track, Dolomite Point, Seventeen Mile Bluff, Fourteen Mile Bluff, Twelve Mile Bluff and Point Elizabeth. These sites are also popular for walking and shore exploration and paua gathering is also done at several rocky shore locations.

The scenic diversity of the coastal landscape and recreational attractions along the Paparoa coast provide opportunities for a wide range of tourism and recreational activities. The Dolomite Point pancake rocks and blowholes is one of the most popular tourist sites on the West Coast (with an average of 350,000 visitors per year[140], with peak number during the summer months). Formed walking tracks with interpretation panels and high levels of use are also present at Truman Track and the Point Elizabeth Walkway. Managed roadside viewpoints and stopping places include: Kaipakati Point, Irimahuwhero Point, Coghlan's Lookout, Pororari Beach, Fourteen Mile Bluff, Twelve Mile Bluff and Rapahoe. Walking routes to the coastline also occur at numerous other locations.

Coastal dwellings along State Highway 6 at Greigs.
Photo: D Neale, DOC.

Surfing and swimming are possible at several sites including Pororari and Rapahoe Beaches and the Fox, Pororari and Punakaiki River mouths. Other recreational activities include beach walking and fossicking, motorcycling and driving, birdwatching, exploring and boating.

5.5.5 Commercial Use

Like the rest of the inshore west coast of the South Island, the Paparoa marine segment is fished by commercial fishers using a variety of fishing methods, the most common being bottom trawl[141]. Vessels in this area mostly operate out of Westport and Greymouth, but vessels from Nelson and Motueka are known to frequent the coastal fishing grounds.

Farming and forestry are common land uses on the Barrytown Flat and some smaller coastal areas.

Seven mining licenses exist on the coastal strip of Barrytown Flat, and another at Rapahoe Beach. Gravels in the lower reaches of Thirteen Mile Creek are locally regarded as a high quality building aggregate. Gravels and stone are also taken from Canoe Creek.

140 C. Jose, unpublished DOC data
141 Booth et al 2005

Top:
Limestone blocks in the surf at Irimahuwhero Point. Kaipakati Point and Seal Island, with Woodpecker Bay behind.
Bottom:
Maher Swamp on the Barrytown Flats. Motukiekie Rocks, looking south towards Nine Mile beach.
Photos: D Neale, DOC.

Proposals for a port facility in the vicinity of Rapahoe have been considered for many years[142] but no specific proposals are currently active.

5.5.6 Other Public Uses and Facilities

All parts of the Paparoa segment lie within two kilometres of State Highway 6, which provides vehicle access to many coastal localities and roadside viewpoints, as well as access to the foreshore at Woodpecker Bay, Barrytown Flat, Nine Mile and Rapahoe. Foot access is possible to most parts of the coast from State Highway 6 via numerous tracks and routes to the shore, but public access is restricted in some places by private land and/or difficult terrain.

Residential buildings are mostly concentrated in and near settlements at Punakaiki, Rapahoe, Barrytown and Twelve Mile. Buildings include a variety of permanent housing, rental properties and holiday baches.

Coastal hazard protection works occur at numerous locations, including several sites in Woodpecker Bay, Pororari Beach, Punakaiki River and beach, residential sites from Seventeen Mile to Twelve Mile, State Highway 6 north of Rapahoe and at Rapahoe township. Most of these works comprise dumped rock, rock retaining walls, or concrete walls.

The accessibility, size and natural features of the Twelve Mile rocky shore platform makes it a suitable coastal site for natural science studies and it is often used by local schools and for university research. In particular, the University of Canterbury have used this site and others (at Nine Mile, Fourteen Mile and Woodpecker Bay) for marine biological research and monitoring[143].

142 Pfahlert 1984, Simpson 1959, Blackett & Hector 1889, Coode 1880b

143 D. Schiel pers comm 2004

There are Resource Management Act coastal permits issued in this segment[144] for:

- stream outlet opening (Collins Creek);
- river and coastal protection works (Woodpecker Bay, Fox River, Pahautane, Pororari Beach, Punakaiki River, Seventtn Mile Bluff, Twelve Mile Bluff, Rapahoe);
- foot and boat access facilities (Truman Track, Pororari Beach, Barrytown, Point Elizabeth);
- stone extraction and horse races (Rapahoe);
- blacksand goldmining (Barrytown Beach);
- sand extraction (north Barrytown Beach).

Pahautane beach and Motukutuka Point.
Photo: D Neale, DOC.

5.5.7 Existing Protection and Management Areas

While many of the inland catchments of this segment are within Paparoa National Park and other conservation lands, the land along the coastline itself is mostly private land and legal road (formed and unformed). The National Park extends to or very near parts of the coast between about Hatters Bay and Pororari River and at Dolomite Point and Razorback Point.

Scenic Reserves are located at Seal Island and Kaipakati Point, Nikau Scenic Reserve and Rapahoe Range. Te Ana o Matuku Caves Historic Reserve is near the mouth of the Fox River. Other conservation lands extending close to the coast include areas around Whitehorse Creek, Maher Swamp, Canoe Creek, Seventeen Mile Bluff to Thirteen Mile Bluff and Nine Mile Bluff.

Several waterways in this segment are closed to whitebaiting[145]:

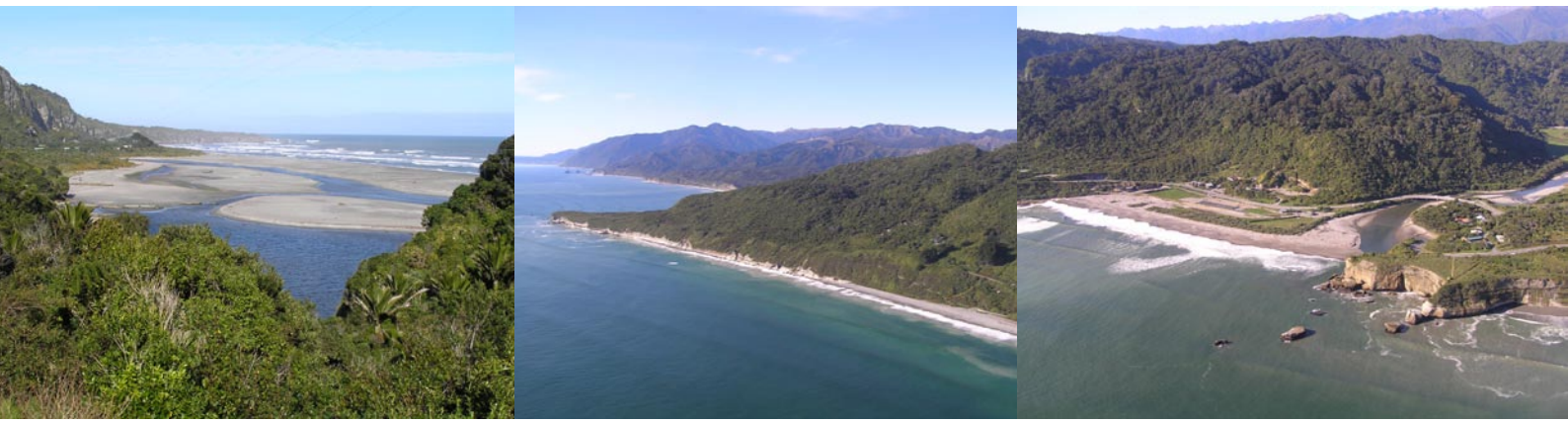
- Bullock Creek (a tributary of the Pororari River);
- All tributaries of the Punakaiki River.

Whitebaiting is not permitted in non-tidal areas, nor upstream of 'back pegs' on the Fox, Pororari and Punakaiki Rivers.

The Pororari River is a significant water body which is closed to commercial eel fishing (on account of its protected land status)[146].

Dolomite Point Pancake Rocks
Photo: D Neale, DOC.

144 www.wcrc.govt.nz "Maps on the Web", June 2006
145 Whitebait Fishing (West Coast) Regulations 1994
146 Tai Poutini Tuna 1999



From left:
Porarari River;
Point Elizabeth;
Punakaiki River
Photos: D Neale, DOC.

The area lies within Fisheries Statistical Area FSA 34, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Buller District north of Punakaiki River and the Grey District south of this point.

The operative West Coast Regional Coastal Plan recognises:

- Coastal Protection Area; CPA6 Greigs to Nine Mile Bluff
- Culturally Significant Areas; CSA8 Pahautane, CSA9 Te Miko to Punakaiki, CSA10 Kararoa, CSA11 Rapahoe
- Coastal Recreation Areas; CRA Punakaiki/Pororari Beach, CRA Rapahoe to Point Elizabeth
- Coastal Development Area; CDA5 Rapahoe
- Outstanding Natural Features and Landscapes; ONFL 4 Parsons Hill to Razorback Point, ONFL5 Seventeen Mile Bluff to Motukiekie Rocks, ONFL6 Point Elizabeth
- Marine Mammal and Bird Sites; MMB8 Seal Island to Perpendicular Point, MMB9 Dolomite Point, MMB10 north Barrytown flats, MMB11 Point Elizabeth.
- Coastal Hazard Areas; CHA6 Woodpecker Bay, CHA7 Punakaiki village beach, CHA8 Punakaiki River beach, CHA9 Barrytown beach, CHA10 Seventeen Mile Bluff to Motukiekie Rocks, CHA11 Rapahoe.

Rapahoe Beach
Photo: D Neale, DOC.

5.6 Greymouth

(Darkies Terrace – Waimea Creek, 29 km)

5.6.1 Summary

The Greymouth segment mostly comprises a coastal plain backed by marine terraces and broad river flats. Two large rivers and numerous smaller ones flow out to sea in this segment. The seabed is mostly of a uniform shelf grading out to fine sediments, with mostly coarse-grained mixed sand and gravel or cobble beaches and no evidence of rocky reefs. The area supports marine life that is typical of such habitats in the central West Coast. Access to the coastal and marine area is made for a variety of uses and at numerous points along the coast. This segment is one of the more densely populated parts of the West Coast. Residential development and farming are predominant uses of the coastal plains and terraces.

Notable features of the Greymouth segment include its high resident population, accessibility from Greymouth and State Highway 6, uses related to the Grey River/Mawheranui port, several river mouth wetlands, coastal landscapes, cultural and historic heritage and recreational uses.

Existing protection includes small areas of conservation lands associated with coastal forest remnants and wetlands. There are also several specified areas under the Regional Coastal Plan, and the Taramakau River is a Statutory Acknowledgement area under the Ngai Tahu Claims Settlement Act.

5.6.2 Natural Features

The coastal sand plain of this segment has been modified by drainage and land development. Remaining natural features include: coastal wetlands and terrace slopes, river mouths, a variety of sand and gravel beaches and a broad continental shelf.

Cobden's 'North Beach', towards Point Elizabeth.
Photo: T Hume, NIWA

COASTAL LAND AND ISLANDS

Coastal land has been modified by residential, industrial, farming and other land development on the coastal flats but some small forest remnants remain The Greymouth segment contains the southern recorded natural limits on the West Coast for at least eight coastal plant species, such as taupata[147] and ngaio; the Blaketown coast supports one of the West Coast's most extensive areas of taupata. Areas of coastal forest remain at the Kowhai Bush walk, the New River/Kaimata lagoon area, and the Taramakau Scenic Reserve.

This coastal segment is subject to the effects of coastal erosion and other physical shoreline changes due to the construction of the Grey River/Mawheranui mouth training works in 1884. These have had a significant effect on coastal dynamics, causing the Blaketown coast to aggrade (build out) by up to 500 metres, while the Cobden beach has eroded by up to 100 metres.[148] Movements of river and creek mouths have also affected coastal land especially at New River/Kaimata, Taramakau River and Kapitea Creek.

147 Overmars et al unpublished DOC data

148 Pfahlert 1984

From top:
Kapitea Creek lagoon;
Camerons settlement;
Paroa settlement.
Photo: T Hume, NIWA

COASTAL WETLANDS AND WATERWAYS

The largest waterways in the Greymouth segment are the Grey/ Mawheranui and Taramakau Rivers, with estimated annual suspended sediment discharges of 2.1 and 2.2 million tonnes respectively[149].

The Grey/ Mawheranui River has one of the largest catchments of any West Coast river (3830 km^2), large parts of which (particularly the valley floor) have been deforested through historic goldmining or for agriculture. In its tidal reaches, the river is restricted to a single major channel by both the natural rock structure of the Rapahoe Range and river training works. The Grey/Mawheranui River mouth includes two main wetland areas, the Cobden Lagoon on the north bank and Blaketown Lagoon-Erua Moana on the south bank. The coastal marine area boundary across the Grey/Mawheranui River is positioned at the downstream bank of the Blaketown Lagoon outlet.

The lower Taramakau is a high volume river which leaves the broad coastal and outwash plain through a river channel with shingle spits, limited tidal sand flats, and a changeable outlet. Morse[150] considered the Taramakau River mouth to be a wetland of moderate wildlife value, providing breeding areas for gulls and terns.

Cobden Lagoon is a semi-tidal area draining out to the Grey/ Mawheranui River. It is adversely affected by adjoining land development, drainage and weed infestation but it retains some value as a habitat for wetland birds and fish. A short distance to the north but unconnected to Cobden Lagoon and outside the coastal marine area, is the freshwater pond area of the Lake Ryan Wildlife Refuge Reserve.

Blaketown Lagoon-Erua Moana is a tidal flat wetland that has been modified by adjoining land development and drainage works, but retains areas of natural habitat and vegetation. The lagoon is surrounded by a high floodbank, which protects both coastal assets and the lagoon from further land development and incremental encroachment. This lagoon has the largest tidal mudflats between Okari Lagoon and Saltwater Lagoon (Poerua). Studies in 1974 indicated that control structures and embankments (which have since been extended even more) have reduced the salinity and tidal flows into the mouth of Blaketown Lagoon, turning it from a brackish tidal ecosystem into a predominantly freshwater one[151].

The New/Kaimata River – Saltwater Creek lagoon is one of the largest coastal lagoon systems between Okari Lagoon and Totara Lagoon. It supports wetland and riparian vegetation, as well as a variety of coastal fish and birdlife, and was considered by Morse[152] to be a wetland of high wildlife value. The coastal ponding in nearby Paroa Lagoon is a landform of geological interest[153].

149 Hicks & Shankar 2003
150 Morse 1980
151 Knox 1974
152 Morse 1980
153 Hayward & Kenny 1999

New River/Kaimata, Kapitea Creek and Waimea Creek are part of a network of similar wetlands extending along the central West Coast: these are brackish 'hapua' wetlands that are significantly affected by the natural mobility of their mouths[154]. Waimea Creek is the outlet to the sea for the Awatuna Cultural Reserve, for which migratory fish (such as freshwater eels tuna) are a management consideration.

From top:
Blaketown beach mining operation and suburban housing, with Blaketown Lagoon behind.
Central Greymouth, Blaketown and the Grey/Mawheranui River mouth
Photo: T Hume, NIWA

SEASHORE AND MARINE AREAS

The only natural rock bed in this segment is a moraine boulder bed that occurs at spring low tide level near the mouth of Serpentine Creek. It supports mussels and other rocky shore species but it is sometimes smothered by beach sediments.

Beaches between Cobden and Karoro are primarily composed of cobbles and gravel, with a sand bed extending out below the low tide level. Further south the beaches change to more of a sand-gravel mix of sediments.

Offshore, the seabed slopes gradually out across the inner shelf towards the Challenger Plateau at a gradient of less than two degrees within the territorial limit, reaching a depth of about 150 metres at the territorial limit. The coarse sediments of the beaches grade offshore to finer silts and mud.

COASTAL AND MARINE WILDLIFE

Speckled skinks occur in relatively high abundance at Cobden beach[155] where the scrub and driftwood-covered cobble surface provides an ideal habitat.

Boat surveys from 1995 to 1997 recorded Hector's dolphins in high densities in this area relative to other parts of the West Coast that were surveyed[156].

Blue penguins nest in parts of this segment, with documented evidence of their occurrence especially between Paroa and Taramakau[157]. Wading birds utilise tidal flats and wetland margins especially at Cobden Lagoon, Blaketown Lagoon, New River Lagoon, Taramakau River mouth and Kapitea Creek mouth. Black backed gulls nest on the Kapitea Creek beach[158] and inland from Karoro[159].

MARINE FISH AND OTHER SPECIES

When it is not smothered by beach sediments the moraine boulder bed at the Serpentine Creek mouth supports mussels and other rocky shore species, but no formal survey has been done of this site.

Whitebait species are a significant feature of the waterways in this segment, with large numbers migrating up the Grey/Mawheranui, Taramakau and other rivers.

This coastal region, as does the whole west coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

154 Neale 2006a
155 Whitaker 2002
156 Brager & Schneider 1998
157 Blyth et al 2006, Hughes 2005
158 S. Hall pers comm 2006
159 R. Barber pers comm 2006

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[160].

The coastline south of Point Elizabeth, towards Greymouth. Photo: T Hume, NIWA

5.6.3 Historical and Archaeological Heritage

Physical evidence of pre-European sites is scarce (as are European sites), probably due to coastal instability. Traditionally there was Maori occupation around the Grey/Mawheranui) and Taramakau estuaries[161] and the Taramakau has a significant place in Maori history[162].

The town of Greymouth developed as a port town during the West Coast goldrush period in the 1860s, and retains a history based on exploration, minerals, fishing, shipping, farming, forestry, conservation and tourism.

5.6.4 Recreation and Tourism

The proximity of Greymouth's population has led to the development of numerous coastal recreation facilities and uses in this segment. Particular sites where there are facilities, walkways or structures suited to recreation include (from north to south):

- Cobden beach – beachwalking
- Grey/Mawheranui River tipheads – sightseeing, relaxation, surfing, and bodyboarding,
- Nimmo Park – organised sports
- Mawhera Quay and the Heritage park – sightseeing and relaxation, historic interpretation;
- Greymouth fishing wharves and boatramp – fishing, walking;
- Blaketown rugby grounds – organised sports;
- Kowhai Bush – walking, birdwatching;
- Karoro Domain – open space recreation, swimming, and surfing;
- Ted McGrath Walk – beachwalking;
- Taramakau SR – forest and riverside walking.

Greymouth Harbour, Blaketown and the Grey/Mawheranui River mouth area. *Photo: D Neale, DOC.*

Fishing occurs in numerous places and by various methods:

- surfcasting on beaches and angling at river mouths;
- whitebaiting at river and stream mouths (most commonly on the Grey/Mawheranui and Taramakau Rivers, including whitebait stands on the Taramakau);
- boatfishing out of the Grey/Mawheranui River;
- set netting from boats or sometimes off the beach;
- mussel gathering at Serpentine beach.

Boating is most commonly undertaken at sea (motorboats out of the Grey/Mawheranui River), in the Grey and Taramakau Rivers (mostly jetboating) and in the New River lagoon (stillwater kayaking). Several commercial boat operators run fishing, sightseeing and marine mammal tourism charters out of the Greymouth port.

Tourist accommodation places with coastal outlooks include King's Hotel, Greymouth Seaside Top 10 Holiday Park, and Kapitea Ridge Lodge. Numerous other accommodation places are located close to the coast.

160 Stevenson & Hanchet 2000
161 Hooker 1990
162 Ngai Tahu Settlement Act 1998

Cobden Island and surrounding areas.
Photo: D Neale, DOC.

5.6.5 Commercial Use

The Port of Greymouth in the Grey/Mawheranui River is the West Coast's second largest shipping port, supporting a fishing fleet and a barging and shipping facility used for transporting bulk products like coal and gravel aggregate. Fish processors, transport companies, railway operations and other industries are closely linked to the port operations. Most of the port's infrastructure lies upstream of the coastal marine area. Dredging is undertaken periodically in the fishing vessel berthage area in Erua Moana, a side basin away from the main river flow, and a slipway that can accommodate all but the largest vessels in the port[163].

This segment – as for most of the inshore West Coast – is fished by commercial fishers using a variety of methods, the most common being bottom trawl[164]. Vessels in this area mostly operate out of Greymouth, but also Westport and Nelson. In 2000, about 50 inshore fishing vessels were domiciled in Greymouth, made up of some 38 trawlers, seven line boats and two set netters[165]. Vessels from further afield are sometimes based in Greymouth, such as tuna trollers and trawlers throughout the year.

Blaketown and Greymouth
Photo: D Neale, DOC.

Farming is a feature of the coastal flats, especially in the areas north of Cobden township, the Camerons area, and south of the Taramakau River.

Commercial/ industrial activity occurs in numerous places but especially in central Greymouth, which supports a variety of businesses in the retailing, service and light industrial sectors. The adjacent port area is important to commercial and recreational operators in the fisheries, transport and manufacturing industries. The South Beach area is home to several businesses mostly related to construction and manufacturing industries.

163 Stevens 2000
164 Booth et al 2005
165 Stevens 2000

There are Resource Management Act coastal permits issued in this segment[166] for:

- river and coastal protection works (Grey/Mawheranui River and Serpentine beach).
- driftwood, gravel and pebble removal (several locations).
- whitebait stands (Taramakau River).

Chesterfield and Kapitea Creek.
Photo: D Neale, DOC.

Gravel extraction occurs on the Blaketown to South Beach coast, in the Taramakau River mouth area and upstream in the Grey/Mawheranui River bed.[167]

The Greymouth Aerodrome is located on the coastal strip south of Blaketown, providing facilities for both commercial and private operators.

5.6.6 Other Public Uses and Facilities

Public access can be gained to any part of the coastline from a series of roads and tracks leading to the beach, and the only significant impediments to access along the coast are from the larger streams and rivers. State Highway 6 bridges cross many waterways within or close to the coastal marine area.

Residential areas occur along most of this segment, including the greater Greymouth area (Cobden, central Greymouth, Blaketown, Karoro and South Beach), Paroa, Camerons, Kumara Junction, Chesterfield and a number of other localities and single residences.

Untreated sewage and stormwater are discharged directly to water in the lower Grey/Mawheranui River and Blaketown Lagoon. Sewage ponds at Karoro discharge to sea through a subterranean pipe and soakage system. An area at Cobden on the north bank of the Grey/Mawheranui River was the district's main refuse station prior to about 2000 and still retains much of the waste deposited there.

The mouths of several waterways are controlled for the purpose of flood and erosion management (both with and without resource consent authority), including New River/Kaimata, Saltwater Creek and Kapitea Creek/Acre Creek, mostly by excavation and reopening of blocked mouths and channels.

From left below:
Beach at Karoro;
New River Lagoon
Photos: D Neale, DOC.

There is a scout camp on the south bank of the Taramakau River mouth.

166 www.wcrc.govt.nz "Maps on the Web", June 2006
167 Benn 2004

Raupo on New River lagoon
Photo: D Neale, DOC.

5.6.7 Existing Protection and Management Areas

Small areas of conservation land protect coastal forest remnants and wetlands. The largest protected aquatic/ wetland areas are the bed of the Taramakau River (which is also a Statutory Acknowledgement area under the Ngai Tahu Claims Settlement Act) and parts of the New River (within the Paroa Wildlife Management Reserve). Coastal forests within conservation land include the Rapahoe Range Scenic Reserve above Point Elizabeth and Cobden, the Kowhai Bush Recreation Reserve at Blaketown and the Taramakau Scenic Reserve on the river's lower south bank.

Other small reserves in the area include the Karoro Recreation Reserve and the Greymouth Aerodrome Reserve.

Whitebaiting is not permitted in non-tidal areas nor upstream of 'back pegs' on the Grey/ Mawheranui, New/Kaimata and Taramakau Rivers and Serpentine and Waimea Creeks[168].

From left:
Paroa
South Beach
Photos: D Neale, DOC.

168 Whitebait Fishing (West Coast) Regulations 1994

Taramakau River mouth, with Serpentine Creek on the right.
Photo: D Neale, DOC.

The Greymouth Flood Protection Scheme includes a series of stopbanks and other measures that provide security for the town against river flooding by the Grey/Mawheranui River and tributaries.

The Greymouth Harbour limits (mostly designated for controlling navigation and shipping infrastructure matters under the Maritime Transport and Harbours Acts) extend in a two mile radius from the Grey River tipheads.

The Greymouth segment lies within Fisheries Statistical Area FSA 34, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Grey District north of Taramakau River and Westland District south of there.

The operative West Coast Regional Coastal Plan recognises:

- Coastal Development Area; CDA2 Grey/Mawheranui River mouth.
- Culturally Significant Area; CSA12 Taramakau.
- Coastal Recreation Areas; CRA8 Cobden Beach, CRA9 Lower Grey/Mawheranui River, CRA10 Blaketown to Karoro.
- Coastal Hazard Areas; CHA12 Cobden Beach to Karoro, CHA13 south of Taramakau.

Sand and gravel beach near Chesterfield.
Photo: D Neale, DOC.

5.7 Hokitika

(Awatuna – Donoghues, 38 km)

5.7.1 Summary

The Hokitika segment mostly comprises a coastal plain backed by marine terraces and broad river flats. Two large rivers, the Arahura and Hokitika, and numerous smaller ones flow out to sea in this segment. The seabed is mostly a uniform shelf grading out to fine sediments. The beaches are mostly coarse-grained mixed sand and gravel or cobble, with little evidence of rocky reefs. The shelf is broken by a more complex formation at the head of the Hokitika Canyon, and broadens to a shallow seabed plain in the south.

The area supports marine life that is typical of such habitats in the central West Coast. Access to the coastline is possible at numerous points along the coastal plain and the coastal areas are popular for a variety of recreational uses. Residential development and farming predominantly use the coastal plains and terraces.

Notable features of this segment include its:

- higher resident population.
- easy accessibility from adjacent settlements and State Highway 6.
- several river mouth wetlands.
- coastal sandplain landscapes.
- underwater Hokitika Canyon area.
- cultural and historic heritage of early Maori occupation and the goldrush period.
- recreational uses of beaches and river mouths.

The areas of coastal conservation lands are mostly small, associated with coastal forest remnants and wetlands. Other protected areas are controlled whitebaiting areas. There are also several management areas under the Regional Coastal Plan.

5.7.2 Natural Features

COASTAL LAND AND ISLANDS

Sand and gravel beach at Mananui. *Photo: T Hume, NIWA*

Most of the beaches along the Hokitika segment have low dunes of up to one to five metres in height. The foredunes are mostly scrub-covered and often extend back to pasture land on the Holocene coastal plain and outwash surfaces. Buildings and settlements dominate the coastal landscape in some places, The coastal terraces and sand plains formed from tectonically raised shorelines have been substantially cleared of their original forest cover.

Mananui Bush (extending inland to Mahinapua Scenic Reserve) is one of only a few remnant indigenous coastal dune forest remnants in central Westland[169]; it is also a dunefield landform of geological interest[170]. Mananui Bush/Mahinapua Scenic Reserve is the only native bush remnant between Greymouth and Waitaha that extends as a corridor right to the coast; yet even here the foredune has been previously cleared of indigenous vegetation and is now covered in gorse and regenerating shrub species. Other sandplain forest remnants also exist in the Hokitika segment but most are smaller, on private land, and subject to grazing. Dune blowouts are more common in the vicinity of Totara Lagoon – Mahinapua, and the threatened dune sedge pingao grows in patches.

169 Wardle 1980
170 Hayward & Kenny 1999

Takutai Beach, south of Hokitika
Photo: D Neale, DOC.

COASTAL WETLANDS AND WATERWAYS

The main coastal wetlands are the Arahura and Hokitika river mouths, with several other tidal lagoons. The dune and swale formations on the sand plain have led to the formation of hapua-type wetlands running parallel to the coast in several locations, such as Waimea Creek, Flowery Creek, Mahinapua Creek/Tuwharewhare and Totara Lagoon. Of these the last two remain in the most natural state.

Mahinapua Creek/Tuwharewhare is a slow semi-tidal coastal stream with high natural values, flowing parallel to the coast into the Hokitika River mouth. Its margins remain largely in indigenous vegetation and its catchment includes the protected areas of Lake Mahinapua and Mahinapua Scenic Reserve. It, provides excellent habitat for waterfowl and indigenous freshwater fish such as inanga, giant kokopu and eels. The marginal vegetation and adjoining swamplands of the creek are both ecologically important and scenically attractive. Inanga spawning sites have been recorded in Mahinapua Creek/Tuwharewhare[171] and its tributary Fisherman's Creek.

Totara Lagoon is a long, narrow tidal lagoon and river mouth occupying dune depressions protected from the sea by a sand and gravel beach with low sand dunes and wave-washed surfaces. It extends along about 10 kilometres of coastline and includes about 100 ha of open water, making it the most extensive and unmodified lagoon system between Charleston and the Waitaha River. It is fed in the south by the Totara River and, in the north, by smaller tributaries such as Rocky Creek, Camp Creek, Woolhouse Creek and Gows Creek. Although much of the surrounding land has been cleared and is used for grazing and forestry, a good cover of forest (mainly regenerating rimu and kahikatea) and marginal wetland vegetation (extensive rush areas with bullrush and flax) still remains around the lagoon. Tidal reaches extend for several kilometres along narrow vegetated channels, providing habitat for at least 14 estuarine and freshwater fish species, as well as wading birds and other waterfowl. Totara Lagoon has been rated of high wildlife value, being used by a diversity of birds (27 species), particularly waterfowl but also waders and marsh birds[172].

Totara River mouth, with Ross in distance
Photo: T Hume, NIWA

The Hokitika River is a large waterway which flows across a large braided gravel bed to the sea. It has a total catchment area of 1100 sq km and an estimated annual suspended sediment discharge of 6.2 million tonnes[173] (among the highest recorded in New Zealand). The lower reaches of the river are popular for walking and fishing. Wadeson Island located upstream of the bridge is the site of a wetland restoration project.

The Arahura River mouth is a wetland of moderate importance to wildlife and is noted as one of the few mainland white-fronted tern colonies on the West Coast[174]. Other smaller rivers and streams cut out through the foredune in places or converge with the mouths of larger waterways.

171 Taylor et al 1992
172 Eastwood 1998, Morse 1981
173 Hicks & Shankar 2003
174 Morse 1981

From left: Totara Lagoon and beach; The Mananui coastline, with Lake Mahinapua beyond. *Photos: T Hume, NIWA*

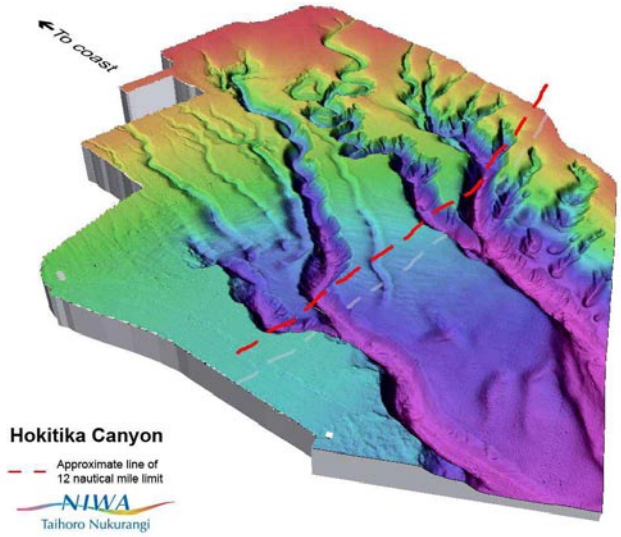
SEASHORE AND MARINE AREAS

The Hokitika segment beaches are predominantly sand and gravel foreshore with a very low foredune. Beach dynamics are greatly affected by the mouth and channel movements of the nearby rivers and shoreline changes of up to 100 m have occurred, sometimes as a result of artificial river training works[175]. The intertidal zone is dominated by mixed sand and gravel beaches of variable width; they generally have very low biological diversity. Despite the high degree of modification resulting from agricultural and residential use of the adjoining coastal plain, the beaches and river banks are mainly in a natural state.

The Hokitika River mouth area, with Mahinapua Creek/ Tuwharewhare in the foreground. *Photo: T Hume, NIWA*

Rocky shores are almost absent from the Hokitika segment, the only exceptions being the Arahura and Mikonui mussel beds. Here, extensive moraine boulder 'ramps' (that are larger than several hectares each and exposed only at spring low tides) form suitable habitats for mussels and other shorelife. The Hokitika River mouth is a site of scientific importance as the type locality for the giant triplefin[176], a nationally uncommon species that is abundant in the northern West Coast[177]. The location of this type locality is unusual insomuch as this fish is predominantly a reef dweller and the area has no nearby reefs.

Offshore the Hokitika Canyon dominates a moderately complex seabed form. The canyon head reaches to within about twelve kilometres of the shoreline with depths of about 300-400 metres within territorial waters, so it is likely that the canyon has a significant influence on the ecology of the territorial waters in this segment. The sediments and topography of the canyon area have recently been surveyed in detail, and the canyon has been found to be made up of an intricate channel network which acts as a 'sink' that carries the supply of silt and other continental shelf sediments into the deep sea[178] (see Chapter 2).



175 Hicks 1988; Gibb 1985, 1987; Sharp 1915; Coode 1880c; Rochfort 1870
176 Clarke 1879
177 Roberts et al 2005
178 P. Barnes pers comm 2006, Price 1985

A broad shelving area to the south of the canyon is informally known as Bold Head (after a nearby landmark), where depths of less than 50 metres reach out beyond the 12 nautical mile territorial limit. To the north of the Hokitika Canyon, the seabed shelves off more steeply across the inner shelf towards the Challenger Plateau, reaching a depth of about 150 metres at the territorial limit. Seabed sediments grade from coarse sand and gravel beaches to sandy mud offshore, but tend to remain somewhat coarser at the head of the canyon.

Arahura River, with Flowery Creek flowing in from the left.
Photo: T Hume, NIWA

Most of the seabed from 100 to 200 metres depth around and to the north of the canyon head in this Hokitika segment is regarded for the purpose of the NIWA inshore trawl surveys as 'foul' (untrawlable) ground[179]. A 1985 study identified a 25 km-long fluvioglacial deposit (covering 155 km^2), largely uncovered by modern sediments, lying from six to fourteen kilometres off Hokitika and referred to as the 'Harvester Prospect'[180]. However, this Harvester Prospect area and some of the 'foul ground' areas of the NIWA surveys are reported to be trawled by commercial fishers.

Donoghues, south of Ross.
Photo: D Neale, DOC.

COASTAL AND MARINE WILDLIFE

The Hokitika segment is part of a much wider area of habitat for Hector's dolphin[181].

Blue penguins nest in dispersed locations along this coastline where buildings and vegetation provide shelter. The Hokitika River mouth and nearby beaches serve as roosting and feeding areas for large numbers of gulls and terns.

179 Stevenson 2004
180 Price 1985
181 Dawson 2002

MARINE FISH AND OTHER SPECIES

This coastal region like the whole west coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[182].

The canyon is a core area for the west coast winter spawning aggregations of hoki ranging from depths of 50 m to 1500 m, with the majority of fish caught in the deeper depths. The extent to which these biological features reach into territorial waters has not been assessed. The upper reaches of the Hokitika Canyon are also fished by longliners targeting ling throughout various times of the year.

The restored historic Custom House and cannon on the Hokitika quayside in 2007.
Photo: D Neale, DOC.

5.7.3 Historical and Archaeological Heritage

Physical evidence of pre-European coastal sites is scarce (as are European sites), probably due to the physical instability of the coast. Traditionally there was early Maori occupation around the Arahura and Hokitika estuaries[183], largely because of the area's importance as a source of pounamu. Lake Mahinapua is wahi tapu, recognising the significance of a battle that occurred on its shores.

Hokitika and most of the other settlements in this segment have their European origins in the goldrush days dating from 1865. At that time Hokitika became a busy river mouth port servicing the goldfields from Kumara to Ross.

The Hokitika quayside was once a busy area for shipping: this scene is from the early 1900s.
Photo: DOC collection.

182 Stevenson & Hanchet 2000
183 Hooker 1990

Driftwood and Sand Beach Sculpture event, Hokitika beach. *Photos: D. Buglass, Hokitika*.

5.7.4 Recreation and Tourism

Fishing (surfcasting, river mouth angling, whitebaiting and set netting) occurs throughout the Hokitika segment. The locations preferred by fishers depend largely on prevailing conditions, but they tend to be mainly near population centres, river and stream mouths and public access points. Recreational boats gain access out to sea mostly from the Hokitika River mouth boat ramp. The Hokitika River whitebait fishery is of major recreational, as well as commercial, importance[184]. Mussels are gathered at large beds southwards from the Arahura River mouth and north of the Mikonui River mouth.

Pounamu fossicking occurs mostly around the mouth of the Arahura River (the main West Coast source of the stone) and along its nearby beaches – to the north and at least as far south as Hokitika.

Beachwalking is popular throughout the Hokitika segment, especially near settlements and public access points. The Hokitika beach and river mouth area is a particular focal point for recreational activities and is popular with both local residents and visitors. These activities include beachwalking, stone and driftwood fossicking, firewood gathering and bonfires; the surf is moderately popular for swimming, bodyboarding and kayaking. Hokitika Beach is also a popular venue for public events, such as the Driftwood & Sand Beach Sculpture week, the Sand Dunes Classic golf tournament and activities during the Wildfoods Festival.

Farming, mining, housing and a golf course are the main uses of the sand dunes. State Highway 6 runs parallel to the coast throughout most of the segment and includes a 700 metre bridge over the Hokitika River which affords good views of the tidal river mouth. The Mananui Bush Walk to the beach is of local recreational significance and receives high use (Groome, 1990).

Totara Lagoon is popular for duckshooting, whitebaiting, canoeing and walking, although much of the surrounding land has been modified for farming and forestry. There is vehicle access at both ends of the lagoon.

Hokitika's tourism relies heavily on the coastal area's historic and natural heritage. The north bank of the Hokitika River at Gibson Quay has been developed by Heritage Hokitika as a historic quayside reconstruction. A 'heritage walkway' has been developed through Wadeson Island, the quayside area, Sunset Point and the beachfront up to Tudor St. Many old buildings, structures and sites of historic importance still remain here.

184 Kelly 1988

Kaihinu
Photo: D Neale, DOC.

5.7.5 Commercial Use

Like most of the inshore West Coast the Hokitika segment is fished by commercial fishers using a variety of methods, the most common being bottom trawl[185]. Vessels in this area mostly operate out of Greymouth, but also come from Westport and Nelson.

The Hokitika segment is part of a marine gold exploration proposal presently being sought by Seafield Resources Ltd for most of the West Coast's coastal marine area. The section of seabed known as the 'Harvester Prospect' (see above) has received attention for its potential as a gold resource[186], but to date has not been mined.

Gravel aggregate is extracted from the river bed above the Hokitika bridge, mostly for the building trade. Small-scale blacksand mining operations occur on several beaches in this segment and decorative stones (e.g. flat cobbles) are also collected.

Commercial and industrial activity occurs in numerous places close to the coastline but is especially focused in the Hokitika area. Central Hokitika supports a variety of businesses in the retailing, service and light industrial sectors, while the area north of Hokitika to Three Mile supports light industry.

Farming including dairy, deer, sheep and food crops, occurs on the coastal sandplain along much of this segment. Most of the dune areas are grazed, usually with the scrub-covered foredune fenced off.

Top: The Hokitika beachfront area.
Hokitika from sea
Photos: D Neale, DOC.

185 Booth et al 2005
186 Price 1985

Mananui
Photo: D Neale, DOC.

5.7.6 Other Public Uses and Facilities

The township of Hokitika (including its residential outliers to the north and south) abuts the beach and river bank and is the main concentration of residential use and public amenities. Smaller settlements near the coast include Awatuna, Arahura, Ruatapu and Ross.

Water discharges to the coastal marine area include the town stormwater pipes to the Hokitika River and beach, outfall pipes from the Westland Milk Products factory and the town's treated sewage outfall from settling ponds near Three Mile.

Coastal erosion is a significant threat to properties on the seafront, including part of the central Hokitika business district[187]. Houses were built close to the shore when the town was first surveyed in 1865 and these properties remain occupied. Attempts to alleviate the erosion problem have included: the construction of rock groynes at several locations (with more intended), coastal hazard provisions in the district plan and regional coastal plan, dumping of spoil and other material at numerous points along the foreshore and adjusting the orientation of the Hokitika River's discharge.

There are Resource Management Act coastal permits issued in this segment[188] for:

- river outlet and channel alteration (Arahura River, Flowery Creek, Houhou Creek).
- river and coastal protection works (Arahura River, Houhou Creek, Hokitika Beach, Hokitika River).
- whitebait stands (Hokitika River).
- stone extraction (several locations)[189].
- a footbridge (Wadeson Island).
- blacksand goldmining (Hokitika Beach).

187 Gibb 1987, Hicks 1988, Benn & Neale 1992
188 www.wcrc.govt.nz "Maps on the Web", June 2006
189 Hicks 2003

5.7.7 Existing Protection and Management Areas

Much of the Hokitika segment consists of private land lying immediately behind a strip of legal road along the beachfront. Public access to the shoreline is mostly via formed or unformed legal roads.

Several coastal areas are administered by the Department of Conservation: areas near the Arahura River mouth and Flowery Creek, the bed of the Hokitika River, parts of the Hokitika south spit, Mananui Bush and the forested margins of Lake Mahinapua (including Mahinapua Scenic Reserve) and Totara Lagoon (including the Totara Lagoon Wildlife Management Reserve).

The bed of the Arahura River is privately owned by Mawhera Inc, and the bed of Lake Mahinapua is owned by Te Runanga o Ngai Tahu. The margins of Mahinapua Creek/Tuwharewhare are owned by the West Coast Fish and Game Council.

Several waterways in this segment are closed to whitebaiting:

- Mahinapua Creek/Tuwharewhare to the south side of the Hokitika River; any tributary of Mahinapua Creek/Tuwharewhare; Lake Mahinapua and any stream running into the lake.
- The south bank of the Hokitika River from a point 500m downstream from the state highway bridge to the sea.

Whitebaiting is not permitted in non-tidal areas nor upstream of 'back pegs' on Houhou Creek, and the Arahura, Hokitika and Totara Rivers.

Coastal gold mining near Ross
Photo: D Neale, DOC.

Totara Lagoon beach
Photo: D Neale, DOC.

The Totara Lagoon Wildlife Management Reserve and the Arahura River (under private ownership) are noted in the Tai Poutini Eel Management Plan as "significant water bodies which are closed to commercial eel fishing"[190].

The Hokitika segment lies within Fisheries Statistical Area FSA 34, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Westland District.

The operative West Coast Regional Coastal Plan recognises:

- Coastal Protection Area; CPA7 Totara Lagoon
- Culturally Significant Area; CSA13 Arahura
- Coastal Recreation Areas; CRA11 Hokitika Beach, CRA12 Lower Hokitika River
- Coastal Hazard Area; CHA14 Arahura to Takutai

Wadeson Island recreation area, in the upper tidal reach of Hokitika River
Photo: D Neale, DOC.

190 Tai Poutini Tuna 1999

5.8 Wanganui

(Mikonui River – Abut Head, 50 km)

5.8.1 Summary

The Wanganui segment mostly consists of a coastal plain backed by marine terraces and broad river flats, interspersed with a number of headlands that are being eroded into bluffs by wave action. Saltwater Lagoon is a prominent coastal lagoon and four moderately large rivers flow out to sea in this segment. The coastal plain and terraces are a mixture of protected forests, wetlands and farmland with little residential development. The seabed is mostly of a uniform shelf grading out to fine sediments, with mostly coarse-grained mixed sand and gravel or cobble beaches, while boulder reefs provide patches of hard shore. The shelf is broad and shallow in the northern part of this segment.

The Wanganui coastal and marine area supports marine life that is typical of such habitats in the central West Coast. Notable features include: accessibility to the coastline and use of the river mouths; Saltwater Lagoon and other coastal wetlands; ease of travel along the coast; natural coastal landscapes; cultural and historic heritage features; and recreational uses.

Existing coastal protection includes several portions of conservation land, especially Saltwater Lagoon and Abut Head Scenic Reserves and the Kakapotahi and Saltwater Ecological Areas. There are also three waterways closed to whitebaiting and several specified areas under the Regional Coastal Plan.

5.8.2 Natural Features

COASTAL LAND AND ISLANDS

The glacial landforms in the Wanganui segment are typical of the central part of the West Coast; they include moraine bluffs, shingle riverbeds, outwash terraces and dunes. Overall,the moraine bluffs are in a largely unmodified state, whereas the river mouth flats and coastal strip comprise a mixture of natural landscape (coastal wetlands and podocarp forest) and areas modified by farming development and introduced vegetation (such as marram and gorse).

The moraine bluffs which are such a visual coastal landscape feature of this segment, have been formed by sea erosion of the extensive glacial deposits of the ice ages. Bold Head, the Wanganui Bluffs, and Abut Head are the most prominent moraine bluffs within this segment; Bold Head is the most northerly of these distinctive coastal landforms on the West Coast. Another, The Doughboy/Kokiraki, a moraine remnant landmark at the mouth of the Wanganui River, has a formed track to its summit providing an elevated coastal viewpoint.

Saltwater Lagoon, at a time when the outlet is blocked. *Photo: T Hume, NIWA*

Coastal dunes in this segment are extensive but substantially modified by farming and weed infestation. The main exception to this is the Saltwater Lagoon beach, which has been rated as one of the most biologically valuable coastal dune systems on the West Coast[191].

COASTAL WETLANDS AND WATERWAYS

Shearer Swamp (135 ha) lies mostly outside the coastal marine area but drains to the sea through Waikoriri Creek lagoon, a 'hapua' wetland that lies in a swale behind the foredune and beach[192]. The swamp has been rated a wetland of national importance[193].

191 Johnson 1992
192 Hart & Single 2004
193 Cromarty & Scott 1995

Pouerua River mouth, with Hikimutu and Saltwater Lagoons toward the south.
Photo: T Hume, NIWA

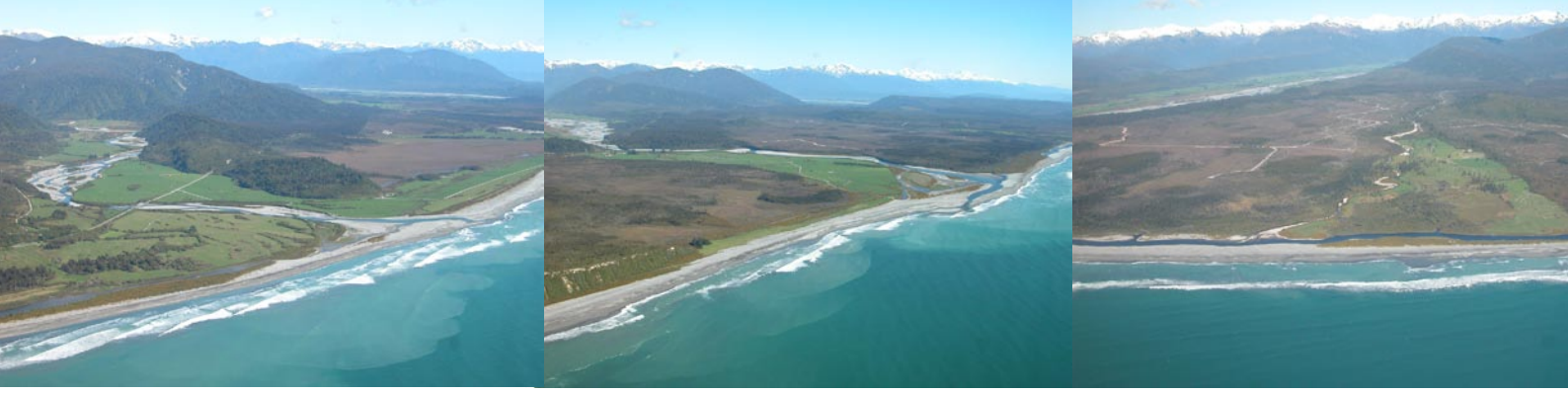
Wanganui River
Photo: T Hume, NIWA

"With the adjoining Fergusons Bush Scenic Reserve, Shearer Swamp forms part of an increasingly rare example of a relatively intact succession from virgin lowland podocarp forest to unmodified inland swamp which eventually progresses into tidal lagoon. It supports a number of endemic threatened species including the giant kokopu ... and Australasian bittern... It also supports whitebait ... and other indigenous [freshwater] fish, as well as considerable numbers of waterfowl."

The largest waterways in the Wanganui segment are the Mikonui, Waitaha, Wanganui and Pouerua Rivers. The Waitaha River has an estimated annual suspended sediment discharge of 2.8 million tonnes[194]. Each of these has river mouth habitats with adjoining tidal and coastal wetlands. The slow-moving, tannin-stained streams flowing into the Waitaha River (Te Rahotaiepa River/ Ounatai Lagoon) and the Pouerua River (Hikimutu Lagoon) are unmodified with good cover of riparian indigenous forests and wetlands. Te Rahotaiepa Lagoon sometimes has its own outlet separate to the main stem of the Waitaha River. The Waitaha and Wanganui River mouths have been rated as habitats of moderate wildlife value[195].

Saltwater Lagoon has been rated as a habitat of high wildlife value[196], and is a Statutory Acknowledgement Area under the Ngai Tahu Settlement Act. Its character is very dependant on the state of its outlet, which can be either blocked or opened for extended periods (months or years) by natural build-ups and breaches of the barrier beach sediments at the mouth. These natural changes tend to cause little disruption to human activities, and so the lagoon is one of the few wetlands on the West Coast that frequently blocks but does not have a history of artificial breaching. The lagoon takes the form of a coastal lake when the outlet is blocked, but becomes a tidal flat estuary when the outlet is open. Although these physical changes have not been studied in detail, it is likely that they have substantial effects on the natural ecology of the lagoon and its catchments.

194 Hicks & Shankar 2003
195 Coker & Imboden 1980
196 Coker & Imboden 1980



From left: Mikonui River and Shearer Swamp; Waitaha River; Ounatai Lagoon. *Photos: T Hume, NIWA*

SEASHORE AND MARINE AREAS

A broad shelving area extending into the northern part of the Wanganui segment is informally known as Bold Head (after the nearby landmark), where depths of less than 50 metres reach out beyond the 12 Mile territorial limit. In the south of the segment the seabed shelves off more steeply across the inner shelf, reaching a depth of about 150 metres at the territorial limit.

The seabed grades from coarse sand and gravel beaches to muddy sediments offshore. The beaches mostly comprise sand and gravel foreshore, with a foredune of low to medium height. Beach dynamics are greatly affected by the mouth and channel movements of the nearby rivers, and shoreline erosion of up to 8.3 metres per year have been reported[197]. The inter-tidal zone is dominated by mixed sand and gravel beaches of variable width that have generally very low biological diversity.

Rocky shores formed from the eroded ends of Ice Age moraines are mainly in the vicinity of Wanganui Bluff and Abut Head. Two areas of extensive moraine boulder 'ramp' occur in this segment, at the 'Mikonui mussel bed' and near the mouth of Saltwater Lagoon. These areas are exposed only at spring low tides and form suitable habitats for greenlip mussels and other shorelife over several hectares each. Other patchy areas of moraine boulder shore and reef occur at Bold Head, Opuku Cliff, The Doughboy/Kokiraki and north of the Pouerua River mouth.

COASTAL AND MARINE WILDLIFE

During the winter months, up to several hundred New Zealand fur seals haul out in the vicinity of rocky coasts near Whakaikai River and at Abut Head, dwindling to much lower numbers in the summer[198].

A small colony of sooty shearwaters was known to breed in burrows near the top of The Doughboy/Kokiraki in the mid 1990s[199], but there is no information on its present status.

MARINE FISH AND OTHER SPECIES

This coastal region like the whole west coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

Glacial moraine bluffs at Abut Head (top) and Bold Head (bottom). *Photos: D Neale, DOC.*

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[200].

197 Gibb 1978
198 Neale & Best 1999
199 J. Reid pers comm 1999
200 Stevenson & Hanchet 2000

From left:
Moraine bluffs at Green's Beach;
Moraine boulder shore at Green's Beach
Photos: D Neale, DOC.

A coastal reef north of the Mikonui River supports a large population of greenlip mussels[201]. Coastal reef fish surveyed at this site revealed a suite of species typical of moraine shores in central Westland and similar to those found in the northern West Coast. This is one of only two known habitats of the mottled clingfish, an intertidal fish known only from the West Coast region[202].

5.8.3 Historical and Archaeological Heritage

Early Maori sites are recorded at Saltwater Lagoon, as well as other sites. The locality has a significant place in Maori history[203], as a settlement site, mahinga kai and the place where the Crown agent James Mackay sealed the purchase of Te Tai Poutini (the West Coast) from the chiefs of Poutini Ngai Tahu in 1860. Remains of goldmining and pack tracks occur intermittently along the whole coastline[204].

Saltmarsh and forested margins of Saltwater Lagoon.
Photos: D Neale, DOC.

201 Stark & Asher 1993
202 Roberts et al 2005
203 Ngai Tahu Settlement Act 1998
204 Hooker 1986, 1990

5.8.4 Recreation and Tourism

Fishing and other recreational activities are dispersed throughout the Wanganui segment, especially near river mouths and access points. The Harihari coastal walk is an especially popular access route to the coast between the Wanganui River mouth, The Doughboy/Kokiraki and the Pouerua River mouth – for fishing, whitebaiting, and beachwalking. Several baches occur near the mouth of the Pouerua River, and whitebaiters' baches and other structures occur along the banks of the Wanganui River. Whitebaiting occurs on each of the main rivers (Wanganui, Pouerua, Waitaha and Mikonui) as well as the smaller creeks in the area. While greenlip and blue mussels are present at several locations (most notably the bed near Saltwater Lagoon) the extent of gathering is not documented.

Waikoriri Lagoon
Photo: D Neale, DOC.

5.8.5 Commercial Use

This area – as for most of the inshore West Coast – is fished by commercial fishers using a variety of methods, the most common being bottom trawl[205]. Vessels in this area mostly operate out of Greymouth, but also Westport, Nelson and other ports.

Six mining licenses exist on the coastal strip from the Waitaha River to Wanganui Bluff, one at the Wanganui River mouth and five from Pouerua River to Saltwater Lagoon.

5.8.6 Other Public Uses and Facilities

The main public access points to the coastal marine area in this segment are at Donoghues, Greens Beach, and the Harihari coastal walkway. Access across private land is also possible in other locations such as Bold Head Road and the Waitaha River mouth north bank. Public access to the more isolated parts of this segment is mostly by walking or beach vehicle from those points, or by boat. Coastal foot travel is restricted by the tide at several points, especially at Abut Head and the major river mouths.

While isolated residences occur in places and the inland settlement of Harihari is nearby, there are no heavily settled coastal areas in this segment.

There are Resource Management Act coastal permits issued in this segment[206] for:

- whitebait stands (Waitaha, Wanganui and Pouerua Rivers);
- stream outlet opening (Waikoriri Lagoon);
- stone and gravel extraction (several locations);
- blacksand goldmining (Greens Beach to Saltwater beach).

Wanganui Bluffs
Photos: D Neale, DOC.

205 Booth et al 2005
206 www.wcrc.govt.nz "Maps on the Web", June 2006

Wanganui River mouth and a small moraine outcrop, The Doughboy/Kokiraki. *Photos: D Neale, DOC.*

5.8.7 Existing Protection and Management Areas

Extensive parts of the coastal strip and adjoining wetlands are within conservation lands, especially:

- in the vicinity of Shearer Swamp, Bold Head (including Kakapotahi Ecological Area).
- between the Waitaha River and Saltwater Lagoon (including Saltwater Lagoon Scenic Reserve and Saltwater Ecological Area surrounding it).
- Abut Head (including Abut Head Scenic Reserve).

Wanganui River beach from the summit of The Doughboy/ Kokiraki. *Photo: D Neale, DOC.*

The largest blocks of private coastal land occur in the vicinity of Mikonui River, Waitaha River and parts of Abut Head.

Pouerua (Saltwater Lagoon) is a Ngai Tahu Statutory Acknowledgement Area.

Several waterways in this segment are closed to whitebaiting:

- Ounatai Lagoon (a tributary of the Waitaha River)
- Oneone Creek (a tributary of the Wanganui River)
- Hikimutu Lagoon (a tributary of the Poerua River)

Whitebaiting is not permitted in non-tidal areas, nor upstream of 'back pegs' on the Mikonui, Waitaha, Wanganui and Pouerua Rivers[207].

Saltwater Lagoon Scenic Reserve is an extensive water body which is closed to commercial eel fishing (on account of its protected land status)[208].

The Wanganui marine area lies within Fisheries Statistical Area FSA 34, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Westland District.

The operative West Coast Regional Coastal Plan recognises:

- Coastal Protection Area; CPA8 Saltwater Lagoon
- Culturally Significant Area; CSA14 Mikonui
- Coastal Recreation Area; CRA13 Harihari Coastal Walkway
- Marine Mammal and Bird Sites; MMB12 Wanganui Bluff, MMB13 Abut Head.

207 Whitebait Fishing (West Coast) Regulations 1994
208 Tai Poutini Tuna 1999

5.9 Okarito

(Whataroa River – Waihapi Creek, 43 km)

5.9.1 Summary

The Okarito segment comprises a coastal plain backed by marine terraces and broad river flats, interrupted by moraine bluff headlands that are being eroded by wave action. The Okarito Lagoon tidal flat estuary dominates the coastal landscape along with two large rivers (Whataroa and Waiau (Waiho)). The seabed is mostly a uniform shelf grading out to fine sediments, the beaches mainly coarse-grained mixed sand and gravel or cobble, while boulder reefs provide patchy 'hard shore' habitat. The area supports marine life that is important to the central West Coast. Access to this coastline is most commonly at Okarito settlement. The coastal plains and terraces are almost all covered in protected forest, but residential development is a feature at Okarito and farming occurs on the Waiau (Waiho) river flats.

Notable features of the Okarito segment include: the coastal settlement of Okarito, coastal accessibility, the network of river mouths and other coastal wetlands, unmodified coastal landscapes, its rich cultural and historic heritage, and the variety of recreational uses.

Okarito beach towards Kohuamarua Bluff.
Photo: T Hume, NIWA

Large areas of the coastal hinterland are protected as conservation land, especially Westland Tai Poutini National Park, Waitangiroto Nature Reserve and the Okarito Lagoon Wildlife Management Reserve. There are also several specified areas under the Regional Coastal Plan.

5.9.2 Natural Features

COASTAL LAND AND ISLANDS

The coastal landforms in this segment reflect the glacial imprint on this central part of the West Coast; prominent landscape features are moraine bluffs, riverbeds, outwash terraces and dunelands. Overall, they remain in a largely unmodified state and the coastal terraces are covered with extensive areas of lowland podocarp forest. The main exceptions to this are:

- parts of the lowland catchments of the Whataroa, Waitangitaona and Waiau (Waiho) Valleys that have been developed for farming,
- the 'North Okarito forest' that was previously selectively logged but is now protected within Westland Tai Poutini National Park, and
- minor areas in and around Okarito settlement.

Forest areas between Okarito and the Waiau (Waiho) River are under intensive pest control, primarily to protect the endangered rowi (Okarito brown kiwi). This segment contains the southern recorded limits on the West Coast for at least eight coastal plant species, such as the kawakawa and some small aquatic herbs.[209]

The Okarito Lagoon beach has the most extensive dune system in central Westland and retains high biological value despite some degree of modification and encroachment of marram grass and gorse[210]. Pingao grows in relative abundance in the dunelands, especially at the northern end of Okarito Lagoon, Okarito township and the southern end of Five Mile beach. Introduced marram grass is being controlled on dunes at Three Mile beach.

There are no islands in this segment.

209 Overmars et al, unpublished DOC data
210 Johnson 1992

COASTAL WETLANDS AND WATERWAYS

Okarito Lagoon and Waitangiroto River (and indeed the entire network of coastal wetlands from Wanganui River to Five Mile Lagoon), are regarded as wetlands of national importance[211] by the Department of Conservation, particularly because of their high numbers and diversity of birds, particularly waterfowl and waders. Okarito Lagoon (3240 ha) is one of the most extensive estuarine areas in the West Coast region and is a landform of geological interest[212] and a habitat of outstanding wildlife value[213]. It comprises sand and mud flats with extensive areas of saltmarsh dominated by sea rush, saltmarsh ribbonwood and jointed rush that provide good cover for birds and fish. Large shellfish beds of cockles, pipi and other bivalves and invertebrates also occupy large areas of the estuary's mudflats and tidal channels, providing a food source for other species. Okarito Lagoon is biologically valuable as an example of the transition from a saltwater to a freshwater wetland with a mixture of sandy and silty substrate. Okarito and the other estuaries provide spawning and rearing habitat for indigenous fish species, including giant kokopu and inanga[214].

From top:
Waikukupa River;
Omoeroa River and
Sandfly Beach
Photos: T Hume, NIWA

Three Mile and Five Mile Lagoons have been rated as habitats of high wildlife value[215]. Three Mile Lagoon is a 110 ha tidal flat estuary that occasionally fills with fresh water due to a natural blockage of the outlet by beach sediments. It has one of the densest recorded populations of native mistletoe[216] and contains areas of saltmarsh vegetation but generally only sparse beds of estuarine invertebrates. Five Mile Lagoon is an 80 ha hapua lagoon wetland that lies within the coastal marine area. It has extensive beds of marginal and aquatic vegetation, primarily rushes, sedges and flax.

The largest rivers discharging into this segment are the Whataroa and Waiau (Waiho) Rivers, with estimated annual suspended sediment discharges of 4.8 and 3.4 million tonnes respectively[217]. Coastal wetlands are associated with these river mouths and others such as the Omoeroa and Waikukupa (which have been rated as habitats of high wildlife value[218]). The Waitangiroto River has been rated as a habitat of outstanding wildlife value[219]. It is a waterway lined with tall kahikatea forest in its lower reaches, best known as the only New Zealand breeding site of the kotuku (along with royal spoonbills and little shags that also nest there). The Waitangiroto River often shares an outlet with the Waitangitaona River.

SEASHORE AND MARINE AREAS

Moraine shores in this segment comprise boulder ramps extending up to several hundred metres off the shore, which support biological communities that are generally typical of such shores in this central part of the West Coast. The most extensive moraine shore occurs at Kohuamarua Bluff, where moraine boulders form patchy reef habitat around the lower tide levels of the foreshore and up to several hundred metres offshore.

211 Partridge 2004, Cromarty & Scott 1995, Davis 1987, Morse 1981
212 Hayward & Kenny 1999
213 Coker & Imboden 1980
214 Davis 1987
215 Coker & Imboden 1980
216 D. Norton pers comm 1998
217 Hicks & Shankar 2003
218 Coker & Imboden 1980
219 Coker & Imboden 1980

From left:
Three Mile Lagoon
Five Mile Lagoon
Photos: T Hume, NIWA

The beaches in the Okarito segment are mostly of mixed sand and gravel, although they tend to be more stony in places (such as at Omoeroa and Waikukupa beaches). Some of the beaches have foreshore ironsand deposits.

Offshore the seabed slopes gradually out across the inner shelf at a gradient of less than two degrees within the territorial limit, reaching a depth of about 160 to 250 metres at the territorial limit. Seabed sediments grade from coarse sand and gravel close to shoreline, to muddy sediments offshore.

COASTAL AND MARINE WILDLIFE

Kotuku, spoonbills and little shags nest at Waitangiroto River. Waders and other estuarine birds breed, feed and roost in the vicinity of the wetlands, barrier beaches and river mouth areas, with greatest abundance at Okarito Lagoon. Banded dotterels are reported to regularly nest on Okarito Beach[220]. Relatively high numbers of blue penguins (about 20 to 30) have been reported on the beaches from Three Mile to Five Mile[221].

Whataroa River and
Okarito Lagoon
Photo: T Hume, NIWA

MARINE FISH AND OTHER SPECIES

The Okarito coastal segment like the whole West Coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawling, longlining, trolling and set netting.

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[222] .

Commercial fisheries for tuna, red cod, flatfish and rig (to mention a few) are an important feature throughout this coastal and inshore segment.

The rocky shores typically support a variety of flora and faunal species such as bull kelp, mussels, limpets, reef stars and coastal reef fish. These are all abundant around Kohuamarua Bluff, including a mussel bed near the northern end of the bluff. Natural sand scour affects most of the rocky shore areas in this segment.

All of the waterways and aquatic habitats in the Okarito segment support whitebait, eels and other native freshwater fish. Surveys have shown that the fish communities of Okarito Lagoon range from marine brackish near the outlet to effectively freshwater in the upper reaches[223].

220 R. Stewart pers comm 1997
221 Hughes 2005
222 Stevenson & Hanchet 2000
223 M. Morrison pers comm 2006

From top:
Commissioner Point;
Kohuamarua Bluff;
Okarito Lagoon
Photos: D Neale, DOC.

5.9.3 Historical and Archaeological Heritage

Early Maori sites are recorded at Okarito Lagoon[224], and the area has a significant place in Maori history[225] as the site of an early Whare Wananga (house of learning), the home of the kotuku (white heron), a rich mahinga kai, and several kainga nohoanga (settlements).

A monument at Okarito township commemorates Abel Tasman's first sighting in 1642 of the West Coast of 'Niew Zeeland', although the exact location was probably further north. The area also has a rich goldmining history and several associated historic sites, with beach claims having been worked since the first gold rush in the area in 1866.

5.9.4 Recreation and Tourism

Nature-based tourism is a significant activity in this segment, with Okarito and Waitangiroto being the focal points. White Heron Sanctuary Tours operates jet boat trips to the Waitangiroto Nature Reserve, and guided access to the kotuku colony along a constructed boardwalk. Okarito Nature Tours provides guided excursions and kayak hire on Okarito Lagoon.

A variety of tourist traffic visits Okarito throughout the year. The Okarito wharf shed and boat launching area is an important access point to the lagoon and the road provides scenic vistas across the lagoon when approaching or leaving the settlement.

The Okarito-Three Mile pack track and coastal route are popular local walks and the Okarito Trig walk provides an expansive view of the coast and the wider forested and glaciated landscape. The beach at Okarito is a popular site for both residents and visitors to the area and DOC interpretation panels provide information about nesting dotterels and pingao.

Recreational fishing in the area includes:

- surfcasting (at accessible locations).
- eeling and shellfish (cockle & pipi) gathering (especially within Okarito Lagoon).
- whitebaiting (especially in the Whataroa River, Waitangitaona River and Okarito Lagoon).

Waterfowl shooting and recreational boating occurs in Okarito Lagoon, as does set netting for flatfish and kahawai. Mussel gathering occurs at a bed near the northern end of Kohuamarua Bluff. The mudflats provide good walking routes to upper reaches of the lagoon around low tides.

5.9.5 Commercial Use

This area, like most of the inshore West Coast, is fished by commercial fishers using a variety of methods, the most common being bottom trawl[226] – see above. Vessels mostly operate out of Greymouth, but also Westport and Nelson.

224 Hooker 1990
225 Ngai Tahu Settlement Act 1998
226 Booth et al 2005

Okarito Lagoon is one (of five listed) of the 'substantial water bodies' on the West Coast available for commercial eel fishing[227], and the only one within the coastal marine area.

Two mining licenses exist on the coastal strip fronting Okarito Lagoon, two at Five Mile and three on the Omoeroa-Waikukupa beaches. Blacksand goldmining using mechanical means has occurred historically on the barrier beaches at Waikukupa and at Five Mile.

5.9.6 Other Public Uses and Facilities

The main public access (including vehicle access) to the coastal marine area in this segment occurs at Okarito settlement. Access is also possible by walking or boating down the Whataroa and Waitangitaona Rivers, thereby gaining access to the white heron colony; there is a vehicle track down the lower Waiho River to its mouth. Public access to other parts of the Okarito segment is mainly by walking, boat or beach vehicle from these points. Access across waterways and along the coast is possible along the full length but restricted by the tide at several points, especially at Okarito Lagoon, major river mouths, and Kohuamarua Bluff. Walking access to the southern reaches of this coastline is possible from the Gillespies Beach pack track and coastal route past Galway Point.

Okarito Lagoon
Photo: D Neale, DOC.

The main settlement is at Okarito where a combination of private residences and holiday accommodation form a cluster of several dozen buildings. A public water supply is pumped from a well in the mudflats behind the settlement, and waste water is mostly managed using private septic tanks. Coastal flooding of buildings and properties sometimes occurs at Okarito, usually as a result of natural blockage of the lagoon outlet causing a backup of water in the lagoon.

There are Resource Management Act coastal permits issued in this segment[228] for:

- whitebait stands (Whataroa and Waitangitaona Rivers).
- boat trips; lagoon outlet opening and water abstraction (Okarito Lagoon).
- sand and gravel extraction (Okarito beach).
- a river ford formation (Waiau (Waiho) River).

Okarito settlement
Photo: D Neale, DOC.

227 Tai Poutini Tuna 1999
228 www.wcrc.govt.nz "Maps on the Web", June 2006

From top:
Waiau (Waiho) River;
Waiau (Waiho) rivermouth;
Waitangiroto Lagoon with Okarito Lagoon in distance
Photos: T Hume, NIWA

5.9.7 Existing Protection and Management Areas

Most of the coastal land in the Okarito segment is under some form of formal protection. In the north, much of the Waitangitaona, Waitangiroto and Lake Windermere areas are within the Waitangiroto Nature Reserve and other conservation lands. Much of the land on the spit and islands of Okarito Lagoon (and probably some wet margins within the coastal marine area) is within the Okarito Lagoon Wildlife Management Reserve. Most of the land inland and south of Okarito Lagoon is within Westland Tai Poutini National Park.

Whitebaiting is not permitted in non-tidal areas, nor upstream of 'back pegs' on the Whataroa, Waitangitaona and Omoeroa Rivers[229].

Waitangiroto Nature Reserve, Lake Windermere and Five Mile Lagoon are "significant water bodies which are closed to commercial eel fishing" (on account of their protected land status)[230].

Okarito Lagoon is a Ngai Tahu Statutory Acknowledgement Area[231].

The area lies within Fisheries Statistical Area FSA 33, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Westland District.

Wetlands in this segment are presently being investigated by the Department of Conservation as possible 'wetlands of international importance' in terms of the Ramsar Convention – the international treaty established (in association with the World Conservation Union (IUCN)) for the conservation and sustainable utilisation of wetlands.

The operative West Coast Regional Coastal Plan recognises:

- Coastal Protection Areas; CPA9 Okarito Lagoon, CPA10 3 Mile Lagoon, CPA11 5 Mile Lagoon
- Culturally Significant Area; CSA15 Okarito.
- Coastal Recreation Area; CRA14 Okarito Lagoon
- Outstanding Natural Features and Landscapes; ONFL7 Waitahi Bluff to Oturokua Point
- Marine Mammal and Bird Site; MMB14 Okarito Bluffs.
- Coastal Hazard Area; CHA15 Okarito Beach.

229 Whitebait Fishing (West Coast) Regulations 1994
230 Tai Poutini Tuna 1999
231 Ngai Tahu Settlement Act 1998

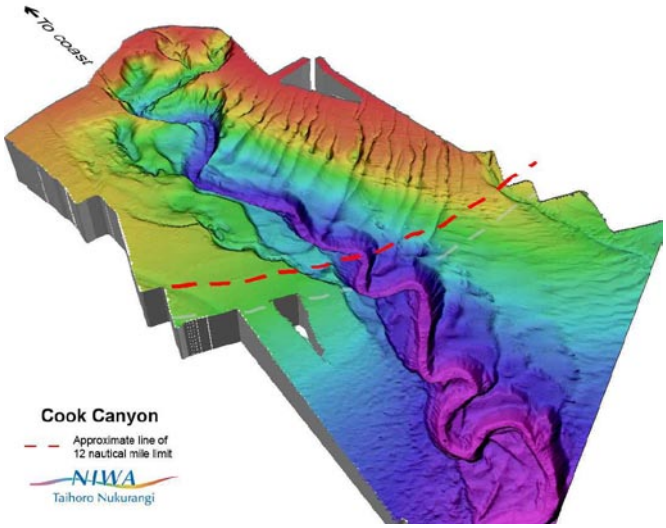
5.10 Cook

(Waihapi Creek – Heretaniwha Point, 43 km)

5.10.1 Summary

The Cook coastal segment is mostly a coastal plain backed by marine terraces and broad river flats, interrupted by moraine bluff headlands that are being eroded by wave action. The Cook/Weheka, Karangarua, Makawhio and Mahitahi Rivers are the main waterways.

The inshore zone is mostly of coarse-grained mixed sand and gravel or cobble beaches, while boulder reefs provide patchy 'hard shore' habitat. The shelf in this segment broadens to a shallow seabed plain in the south but is broken by a more complex formation at the head of the Cook Canyon in the north.



The area supports marine life that is typical of the central West Coast. Access to the coastal and marine area is most commonly at Gillespies Beach, Hunt Beach and Bruce Bay. The coastal plain and terraces are mostly in protected forest, but residential development is a feature at some sites, with farming occurring on some of the river flats.

Notable features of this segment include: the coastal settlement at Bruce Bay, coastal accessibility, a network of river mouths and other coastal wetlands, scenic natural coastal landscapes, cultural and historical heritage and a variety of recreational uses.

Existing coastal protection includes large areas of conservation land, including parts of Westland *Tai Poutini* National Park north from the Cook/Weheka River. Karangarua Lagoon and Makawhio River are Ngai Tahu Statutory Acknowledgement Areas and there are also several specified areas under the Regional Coastal Plan.

Tall indigenous forest exposed to the sea by coastal erosion at Maori Beach, Bruce Bay.
Photo: T Hume, NIWA

From top:
Gillespies Beach
Hunt Beach
Photos: T Hume, NIWA

5.10.2 Natural Features

COASTAL LAND AND ISLANDS

The glacial landforms in the Cook segment are typical of such landforms in this central part of the West Coast; they include moraine bluffs, shingly riverbeds, outwash terraces and dunelands. Overall, the coastal landscape is largely in a natural state, and includes some of the most extensive areas of lowland podocarp forest in New Zealand.

Sites of geological interest include the Cook/Weheka River mouth lateral moraine landform and a huttonite mineral site of international importance at Gillespie Beach[232].

COASTAL WETLANDS AND WATERWAYS

Several large to medium rivers flow out to sea in this segment and are described here along with their associated coastal wetlands from north to south[233]. Of these the Cook River flats, Karangarua River mouth and Waikowhai Stream have been rated as habitats of high wildlife value[234].

The Cook/Weheka River has a 32 km course and a catchment of about 340 km^2. Its cold waters are laden with glacial silt derived from its major source, the Fox Glacier/Te Moeka o Tuawe. Consequently it has a very changeable riverbed and mouth, with the lowest reaches making a major shift to the north in the 1970s to follow the course of the Clearwater River and emerge adjacent to Oturokua Point.

The Ohinetamatea River has a 29 km course and a catchment of about 100 km^2. The lower reaches the river flow in a confined entrenched channel, becoming a wide, tannin-stained sluggishly flowing tidal reach shortly before entering the sea.

The Karangarua River has a 47 km course and a 350 km^2 catchment, with a moderately wide and slightly braided lower reach. It shares a common estuary with the smaller and much-branched Gordon and Nicholson Creeks. Both of these creeks are deeply entrenched, sluggish, tannin-stained, have a mud and gravel bed and are tidal for several kilometres upstream from their common mouth.

The Manakaiaua River is a small rain fed river about 18 km long with a 60 km^2 mostly forested catchment (but with rough pasture in the lower reaches where its channel is less entrenched, slightly tannin-stained, sluggish and tidal). It shares an outlet with Hunt Creek.

The Makawhio River is a 31 km long snow and rain-fed river with a 175 km^2 catchment. It runs across a partly forested flood plain to its lower reaches, becoming wider, sandier and slower flowing as it reaches a large lagoon at its mouth.

The Mahitahi River is 33 km long with a mostly forested 225 km^2 catchment. In the lower reaches it has a narrow flood plain and is slightly braided.

232 Hayward & Kenny 1999
233 Orchard et al 1987
234 Coker & Imboden 1980

SEASHORE AND MARINE AREAS

Rocky shores in this area are made up entirely of glacial moraine and till. The largest of these formations are Heretaniwha Point and Makawhio Point, with others at Gillespies Point/Kohaihai, Malcolm's Knob, Cook Bluff and Karangarua River mouth. Sub-tidal rocky reefs occur at each of these sites as well as locations further offshore, such as Post Rock off the Karangarua River mouth and Tutanekai Rock off Makawhio Point[235].

From top: Mahitahi River mouth; Makawhio Point, looking south to Makawhio River with Mahitahi River in distance
Photos: T Hume, NIWA

Bruce Bay is one of the more sheltered beaches on the West Coast, protected from southerly storms by the prominent headland of Heretaniwha Point. However, the bay's coastline has eroded considerably over the last few decades[236].

Offshore the Cook Canyon dominates a relatively complex seabed form. Although the deepest reaches of the canyon extend outside the territorial limit, it does begin within about two miles off the Gillespies Beach shoreline and reaches depths of approximately 550 metres within territorial waters. The sediments and topography of the canyon area (see Chapter 2) has recently been surveyed in detail by NIWA and it has been found to comprise an intricate channel network acting as a significant 'sink' for continental shelf sediments[237]. South of the canyon, the seabed slopes moderately steeply to the edge of the continental shelf at depths of about 150 metres. Seabed sediments of the continental shelf grade from coarse sand and gravel beaches to sandy mud offshore, but tend to remain somewhat coarser at the head of the canyon.

An important safe anchorage area is located adjacent to Galway Beach offering protection from unfavourable coastal weather patterns.

COASTAL AND MARINE WILDLIFE

Up to several hundred New Zealand fur seals haul out on the rocky coast from Gillespies Point/Kohaihai to Galway Beach during the winter months, dwindling to much lower numbers in the summer[238]. This colony has been rated as a habitat of high wildlife value[239]. Seals also occur in lower numbers at Malcolm's Knob and other moraine headlands in the area.

About 40 tawaki (Fiordland crested penguin) nests occur around the headland of Heretaniwha Point.[240]

MARINE FISH AND OTHER SPECIES

This coastal region, like the whole west coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch

235 RNZN 2002b
236 Pickett 2005
237 P. Barnes pers comm 2006
238 Neale & Best 1999
239 Coker & Imboden 1980
240 McLean et al 1997
241 Stevenson & Hanchet 2000

From top:
Hunt Beach
Karangarua River
Ohinetamatea River
Photos: T Hume, NIWA

include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[241].

Commercial fisheries for crayfish, tuna, red cod, hoki, ling, flatfish and rig (to mention a few) are an important feature throughout this coastal and inshore segment.

5.10.3 Historical and Archaeological Heritage

Mahitahi (Bruce Bay) is regarded as the first landing place of Maui (Te Tauranga Waka a Maui) and the area is steeped in ancient traditions that make it a very significant area for Maori in South Westland. Archaeological sites are located at Bruce Bay[242] as well as relics with a history of shipping and timber milling. The Karangarua Lagoon and the Makawhio River have significant places in Maori history as kainga nohoanga (settlements) and mahinga kai and the area is the source of the stone aotea[243]. Remains of goldmining and pack tracks occur intermittently along the coastline as far south as Gillespie Beach[244].

5.10.4 Recreation and Tourism

Recreational fishing occurs in parts of this segment and includes surfcasting (at accessible locations), river mouth and lagoon fishing and whitebaiting (especially in the Ohinetamatea, Karangarua, Manakaiaua, Makawhio and Mahitahi Rivers). There is also mussel and shellfish gathering (especially at Hunts Beach and Bruce Bay), boatfishing and set netting.

Bruce Bay is a popular scenic viewing place for visitors, being one of the most accessible South Westland beaches from State Highway 6.

Gillespies Beach is visited by tourists often on their way to view the seals at Gillespies Point/Kohaihai. A walking track follows the historic goldminers' route to Galway Beach, and historic goldmining features are interpreted on information panels at Gillespies Beach.

5.10.5 Commercial Use

This area, like most of the inshore West Coast, is fished by commercial fishers using a variety of methods including bottom trawl, trolling, potting, set netting and longlining. Vessels in this area mostly operate out of Greymouth, but also Jackson Bay, Westport and Nelson.

Two mining licences exist on the coastal strip at Gillespies Beach, and seven from the Karangarua River to Heretaniwha Point.

242 Hooker 1986
243 Ngai Tahu Settlement Act 1998
244 Hooker 1990

From left:
Cook/Weheka River with Fox Glacier in the distance;
Cook/Weheka River
Photo: T Hume, NIWA

5.10.6 Other Public and Cultural Uses and Facilities

The main public access (including vehicle access) to the coastal marine area in this segment occurs at Gillespies Beach and Bruce Bay. Access is also possible by vehicle and/or walking to the Cook/Weheka River mouth and Hunt Beach. Public access to other parts of this coastline is mostly by walking or beach vehicle from those points. Access across waterways and along the coast is possible along the full length, but restricted by the tide at several points, especially at the Cook, Karangarua, Makawhio and Mahitahi River mouths. Foot access around Heretaniwha Point is also made difficult by the action of the sea and tides against a steep moraine bluff.

Waikowhai Stream
Photo: T Hume, NIWA

Recreational and commercial fishing vessels occasionally launch out of the Mahitahi River, which provides access to the rocky reef areas to the south and other adjacent fishing areas.

There are few areas of settlement in the Cook segment, though isolated residential buildings occur at Gillespies Beach, Hunt Beach and Bruce Bay.

Te Tauranga Waka a Maui Marae at Bruce Bay was opened in 2005, recognising the importance of the area to South Westland Maori and providing a facility for use.

Rock protection works have been placed along the banks of the Mahitahi River and for several hundred metres along the coast towards the north, aiming to protect the State Highway and other assets at Bruce Bay from coastal erosion.

The traditional practice of collecting seagull eggs from the Karangarua lagoon during spring is still carried out by local Ngai Tahu[245].

The Makawhio River and nearby beaches within this segment are the main sources of aotea (kyanite), a stone traditionally used for carving.

There are Resource Management Act coastal permits issued in this segment[246] for:

- whitebait stands (Ohinetamatea, Karangarua, Makaawhio and Mahitahi Rivers);
- gravel, stone or log removal (Karangarua River, Manakaiaua, Bruce Bay);
- river and coastal protection works (Bruce Bay and Mahitahi River).

5.10.7 Existing Protection and Management Areas

Much of the coastal land to the north of Cook/Weheka River lies within Westland Tai Poutini National Park; other coastal land is protected as conservation land further south and around Gillespies Beach. Private and other land tenures occur, especially in the vicinity of Gillespies Point/Kohaihai, Karangarua Lagoon, Hunt Beach, Makawhio River and Bruce Bay.

245 Ngai Tahu Settlement Act 1998
246 www.wcrc.govt.nz "Maps on the Web", June 2006

Heretaniwha Point
Photo: DOC.

Karangarua Lagoon and Makawhio River are Ngai Tahu Statutory Acknowledgement Areas. As a mark of the significance of the mahinga kai and the kainga nohoanga at Karangarua and Makawhio, reserves were set aside for Ngai Tahu in this area at the time of the 1860 Arahura Deed of Sale, and subsequently under the South Island Landless Natives Act 1906.

Whitebaiting is not permitted in non-tidal areas nor upstream of 'back pegs' on the Omoeroa, Karangarua, Manakaiaua, Makawhio and Mahitahi Rivers and Hunt Creek[247].

The Cook segment lies within Fisheries Statistical Area FSA 33, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Westland District.

The operative West Coast Regional Coastal Plan recognises:

- Culturally Significant Areas; CSA16 Hunt Beach, CSA17 Maori Beach, CSA18 Heretaniwha
- Coastal Recreation Areas; CRA15 Gillespies Beach, CRA16 Bruce Bay
- Outstanding Natural Features and Landscapes; ONFL7 Waitahi Bluff to Oturokua Point, ONFL8 Hunt Beach to Waita River
- Marine Mammal and Bird Sites; MMB15 Gillespies Point/Kohaihai, MMB16 Heretaniwha Point.
- Coastal Hazard Areas; CHA16 Hunt Beach, CHA17 Bruce Bay.

Gillespies Point/
Kohaihai
Photo: D Neale, DOC.

247 Whitebait Fishing (West Coast) Regulations 1994

5.11 Paringa

(Ohinemaka beach – Tauperikaka Point, 39 km)

5.11.1 Summary

The Paringa segment is mostly steep and forested coastline backed by hills, with the exception of lowland swamps in the vicinity of the Ohinemaka River. The Paringa River is the largest waterway in this segment, with several smaller rivers and streams flowing out to sea. The shoreline is dominated by rocky reefs and rock stacks that also extend offshore, with a few beaches of coarse sand and fine gravel. The continental shelf lies almost completely within the territorial limits, with the steeper continental slope and the Moeraki Canyon dropping off from depths of about 200 metres. The area supports marine life important to the southern West Coast, and also represents a biological transition zone between the West Coast and the outer Fiordland coast. Coastal access is mainly for fishing and recreational activities, by several walking routes to the coast or by boat from launching sites. The landscape and habitats in this segment remain substantially in a natural state.

Notable features of this segment include its moderate accessibility by land and boat, unmodified catchments and coastline, scenic natural coastal landscapes, marine wildlife, rocky reefs, canyons and variety of recreational uses. Fishing and tourism are the main uses of this coastal marine area.

Existing protection includes conservation lands covering almost all of the coastal land in this segment (including the Whakapoai Wildlife Refuge for the protection of tawaki), plus several specified areas under the Regional Coastal Plan.

5.11.2 Natural Features

COASTAL LAND AND ISLANDS

The Paringa segment comprises a series of rocky headlands interspersed with embayments backed by steep hillslopes and catchments cloaked in mixed indigenous forest. Lowland areas occur in the vicinity of Ohinemaka River, as well as near the Paringa River mouth, Abbey Rocks and Ship Creek.

Twenty-five small vegetated rock stacks occur throughout this segment, often in small clusters and mostly between Abbey Rocks and Arnott Point. Only a few of these have been surveyed to some extent.

The threatened seal cress occurs at Hanata Island as a relatively large population of about 300-400 plants, and in smaller numbers at Abbey Rocks and Arnott Point[248]. The threatened shore spurge occurs near Cole Creek[249].

Pingao dunes at Ship Creek beach.
Photo: T Hume, NIWA

Several of the coastal dunes in this segment have been assessed to be of considerable botanical value, and some of these are described as follows[250]. Dunes at Cole Creek are rated highly for their biological value because of their dune to forest sequence and also because they have examples of native coastal vegetation easy of access from the highway. The native dune plant pingao is abundant there and marram grass and most of the gorse have been removed. The Ohinemaka beach has good sequences of forested dunes and beach ridges in the central and southern parts despite the presence of gorse, and a large coastal swamp with forested frontal dunes in the north. The threatened shore spurge occurs in places south of Paringa River and the colony on the Piakatu-Paureka beach may be one of the most extensive in the country.

248 Neale 2006e, unpublished DOC data
249 R. Piper pers comm 2006
250 Johnson 1992

View to Arnott Pt from Knights Pt lookout
Photo: T Hume, NIWA

Murphy Beach
Photo: T Hume, NIWA

The area contains a variety of sedimentary and igneous rock formations[251], and sites of geological interest include the igneous and sedimentary geology near the Paringa River mouth and the igneous geology at Ship Creek[252].

COASTAL WETLANDS AND WATERWAYS

There are four main rivers (Ohinemaka, Paringa, Moeraki (Blue) and Whakapohai (Little)) in this segment[253], but more than forty other streams run seaward from small coastal catchments.

The Paringa and Moeraki Rivers are the largest waterways in this segment, draining catchments of mountains and lowland hill country, including Lakes Paringa and Moeraki respectively.

The Ohinemaka River flows for 15 km and has a 72 km^2 catchment. It is a small rain-fed river that has northern tributaries that drain a large dune swamp extending most of the way to Heretaniwha Point.

The Whakapohai River flows for 16 km and has a catchment of 61 km^2. The lower floodplain widens steadily to a width of about 300 metres at the mouth, with the outlet occasionally closed and only a narrow, shallow and swift channel permitting egress to the sea.

SEASHORE AND MARINE AREAS

Shallow rocky reef communities have been surveyed at several locations within this segment and their biological features are generally similar to other parts of South Westland[254]. The reefs often extend to depths of over 20 metres.

Ohinemaka beach in the north is a six kilometre stretch of coarse sand foreshore, while numerous smaller beaches occur to the south, mostly in association with rocky features such as headlands, stacks and patchy reefs.

Offshore, the Moeraki Canyon dominates a complex seabed form. The majority of the canyon formation lies within the territorial limit, and begins within about two to three miles of the shoreline near Knights Point, reaching depths of about 950 metres within territorial waters. Elsewhere in this segment, the seabed slopes out to the continental shelf edge at about 150 metres depth and about ten to fourteen miles offshore. Seabed sediments are not well surveyed in this area; beach sediments are variously coarse sand, gravel and pebbles

251 Institute of Geological and Nuclear Sciences (1992)
252 Hayward & Kenny 1999
253 Orchard et al 1987
254 Shears in prep

Whakapoai River beach
Photo: T Hume, NIWA

Important anchorages for commercial fishing vessels are located on the northern side of Arnott Point and the shore side of Abbey Rocks.

COASTAL AND MARINE WILDLIFE

Hanata Island, Tititira Head, Abbey Rocks, Monro beach, Murphy Beach and Arnott Point have been rated as habitats of high wildlife value[255].

Seals haul out at Hanata Island, Arnott Point and several other locations. Small numbers of pups are born at Hanata Island[256]. Arnott Point (and its adjacent islet) is the main seal haulout in this segment, rising to several hundred animals in the winter months[257]. Lone elephant seals are frequently seen at the Arnott Point colony.

Cole Creek beach and Adiantum Bluff, with the Haast plain beyond.
Photo: T Hume, NIWA

About 190 tawaki (Fiordland crested penguin) nests are dispersed from Buttress Point to Cole Creek, with relatively well-known and accessible colonies at Monro beach and Murphy Beach[258]. Blue penguins have been reported nesting at Tititira Head[259].

MARINE FISH AND OTHER SPECIES

This coastal region, like the whole west coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[260].

255 Coker & Imboden 1980
256 Neale 2006e, Neale & Best 1999
257 Neale & Best 1999
258 McLean et al 1997
259 Coker & Imboden 1980
260 Stevenson & Hanchet 2000

From top:
Knights Point to Arnott Point;
Whakapoai River and Lake Moeraki;
A sequence of four 'pocket beaches' at Monro Track, Moeraki River mouth, Whakapoai River mouth and Murphy Beach.
Photos: T Hume, NIWA

Commercial fisheries for crayfish, tuna, red cod, hoki, ling, bluenose, hapuka, flatfish and rig (to mention a few) are an important feature throughout this coastal and inshore segment.

A diversity of 45 coastal rocky reef fish species have been recorded in this segment, with 37 of these recorded from the reefs between Whakapoai River and Murphy Beach[261].

Paua in this area have been found from limited surveys to be relatively scarce and small[262].

5.11.3 Historical and Archaeological Heritage

There is evidence of pre-European Maori occupation at Ohinemaka and Paringa. The lithographic stone quarry at Abbey Rocks is a site of historical geological interest[263]. While there are no other listed European historic sites here, there is other history in this area for example relating to early European sealers at Arnott Pt[264] and exploration as far south as Tititira Head by Thomas Brunner[265].

5.11.4 Recreation and Tourism

Beachwalking is popular at the more accessible points along the coast, especially the Monro Track beach, Murphy Beach, Arnott Point, Paringa River mouth and Ohinemaka Beach. Monro Track is a benched track that provides foot access to the beach; it is often used by visitors seeking views of tawaki coming ashore.

Recreational fishing occurs throughout this segment, and includes surfcasting (mostly at the more accessible locations), boat-based fishing and diving and whitebaiting (especially in the Ohinemaka, Paringa and Moeraki Rivers). The Paringa segment is popular for recreational diving and crayfishing, mostly from boats but also occasionally by some shore based divers at Whakapoai River mouth and Monro Track. Recreational boating activity is mostly associated with fishing activities.

The area has some remote but high quality surfing sites such as at Buttress Point and Tititira Head.

Wilderness Lodge Lake Moeraki runs guided nature walks for their clients to a variety of sites including Murphy Beach, Arnott Point, Monro Beach and Ship Creek. A carpark, rest area and lookout with interpretation panels at Knights Point provide for a variety of tourist traffic and the elevated site offers picturesque views of the coastline and ocean.

5.11.5 Commercial Use

This area, like most of the inshore West Coast, is fished by commercial fishers using a variety of methods including bottom trawl, trolling, potting, set netting and longlining. Vessels in this area mostly operate out of Greymouth and Jackson Bay, but also Westport and Nelson. Rocky reefs in this area are fished extensively for rock lobster using craypots by vessels out of Jackson Bay and Okuru[266]. Abundance surveys in 1993 indicated poor prospects for a paua fishery in this area[267], though advice from a paua industry representative suggests otherwise.

261 Roberts et al 2005
262 McShane et al 1993
263 Hooker 1990
264 Begg & Begg 1979
265 Brunner 1847
266 Stevens 2000
267 McShane et al 1993

5.11.6 Other Public Uses and Facilities

Jet boats and other small vessels are able to navigate to the Paringa and Moeraki River mouths. Boats also access the area from Bruce Bay, Okuru and Jackson Bay.

There are several coastal walking routes in the area, including to the Ohinemaka River mouth, Monro Track, Whakapoai River, Murphy Beach, Arnott Point and Cole Creek. Foot access can be gained from these access points to numerous other sites along this coast, but access is severely restricted by tides around many of the rocky headlands, especially between Buttress Point and Piakatu Point.

Vehicles are able to access the area only via the rough tracks to the Whakapoai River mouth, the lower reaches of the Moeraki River and Cole Creek Beach. However views of the area are possible from many parts of State Highway 6.

At the mouth of the Ohinemaka River there are several huts used for whitebaiting, surfing and hunting. A house at the Whakapoai River mouth is permanently occupied and a cableway extending from the shore to the nearby rock stack was previously used for launching a commercial fishing vessel.

Rocky coast between Tititira Head and Awataikato Point.
Photo: T Hume, NIWA

There are Resource Management Act coastal permits issued in this segment[268] for:

- whitebait stands (Ohinemaka, Paringa and Moeraki Rivers);
- driftwood and log removal (Moeraki River).

Paringa River
Photo: T Hume, NIWA

268 www.wcrc.govt.nz "Maps on the Web", June 2006

5.11.7 Existing Protection and Management Areas

Much of the coastal land and catchments in this segment are within conservation lands, including the Whakapoai Wildlife Refuge (which provides for the protection down to and including the foreshore of breeding tawaki in colonies from about Abbey Rocks to Breccia Creek). Private and other land tenures occur especially in the vicinity of the Paringa River mouth.

The area lies within Fisheries Statistical Area FSA 33, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Westland District.

Whitebaiting is not permitted in non-tidal areas, nor upstream of 'back pegs' on the Paringa and Moeraki Rivers[269].

The operative West Coast Regional Coastal Plan recognises:

- Outstanding Natural Features and Landscapes; ONFL8 Hunt Beach to Waita River;
- Marine Mammal and Bird Sites; MMB17 Buttress Point, MMB18 Hanata Island, MMB19 Tititira Head, MMB20 Awataikato Point, MMB21 Abbey Rocks, MMB22 Otumotu Point, MMB23 Murphy Beach, MMB24 Arnott Point, MMB25 Seal Point.

Anticlockwise from top right:
Arnott Point reefs
Photo: Nick Shears, Auckland University

Ohinemaka Beach
Photo: T Hume, NIWA

Rocky shore near Knights Point
Photo: DOC

Arnott Point beach
Photo: L.F. Molloy

269 Whitebait Fishing (West Coast) Regulations 1994

5.12 Haast

(Ship Creek – Jackson Head, 56 km)

5.12.1 Summary

The Haast segment has a broad and mostly forested coastal plain backed by mountain ranges of the Southern Alps/Ka Tiritiri o te Moana. Six large rivers and several smaller ones flow out to sea, often with coastal wetlands at their mouths. Beaches are mostly of coarse-grained mixed sand and gravel and rocky reefs occur in places. The continental shelf lies wholly within the territorial limits, with the steeper continental slope and several canyons dropping off from depths of about 200 metres. The area supports marine life that is important to the southern West Coast. Coastal access is made for a variety of uses and at several points along the coast. Residential development and farming are significant land uses in the immediate coastal region.

Notable features of this segment include: its accessibility from a number of coastal settlements and roads, its coastal wetlands, coastal landscapes, rocky reefs, canyons, cultural and historic heritage and recreational uses. Commercial uses of the coastal marine area are significant throughout this segment.

Jackson Bay/Okahu
Photo: T Hume, NIWA

Existing protection includes areas of coastal conservation land associated with coastal forests and wetlands, controlled whitebaiting areas and conservation measures at Open Bay Islands. There are also several specified areas under the Regional Coastal Plan.

Jackson Head and Jackson Bay/Okahu looking north east towards mouth of Arawhata River and Haast coastal plain.
Photo: D.L. Homer GNS

Neils Beach, looking towards Arawhata River mouth.
Photo: T Hume, NIWA

5.12.2 Natural Features

COASTAL LAND AND ISLANDS

The formation of the present-day Haast coastline has been greatly influenced by processes stemming from the ice ages when large glaciers covered much of the land[270]. Valley glaciers merged near the coast to form a huge glacier tongue covering the entire area between Ship Creek and Jackson Head. The Haast coastal sand plain developed since the glaciers retreated and the sea level rose about 6000 years ago and is a landform of geological interest[271]. A huge river sediment output has caused the coastline to advance by up to 10 kilometres over that period. As a result the coastline along this segment mostly comprises sand and gravel beaches backed by a scrub-covered foredune with mostly pasture land behind it on a Holocene coastal plain and outwash surfaces.

Arawhata River mouth and Neils Beach.
Photo: T Hume, NIWA

Taumaka and Popotai (Open Bay Islands) are the two largest islands in the West Coast region. Together measuring about 30 ha in area and rising to 27 metres, the islands are a limestone remnant that was once covered by the ice age glaciers. These islands support a variety of wildlife and biological communities, and have been rated as habitats of high wildlife value[272]. The vegetation cover mostly comprises dense kiekie vine with margins of hebe shrubland[273] supporting a variety of coastal and marine biota[274]. The Open Bay Islands are of particular interest because:

- Taumaka is the only known location for three critically endangered[275] species: the Open Bay Islands leech, the Open Bay Islands gecko, and the Open Bay Islands skink;
- they support large breeding colonies of tawaki and fur seals, and are breeding areas for muttonbirds, fairy prions, spotted shags and gulls. Local populations of weka (introduced to the islands in historic times) and fernbirds are notable features of the islands;
- they support the largest known population of seal cress – a threatened plant known only from the South Island's west coast – and are the type locality from which this species was scientifically described[276].

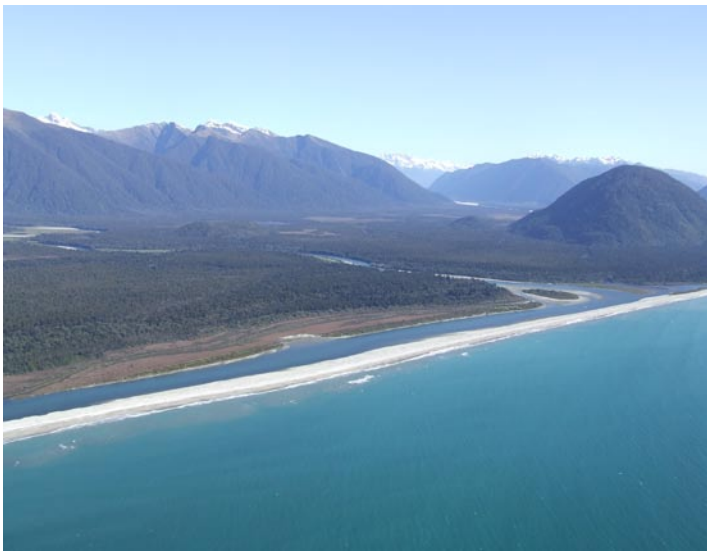
270 Coates et al 1993
271 Hayward & Kenny 1999
272 Coker & Imboden 1980
273 Burrows 1972
274 Newton 2005; Best 2001; Miller 1996; Garnock-Jones & Norton 1995; Richardson 1979; Stirling & Johns 1979; Miller 1996; Skeel 1974; Warham 1974; Crawley & Brown 1971; Benham 1904; Cockayne 1904
275 Hitchmough et al 2007, Molloy et al 2002
276 Garnock-Jones & Norton 1995

The most sheltered harbour in the West Coast is located in the Haast segment, at Jackson Bay. It is sheltered from unfavourable weather coming from most directions except the north to northeast.

The beach along the majority of this segment has generally low foredunes of about one to three metres in height. Coastal dunes at Ship Creek were rated highly for their biological value in a DSIR inventory because of their dune to forest sequence and also because they have examples of native coastal vegetation easy of access from the highway[277]. The native dune plant pingao is abundant there and marram grass and most of the gorse have been removed. The dunes from Waita to Haast Rivers were also rated highly in the same study, whereas the foredunes between the Waita River and Jackson Bay were considered to have relatively low botanical value due to *".....the simple and weedy nature of the beach-fringe vegetation..... this coastal and lowland plain vegetation is much more important for its variety on the older, inland, beach ridge and hollow systems."* (see also section 3.7.2)

The Haast sandplain is important as one of the largest relatively intact indigenous coastal dune forests remaining in New Zealand. Some areas, especially in the vicinity of the river mouths, settlements and the immediate coastal strip, are nevertheless developed as grazed pasture or are dominated by introduced plants such as marram and gorse[278]. However, natural values are high in locations where the forests extend to the riparian margins of the shore and coastal wetlands. The Hapuka River estuary kowhai forest walk is a readily accessible example of such a natural area.

The southern limits on the West Coast for at least 13 coastal plant species, including several saltmarsh plants[279], have been recorded in the Haast segment.



From top:
Waiatoto River
Lagoon and beach;
Mussel Point and
Hannah's Clearing
Photos: T Hume, NIWA

COASTAL WETLANDS AND WATERWAYS

Several large rivers – the Waita, Haast, Okuru, Turnbull, Waiatoto (the mouths of which have all been rated as habitats of high wildlife value[280]), and Arawhata Rivers – drain out to sea in this segment. Other rivers and streams cut out through the foredune in places or more typically converge with the mouths of the larger waterways. Most of the larger rivers fall steeply from mountainous catchments before emerging onto and flowing more slowly across,the Haast coastal plain. The Haast and Arawhata Rivers have estimated annual suspended sediment loads of 5.9 and 7.2 million tonnes respectively – not only two of the three highest on the West Coast (see Table 2.1) but also among the highest in New Zealand[281].

Wetlands on the Haast plain are closely associated with the sand plain forests and the river mouth areas. Semi-tidal wetlands occur in the lower reaches and small coastal tributaries of the larger rivers, and include Mataketake Lagoon (Waita River), 'Haast Beach lagoon' (the southern tributary of the Haast River mouth), Okuru River mouth, Turnbull River mouth, Hapuka River estuary, Waiatoto Lagoon and Hindley Creek (Waiatoto River) and Barton Creek

277 Johnson 1992
278 Johnson 1992
279 Overmars et al unpublished DOC data
280 Coker & Imboden 1980
281 Hicks & Shankar 2003

(Arawhata River). In combination with the river mouths themselves, these waterways provide important habitat for estuarine and lowland fish and birdlife. The Okuru/Turnbull/Hapuka estuary complex is one of the most extensive of these tidal wetlands.

Most of the rivers discharge their water and sediment loads through mouths that often shift according to prevailing sea and river conditions.

Okuru-Turnbull River mouth
Photo: T Hume, NIWA

Ship Creek is a small shaded, tannin-stained, rain-fed river with an 11 km course, several tannin-stained tributaries and a 28 km^2 catchment. The mouth of Ship Creek is frequently closed by beach sediment build-up in heavy westerly seas.

The rain fed Waita River which rises from the Mataketake Range, has an 18 km course and 152 km^2 catchment. Although its river flats are pastured and grazed, forest often lines and overhangs the river. The river's major tributary is the tannin-stained Maori River, draining a large expanse of lowland swamp and the Tawharekiri Lakes complex. Along with a series of dune lakes that feed diffusely into the Waita River, this causes the lower reaches of the Waita River to become light tea coloured. Within its tidal reaches, the river is fast-flowing and wide, with little in-stream cover, although placid waters are also present near the mouth. The location of the river mouth along the coast is variable owing to the influence of beach and sea dynamics.

The Haast River is a large, highly flood-prone, braided river with a wide unstable shingle floodplain. It originates in the alpine catchments of the Landsborough River and the north-west corner of Mount Aspiring National Park. There are some grazing lands on the lower river plains. The seaward end of the river receives the waters from dune swamps typical of the Haast plains. While the swamp to the north of the river mouth is not large, the swamp to the south is extensive but modified by semi-rural development.

Haast Beach
Photo: T Hume, NIWA

The Okuru and Turnbull Rivers have relatively narrow floodplains. In their lower reaches, each of their single channels are entrenched and flanked by grazing lands in one of the oldest settled areas of South Westland. Below this is an extensive estuarine area shared between the two rivers, as well as the smaller Hapuka River emerging from a 17 km^2 swampy catchment.

The lower reaches of the 55 km-long glacier-fed Waiatoto River are stable with a single channel and well-defined banks. There are few tributaries and these are small, but they drain considerable areas of swamp. Content and Halcyon Creeks drain the same area of swamp that the Hapuka River drains to the north, while Nisson Creek, Hindley Creek and Dawn Rivulet drain the swamps around the base of Mt McLean. The 50 km-long Arawhata River is also sourced from glaciated alpine catchments and its braided lower reaches flow across a broad shingle flood plain to a wide mouth at the eastern side of Jackson Bay/Okahu.

Haast River mouth and beach
Photo: T Hume, NIWA

SEASHORE AND MARINE AREAS

Beaches in the Haast segment are mostly of coarse-grained mixed sand and gravel; rocky reefs occur in places near the coast and offshore.

Protected by Jackson Head from the westerly swell, Jackson Bay is the only natural harbour on the exposed west coast of the South Island.[282] Consequently the bay has some distinctive features unknown or uncommon in other parts of the West Coast coastal marine area, including a relatively high diversity of fish, seaweeds and subtidal clam beds.[283] Jackson Bay is of scientific relevance as the 'type locality' for the robust triplefin, being the place from where this small coastal reef fish was first scientifically described in 1878.[284]

Rocky shores occur at inshore locations at Mussel Point and from Neils Beach to Jackson Head and typically extend out to about five metres depth (except on the deeper outer parts of Jackson Head). However, the offshore seabed includes some rocky areas, the most prominent being at Jackson Head and Open Bay Islands, as well as elevated seabed features that approach or break the surface, such as 'Goldie's Reef', Alhambra Rock, Bignell Reef, Open Bay Islands, 'Falcons Reef' and 'Halfway Rock'. Steep reef walls reach depths of over 30 metres in some inshore localities, such as 'Goldie's Reef' and Jackson Head.

The Open Bay Islands not only have significant terrestrial features (as discussed earlier) but also marine habitats with some interesting features, including a range of sheltered and exposed shores and extensive shore platforms on their north-western sides. This small marine area supports the richest diversity of seaweeds known for any site in the West Coast region[285]; it is also an area of abundance for coastal reef fish[286] and invertebrates. The islands' position off the mainland puts it further beyond the influence of inshore sand scour and turbidity that occurs to a greater extent on the mainland coast.

'Goldie's Reef' and 'Halfway Rock' are two uncommon examples on the West Coast of offshore submerged rocky reefs that are shallow enough to scuba dive on, but they have not been biologically surveyed.

282 Cpates et al 1993
283 Roberts et al 2005, Davidson et al 2003, Grange 2003, Grange et al 2001, Neale 2001, Neale & Nelson 1998, Knox 1991
284 Clarke 1879
285 Neale & Nelson 1998, Parsons & Fenwick 1984
286 Roberts et al 2005

Coastal currents in this area are affected by prevailing wind conditions and the topography of the seabed, and flow predominantly alongshore towards the southeast[287].

The continental shelf extends to about 10 miles offshore and is broken by the Haast and Arawhata Canyons. While most of these two canyons lie outside the territorial limit, their heads lie within about four miles of the shoreline and reach depths of about 1000 metres within territorial waters. A broad shelving area reaches offshore between the two canyons, but at a depth of about 200 metres it begins to drop away inside the territorial limit, down the continental slope towards the ocean depths of the Tasman Basin well offshore. The little available published information about the seabed sediments of this segment indicates a dominant cover of fine sand and mud[288]. It is likely then to have the general sediment pattern of the other canyon segment areas to the north – coarse sand and gravel beaches, grading offshore to finer silt and mud, and tending to remain somewhat coarser at the head of the canyons.

The Haast and Arawhata Canyons are significant submarine landforms of this segment, but the natural features and ecology of these, or their surrounding shelf areas within the territorial limits, are not well documented yet.

Important anchorages for commercial fishing vessels are located over an extensive area within Jackson Bay/Okahu and on the inside of Open Bay Islands.

Waita River and Mataketake Lagoon
Photo: T Hume, NIWA

COASTAL AND MARINE WILDLIFE

The Open Bay Islands have the greatest variety of marine wildlife (seabirds and marine mammals) known for any terrestrial site on the West Coast[289]. The islands are breeding sites for NZ fur seals, tawaki, blue penguins, muttonbirds, fairy prions, spotted shags and gulls and an important roosting site for variable oystercatchers. Fur seal pup production has been monitored annually at Taumaka since 1991, during which between 500 and 1400 pups have been born each year, with an overall trend of decline[290].

Hector's dolphins occur in moderate densities in South Westland[291] and are frequently seen (especially in the summer months when calves are born) at such places as Ship Creek and Neils Beach.[292] Bottlenose dolphins are occasionally present in Jackson Bay/Okahu, including a number of individuals known to also inhabit Milford Sound.[293]

Tawaki (Fiordland crested penguin) breed in colonies at Jackson Bay and Open Bay Islands and these sites comprise two of the largest known colonies for this threatened endemic species (316 and 150 nests respectively were estimated in the early 1990s[294]). Both of these sites have been ranked as outstanding wildlife habitats[295].

MARINE FISH AND OTHER SPECIES

This coastal region like the whole west coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

287 Chiswell & Greig 1991; Stanton & Greig 1991
288 RNZN 1984
289 Neale 2006e
290 H. Best pers comm 2006
291 Dawson 2001
292 Brager 1998
293 Russell et al 2005
294 McLean et al 1997
295 Coker & Imboden 1980

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[296].

Deeper waters (200-400 m) in South Westland within the territorial limits include a number of canyon heads and upper continental slope. These are characterised by a predominance of such fish as ling, ghost shark, hoki and tarakihi. There is no published information about the fish communities of waters deeper than 400 metres in this area.

Commercial fisheries for crayfish, tuna, red cod, hoki, ling, bluenose, hapuka, flatfish and rig (to mention a few) are an important feature throughout this coastal and inshore segment.

A relatively high diversity of 51 coastal reef fish species have been recorded in this segment, with 40 of these recorded from the rocky coast on the inside of Jackson Head[297]. Further out, but still within the shelter of Jackson Bay/Okahu, are beds of juvenile surf clams (with densities of up to 2600 per square metre) and other shellfish and invertebrates in the fine sand and silt[298].

Paua in this area have been found from limited surveys to be relatively scarce and small[299].

Bottlenose dolphins in Jackson Bay/Okahu
Photos: D Neale, DOC.

5.12.3 Historical and Archaeological Heritage

This area has a long history, especially relating to occupation and use of the Haast area by early Maori and European explorers, pounamu (nephrite jade) workers, sealers, mariners and pioneer settlers[300]. Important coastal archaeological sites include Taumaka, Okuru, Arawhata/Neils Beach and Jackson Head[301], recording a history of settlement and food gathering.

Jackson Bay/Okahu is an important traditional safe harbour and nephrite working area[302]. Taumaka is the site of New Zealand's oldest surviving European building relic, the remains of a small hut built by ten sealers who were marooned on the island from 1810 to 1814[303]. Early European sites are associated with the Jackson Bay Special Settlement, sealing, gold mining or shipwrecks.

5.12.4 Recreation and Tourism

The Department of Conservation has developed several popular visitor facilities in the coastal zone of this segment, the most frequented of these being:

- the Ship Creek walk, where a carpark, lookout tower, boardwalk and interpretation panels provide opportunities for the appreciation of coastal rainforest, a tidal stream, pingao dunes, open beach, and a dune-impounded lagoon;
- the Hapuka Estuary walk, where a carpark, boardwalk and interpretation panels provide opportunities for the appreciation of the lowland riparian forest and estuarine mudflat;

296 Stevenson & Hanchet 2000
297 Roberts et al 2005
298 Davidson et al 2003
299 McShane et al 1993
300 e.g. Bradshaw 2001
301 Hooker 1990
302 Hooker 1986, 1990
303 Neale 2006e, Cassady-St Clair & St Clair 1990, Begg & Begg 1979

- Jackson Bay, where a carpark, interpretation panels, wharf, walking tracks, and boatramp provide opportunities for the appreciation of this historic settlement and harbour, fishing facilities, coastal forest, beach and rocky shoreline and open vistas to the sea and mountain ranges.

The Haast area is becoming known as an area for marine mammal watching and several commercial operators run boat trips out of Jackson Bay. The wildlife viewing focus is on Hector's dolphins and bottlenose dolphins within the bay and fur seals at Open Bay Islands and Cascade Point.

Whitebaiting is a very significant recreational and commercial activity in the Haast area during the spring months, and the major rivers in this area are widely regarded as providing some of the country's biggest catches.

Recreational boating (including fishing and diving) is an increasingly popular activity in this area, with boats mostly launching out of Jackson Bay, as well as the Okuru River mouth. Recreational vessels travel widely out of Jackson Bay, and the fish caught include blue cod and other reef fish, tuna, sharks, groper, rock lobster and paua. Popular fishing spots include 'Goldie's Reef', Open Bay Islands, 'Halfway Rock' and Jackson Head to Cascade.

Other recreational fishing activities include shore diving (at Jackson Bay), surfcasting and angling (mostly near settlements, river mouths and access points) and mussel gathering (mostly at Neils Beach and Mussel Point). Beachwalking activities occur at most access points. Mussel Point beach is sometimes a venue for public and community events.

5.12.5 Commercial Uses

The Jackson Bay wharf, vessel moorings, storage facilities and road access provide the main infrastructure for the operation of fishing vessels in the area. The wharf includes berthage, winching and refuelling facilities, and up to a dozen moorings for commercial fishing vessels are located in the vicinity of Jackson Head, providing sheltered anchorage from most storm conditions[304]. The bay is the main base for about 14 commercial fishing vessels, with up to five other vessels launching out of Okuru River; the majority are rock lobster boats[305], but more vessels occupy the moorings during the tuna season and certain times of the year.

Jackson Bay wharf
Photo: T Hume, NIWA

304 Stevens 2000
305 Stevens 2000

The Haast segment area, as for most of the inshore West Coast, is fished by commercial fishers using a variety of methods including bottom trawl, trolling, potting, set netting and longlining. Vessels in this area mostly operate out of Jackson Bay and Greymouth, but also Milford, Westport and Nelson. Reefs in this area are also fished for rock lobster using craypots by vessels out of and Okuru and Jackson Bay.

Resource consents and a Fisheries Act permit are held by Jackson Bay Mussel Farms Ltd for a mussel farm to operate in a 45 hectare area in a portion of Jackson Bay/Okahu.

Resource consents are also held by Okuru Enterprises Ltd for a water export facility, including a 5.5 kilometre pipeline running northwards out from Neils Beach and a mooring for large 'Panamax' size cargo ships located about three kilometres off Jackson Head.

A mining license for beach aggregate exists to the north of the Haast River.

Whitebaiting is a very significant commercial activity in the Haast area during the spring months, and the major rivers in this area provide some of the country's biggest catches. During the season, whitebait stands line the banks of the Waita, Haast, Okuru, Turnbull, Waiatoto and Arawhata Rivers.

Open Bay Islands from Okuru Beach; *Photo: P. Ross, Auckland University*

Open Bay Islands *Photo: P. Ryan, DOC collection*

5.12.6 Other Public Uses and Facilities

Small settlements occur close to the coast in some places, including Haast, Haast Beach, Okuru, Hannah's Clearing, Neils Beach and Jackson Bay, and contain a mixture of residential and holiday accommodation, as well as various shops and services.

Public access to the coastline is possible particularly between Ship Creek and Hannah's Clearing (but is in places restricted by private land, wetlands and forest) and along the roadside between Neils Beach and Jackson Bay. Frequent landslips onto the Jackson Bay road are typically cleared by bulldozing over the shore adjacent to the shore.

The Open Bay Islands have been important for ecological research and monitoring since the hut was built there in the early 1970s, with a particular focus on fur seals and tawaki. A scientific monitoring station on the Jackson Bay wharf comprises a small shed and instrument cable that is part of a nationwide network managed by NIWA and providing accurate information on tides and other water level changes.

The Jackson Head lighthouse serves to guide vessels into Jackson Bay.

There are Resource Management Act coastal permits issued in this segment[306] for:

- whitebait stands (Haast, Okuru, Turnbull, Waiatoto and Arawhata Rivers);
- river and coastal protection works (Okuru River and Jackson Bay);
- stone extraction (Waita to Okuru River beaches);
- driftwood removal (several locations);
- gravel extraction (Waita River);
- a water export pipeline and mooring buoy, a mussel farm, a polythene cable and a wharf (Jackson Bay/ Neils Beach);
- a boat ramp (Okuru R);
- blacksand goldmining (north Haast beach).

306 www.wcrc.govt.nz "Maps on the Web", June 2006

Jackson Bay/Okahu from Neils Beach. *Photo: Nick Shears, Auckland University*

5.12.7 Existing Protection and Management Areas

Most of the coastal land and catchments in this segment are within Crown conservation lands, including the Okahu Wildlife Refuge (which provides for the protection of breeding tawaki in the Jackson Head colony). Private and other land tenures occur especially in the vicinity of the Waita River mouth, Haast River, Haast beach, Okuru-Turnbull River mouth and Mussel Point, Hannah's Clearing, Arawhata River mouth and Neils Beach, and Jackson Bay.

The Open Bay Islands are privately owned Maori land, but are also gazetted as a Wildlife Refuge. Helicopter landings on the islands are addressed by the provisions of a gazette notice under the Marine Mammals Protection Act. A biosecurity plan developed by the Department of Conservation aims to minimise the risks of pest introductions to these islands[307].

Several waterways in this segment are closed to whitebaiting [308]:

- Crikey Creek (a tributary of the Haast River)
- Nolans Creek (a tributary of the Okuru River)
- Collyer Creek (a tributary of the Turnbull River)
- The area known as the Hapuka River (including any tributary stream of the Hapuka River) that extends to the sea on the south bank and to the Okuru Lagoon on the north bank.
- Any tributary stream of the Waiatoto River and the waters of the Waiatoto River above the mean high water mark.

Whitebaiting is not permitted in non-tidal areas, nor upstream of 'back pegs' on the Waita, Haast, Turnbull, Okuru, Waiatoto and Arawhata Rivers.

The area lies within Fisheries Statistical Area FSA 33, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Westland District.

The operative West Coast Regional Coastal Plan recognises:

- Coastal Protection Area; CPA12 Open Bay Islands
- Coastal Development Area; CDA3 Jackson Bay wharf.
- Culturally Significant Areas; CSA19 Hapuka (Mussel Point), CSA20 Jackson Bay/Okahu, CSA21 Jackson Bay/Okahu
- Coastal Recreation Areas; CRA17 Ship Creek, CRA18 Jackson Bay/Okahu
- Outstanding Natural Features and Landscapes; ONFL8 Hunt Beach to Waita River, ONFL9 west Jackson Bay/Okahu to Awarua Point.
- Marine Mammal and Bird Sites; MMB26 Open Bay Islands, MMB27 Jackson Head.
- Coastal Hazard Area; CHA18 Okuru River to Waiatoto River.

307 Newton 2005

308 Whitebait Fishing (West Coast) Regulations 1994

5.13 Cascade

(Jackson Head – Cascade Point, 22 km)

5.13.1 Summary

The Cascade segment comprises a mostly steep and forested coastline, backed by hilly catchments in the north and the Cascade Plateau in the south, with several small streams flowing out to sea and no coastal wetlands present. The shoreline is dominated by rocky reefs that also extend offshore and the few beaches are mostly of coarse sand and fine gravel. The continental shelf lies wholly within the territorial limits, with the steeper continental slope and several canyons dropping off from depths of about 200 metres. The area supports marine life that is important to the southern West Coast, representing a transition between the northern parts of the West Coast and the outer Fiordland coast. Coastal access to this area is for fishing and recreational activities, mostly by boat from Jackson Bay or by several walking routes to the coast. The landscape and habitats in this segment are unmodified.

Notable features of this segment include accessibility by boat from Jackson Bay in the north, limited access by land, unmodified catchments and coastline, the visually-impressive coastal landscape of the Cascade Bluffs, rocky reefs, canyons and other seabed formations, and recreational uses. Fishing is the main commercial use of the coastal marine area.

Existing protection includes conservation lands that cover almost all of the land in this segment and several specified areas under the Regional Coastal Plan.

Cascade Bluffs waterfall
Photo: N. Shears, Auckland University

5.13.2 Natural Features

COASTAL LAND AND ISLANDS

The coast from Jackson Head to near Teer Creek comprises a series of rocky headlands and small embayments, backed by generally steep hillslopes and catchments covered in indigenous forest.

The Cascade Bluffs are an imposing landscape feature, extending from about Teer Creek to Cascade Point. The bluffs are the eroded end of a large lateral moraine from glaciers that once flowed down from the Olivine Range and the Red Hills, and are composed mostly of compacted ultramafic boulder deposits. A ramp of large boulders forms the shoreline at the base of the bluffs in most parts, but in places (especially in the vicinity of Cascade Point) the bluffs drop vertically down to well below sea level. Cascade Point is a fossil site of geological interest[309].

About ten vegetated rock stacks of less than 0.1ha each are scattered throughout this segment, including 'Cascade Island', which has a dominant cover of the threatened seal cress[310].

COASTAL WETLANDS AND WATERWAYS

Several small rivers and streams enter the coast in this segment, including the Smoothwater and Stafford Rivers and Teer Creek. The Duncan, Donald and Dougal Creeks terminate in waterfalls over the edge of the bluffs, inspiring the name 'Cascade' for several features in this area. There are no coastal wetlands of note in this segment due to the general absence of lowland flats.

309 Hayward & Kenny 1999
310 Neale 2006e

From top:
Cascade Point reefs
Photo: N. Shears, Auckland University
Jackson Head boulder shore
Photo: D Neale, DOC.

SEASHORE AND MARINE AREAS

Coastal rocky reefs occur along the whole segment, and these support a diversity of habitats that are generally typical of such habitats in the southern West Coast, representing a transition between the northern parts of the West Coast and the outer Fiordland coast.

Small beaches occur only at Ocean Beach, Smoothwater Bay, Homminy Cove and Stafford Bay. Nephrite and semi-nephrite cobbles can be recovered from some of the beaches in this segment[311].

A complex formation of submarine canyons extends to within about two kilometres of the coastline in this Cascade segment. The accurate detail of these formations is uncertain, as charts portray different topographies[312]. NZ Oceanographic charts label three main canyons in this area (the Arawhata, the Jackson and part of the Cascade), and show small extensions of continental shelf extending out no more than about 10 kilometres in the vicinity of Smoothwater Bay and Cascade Point. The seafloor reaches depths of about 2000 metres within the territorial limits, while locally rising to about 1000 metres in some outer parts of the territorial waters. The continental slope and canyons are very steep-sided formations with slopes of up to about 30 degrees in some places.

Important anchorages for commercial fishing vessels are located inside Cascade Island, around a headland just north of there and in Smoothwater Bay.

COASTAL AND MARINE WILDLIFE

The Jackson Head – Cascade Point coast has been rated as a habitat of outstanding wildlife value[313].

About 300 tawaki (Fiordland crested penguin) nests are dispersed from Stafford Bay to Cascade Point, while others occur at the large Jackson Head colony (see Segment 12).[314]

When surveyed in 1990, the rocky coast north from Cascade Point had one of the largest New Zealand fur seal breeding colonies on the West Coast, with an estimated 3000 seals (including at least 500 pups)[315].

Petrels and possibly prions were reported in 1980 to be breeding at Jackson Head[316] but there are no more recent published reports.

MARINE FISH AND OTHER SPECIES

This coastal region, like the whole west coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

311 Hooker 1986
312 Carter 1981, RNZN 1985
313 Coker & Imboden 1980
314 McLean et al 1997
315 Anderson 1990
316 Coker & Imboden 1980

Jackson Head
bedrock shore
Photo: D Neale, DOC.

Ocean Beach,
Jackson Head
Photo: D Neale, DOC.

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[317].

Commercial fishing using other methods such as longline, potting, set net, and trolling for a number of species such as bluenose, ling, stargazer, warehou, lemon sole, hapuka, school shark, tuna and crayfish (to mention a few) is extensive.

Surveys in this area of shallow reef communities[318] and coastal reef fish[319] indicate that the reefs in this segment are generally typical of the South Westland coast, representing a transition between the northern parts of the West Coast and the outer Fiordland coast. A high diversity of 60 coastal reef fish species have been recorded in this segment. Paua in this area have been found to be relatively scarce and small[320].

There is little published information on the fish communities of the continental shelf and canyons in this area, in part because the NIWA West Coast trawl surveys do not extend this far south.

5.13.3 Historical and Archaeological Heritage

The Cascade coastal segment was an important nephrite collecting and working area. Post European sites are generally associated with shipwrecks[321], including the Pacific in 1857[322]. Cascade Point was named by Captain Cook in 1776, after the several waterfalls on the nearby bluffs.

5.13.4 Recreation and Tourism

Walking tracks lead through coastal forest from Jackson Bay to Ocean Beach (the Wharekai Te Kou track), and to Smoothwater and Stafford Bays, providing access to natural coastal landscapes and rocky coasts that are used for exploring, fishing and other activities.

Recreational boats access this area from nearby Jackson Bay for such purposes as fishing and sightseeing, and these activities appear to have increased significantly here in recent years[323]. Rod fishing is the main type of fishing, but scuba diving, snorkelling and recreational set netting appear to be popular in this region as well.

317 Stevenson and Hanchet 2000
318 Shears in prep
319 Roberts et al 2005
320 McShane et al 1993
321 Hooker 1990
322 Ingram 1990
323 G. Newton pers comm 2005

Bluffs of Cascade Point, looking south to mouth of Cascade River and Barn Bay
Photo: D.L. Homer, GNS

5.13.5 Commercial Use

The Cascade area, as for most of the inshore West Coast, is fished by commercial fishers using a variety of methods including bottom trawl, trolling, potting, set netting and longlining. Vessels in this area mostly operate out of Jackson Bay and Greymouth, but also Milford, Westport and Nelson. Reefs in this area are also fished for rock lobster using craypots by vessels out of Jackson Bay and Milford.

Abundance surveys have indicated that there are poor prospects for a paua fishery in this area[324] but there is still potential for development of a fishery.

5.13.6 Other Public Uses and Facilities

Access to the area is mainly by boat from Jackson Bay, and also from the airstrip at the mouth of the Cascade River, or the track down the Cascade River from the roadend at Martyr Homestead. Walking routes exist on the Wharekai Te Kou, Smoothwater Bay and Stafford Bay tracks. There is a Department of Conservation hut at Stafford Bay.

There is one Resource Management Act coastal permit issued in this segment[325], for stone extraction in Homminy Cove.

5.13.7 Existing Protection and Management Areas

Most of the coastal land and catchments in this segment are within conservation lands, except for small areas of legal road along the Smoothwater River.

Whitebaiting is not permitted in non-tidal areas, nor upstream of 'back pegs' on the Smoothwater River[326].

The area lies within Fisheries Statistical Area FSA 33, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Westland District.

The operative West Coast Regional Coastal Plan recognises:

- Culturally Significant Areas; CSA22 Smoothwater Bay, CSA23 Homminy Cove, CSA24 Teer Creek
- Coastal Recreation Area; CRA18 Jackson Bay/Okahu
- Outstanding Natural Features and Landscapes; ONFL9 west Jackson Bay/Okahu to Awarua Point
- Marine Mammal and Bird Sites; MMB27 Jackson Head, MMB28 Stafford Bay to Cascade Point.

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324 McShane et al 1993

325 West Coast Regional Council, www.wcrc.govt.nz "Maps on the Web", June 2006

326 Whitebait Fishing (West Coast) Regulations 1994

5.14 Hope

(Cascade Point – Awarua Point, 40 km)

5.14.1 Summary

The Hope segment comprises a mostly steep and forested coastline, backed by hilly catchments in most places. One major river, the Cascade, and several smaller rivers and streams enter the sea in this segment. The shoreline is dominated by rocky reefs that also extend offshore and the few beaches are mostly of coarse sand and fine gravel. The continental shelf lies wholly within the territorial limits, with the steeper continental slope and several canyons dropping off from depths of about 200 metres. The area supports marine life that is important to the southern West Coast, representing a transition between the northern parts of the West Coast and the outer Fiordland coast. Coastal access to this area, for fishing and recreational activities, is mostly by boat from Jackson Bay and Milford, or by a remote tramping route along the coast linking Barn Bay and Big Bay. The landscape and habitats in this segment are unmodified.

Notable features of the Hope segment are its remoteness, limited access by land, unmodified catchments and coastline, natural coastal landscapes, rocky reefs, and canyons. Fishing is the main commercial use of the coastal marine area.

Existing protection includes: conservation lands that cover almost all of the land in this segment, closed whitebaiting areas and several specified areas under the Regional Coastal Plan.

Barn Islands
Photos: P. Ross, Auckland University

5.14.2 Natural Features

COASTAL LAND AND ISLANDS

The coast along the Hope segment is mostly a series of rocky headlands, interspersed with boulder shores, beaches and embayments and backed by steep hillslopes and catchments cloaked in indigenous forest. Enclosed coastal lowlands and sand dunes occur at several places, the largest being at Cascade Beach and Barn Bay

Coastal dunes at Cascade River mouth and Barn Bay are rated more highly for their biological value than any other dune system in the West Coast, and "are very important for their diversity of dune communities and associated wetlands, in good condition"[327]. The native dune plant pingao is abundant there, and marram grass and gorse have been eradicated. The Spoon River beach vegetation is also rated highly for its variety and good condition despite its limited extent.

There are four main groups of offshore rock stacks in this segment: Barn Islands, Browne Island, The Steeples and Gorge Islands. Browne Island is a low and barely vegetated rock formation that is often occupied by fur seals. The others are more steep sided formations with a capping of coastal scrub, but no particular species or habitats of note are known to occur on them.

The Cascade River– Barn Bay coast, Gorge River to Longridge Point coast, and Browne Island have been rated as habitats of high wildlife value[328].

327 Johnson 1992
328 Coker & Imboden 1980

Browne Island
Photo: N. Shears, Auckland University

Nephrite and semi-nephrite (pounamu) sources include the Cascade, Hope, Spoon and Gorge Rivers and the beach between Cascade River and Barn Bay[329]. These rocks originate from the Red Mountain ultramafic formation located east of the Alpine Fault between the Jackson and Pyke Rivers, and have been redistributed by glacial action and rivers[330].

COASTAL WETLANDS AND WATERWAYS

The Cascade River is the largest of the waterways in this segment, and the Hermitage Swamp (1300 ha) in its lower reaches has been rated as a wetland of national importance[331]. The lower reaches of the Cascade River are tidal for up to 18 kilometres upstream, and the channel meanders across a swampy floodplain in which over 60 km^2 of the catchment lies below 30 metres altitude[332].

The Barn Bay dune swamp (140 ha) has been rated as a habitat of high wildlife value[333]. The Hope River is a natural waterway flowing seaward from here.

SEASHORE AND MARINE AREAS

Rocky coastline and reefs dominate the coastline in this segment, with the substrates mainly bedrock and boulders.

The limited number of beaches consist of coarse sand and fine gravel. Except at Cascade River beach and Barn Bay, the beaches are often interspersed with rocky reefs.

Gorge River boat landing
Photo: D Neale, DOC

329 Beck 1984
330 Hooker 1986
331 Cromarty & Scott 1996
332 Orchard et al 1987
333 Coker & Imboden 1980

North of Gorge River, with The Steeples rock stacks, and Cascade Point in the distance.
Photo: D Neale, DOC.

A complex formation of submarine canyons extends to within about three kilometres of the coastline in this segment. The detail of these formations is uncertain as charts portray different topographies[334]. NZ Oceanographic charts label the main 'Cascade' canyon in the northern part of the segment, with the continental shelf extending between six and 16 kilometres off the coast. The seabed reaches depths of about 800 to 1500 metres at the territorial limit, and the continental slope and canyons are very steep-sided formations with slopes of up to about 25 degrees in some places[335]. Sediments have not been documented in published sources, but the continental shelf in this segment is reported to comprise significant areas of gravel and foul ground.

Seals on Browne Island
Photo: P. Ross, Auckland University

334 RNZN 1985, Carter 1981
335 Carter 1981

One of the few dwellings on the isolated coast of the Hope segment, at Gorge River
Photo: D Neale, DOC.

Important anchorages for commercial fishing vessels are located near Crayfish Rock, Gorge Islands and Barn Islands.

COASTAL AND MARINE WILDLIFE

Iota Bluff to Cascade Bay, Browne Island, and Gorge River to Longridge Point have been rated as habitats of high wildlife value[336].

About 100 tawaki (Fiordland crested penguin) nests are dispersed from Cascade River to Sandrock Bluff, with also a small number north of Gorge River.[337]

Browne Island is a small haulout site for NZ fur seals, with up to about 20 animals at any time[338]. Seals are also reported to haul out on the Iota Bluff to Barn Bay coast[339].

Sooty shearwaters have been reported to breed between Cascade River and Barn Bay, with 69 occupied burrows reported in the 1970s; Barn Bay was reported to support a dense colony of blue penguins at that time[340].

MARINE FISH AND OTHER SPECIES

The Hope coastal region, like the whole west coast of the South Island, supports a rich diversity of fish and invertebrate species that are fished both commercially and recreationally by a number of fishing methods including trawl, longlining, trolling, potting and set netting.

Inshore trawl fisheries are multi-species and are primarily based on flatfish (several species), red gurnard, red cod, giant stargazer, tarakihi and blue warehou. Other species taken as bycatch include arrow squid, dark ghost shark, ling, barracouta, jack mackerel, spiny dogfish, rig, school shark, sea perch, rough skate and smooth skate[341].

336 Coker & Imboden 1980
337 McLean et al 1997
338 Neale 2006e, Neale & Best 1999
339 Coker & Imboden 1980
340 Coker & Imboden 1980
341 Stevenson & Hanchet 2000

Commercial fishing using other methods such as longline, potting, set net, and trolling for a number of species such as bluenose, ling, stargazer, warehou, lemon sole, hapuka, school shark, tuna and crayfish (to mention a few) is extensive.

There is no published information on the fish communities of the continental shelf and canyons in this area because the NIWA West Coast trawl surveys do not extend this far south.

Whitebait migrate up the rivers in this segment during the spring, and the Cascade River is of particular importance for this species as a spawning habitat, feeding area and migration route, being rated as the most important whitebait river in New Zealand[342].

5.14.3 Historical and Archaeological Heritage

The archaeological values of this ancient nephrite collecting and working area are of national significance[343]. Archaeological sites are concentrated on flat areas at Cascade River mouth, Barn Bay and Big Bay, with other sites recorded at most of the creek and river mouths. Barn Bay is a traditional kai moana area.

5.14.4 Recreation and Tourism

Fishing is the main recreational use of the coastal marine area in this segment, with vessels mostly travelling from Jackson Bay. The coastline provides a route for remote experience tramping between Cascade River and Big Bay[344]. Recreational deer hunters also access this area.

The Gorge Islands from the Gorge River beach.
Photo: D Neale, DOC.

342 Hutching & Potton 1987
343 Hooker 1990
344 Gilbertson 1991

Seal on boulders, Awarua Point
Photo: L.F.Molloy

5.14.5 Commercial Use

This area, like most of the inshore West Coast, is fished by commercial fishers using a variety of methods including trawl, longline, set netting and potting. Vessels in this area mostly operate out of Jackson Bay, but also Milford, Greymouth, Westport and Nelson.

Abundance surveys have indicated that there are poor prospects for a paua fishery in this area[345] but there is still potential for development of a fishery.

The Cascade River supports a major whitebait fishery from September to November, and whitebaiting also occurs less intensively in other waterways.

5.14.6 Other Public Uses and Facilities

A small cluster of buildings and an airstrip on the south bank of the Cascade River mouth are used mostly during the whitebait season, and a previously occupied homestead at Barn Bay is used occasionally by visitors. A small house on the beach at Gorge River mouth is frequently occupied.

There are Resource Management Act coastal permits issued in this segment[346] for whitebait stands on the Cascade River.

5.14.7 Existing Protection and Management Areas

All of the coastal land and most of the catchments in the Hope segment (except for a portion of the Cascade River) are within conservation lands.

Several waterways in this segment are closed to whitebaiting[347]:

- The north bank of the Cascade River, between a point 20 m upstream from Old Man Creek and the sea;
- Old Man Creek;
- Barn Creek that enters the Cascade River, and any tributary stream of Barn Creek.

Whitebaiting is not permitted in non-tidal areas nor upstream of 'back pegs' on the Cascade River.

The area lies within Fisheries Statistical Area FSA 32, which is part of the Challenger Fishery Management Area (FMA 7). The adjoining land area is within the Westland District.

The operative West Coast Regional Coastal Plan recognises:

- Coastal Protection Area; CPA13 Cascade River mouth;
- Outstanding Natural Features and Landscapes; ONFL9 west Jackson Bay/Okahu to Awarua Point;
- Marine Mammal and Bird Sites; MMB29 Halfway Bluff, MMB30 Cascade Bay, MMB31 Browne Island, MMB32 north of Gorge River.

345 McShane et al 1993
346 www.wcrc.govt.nz "Maps on the Web", June 2006
347 Whitebait Fishing (West Coast) Regulations 1994

6. Acknowledgments and Forum Membership

6.1 Acknowledgments

The West Coast Marine Protection Forum wishes to acknowledge the contributions of many people who assisted in the assembly and publication of this report.

The principal author, Don Neale of the West Coast Tai Poutini Conservancy of the Department of Conservation, assembled most of the data in the report. Further information was provided by Nicola Pindur of the Ministry of Fisheries. Other contributing authors were Murray Reedy, Les Molloy, and Bruce Watson. Useful advice on the content of the report was provided by Forum members Carol Scott and Eugenie Sage; several research and policy staff of the Department of Conservation and the Ministry of Fisheries also provided comment and advice.

The project was managed by Murray Reedy on behalf of the Conservator West Coast Tai Poutini Conservancy of the Department of Conservation. A Steering Committee of the Forum, consisting of Bruce Watson (chair), Eugenie Sage, Carol Scott and Denis Shannahan, assisted with the development of the report. Contributions to the report were sought from all Forum members and provided during their regular meetings.

Scientific editing was undertaken by Les Molloy and further editorial assistance was provided by Ted Brennan and Kara Edwards of the Department of Conservation. The report was designed by Becky Bliss Design of Wellington.

Maps and other cartographic input were provided by Gary Eason of the Department of Conservation West Coast Tai Poutini Conservancy. The assistance of the National Institute of Water and Atmospheric Research (NIWA) in allowing the use of a number of their maps (and many of the photographs) in the report is gratefully acknowledged. Other assistance with diagrams was given by Sue Asplin.

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6.2 Members of the West Coast Marine Protection Forum

Bruce Hamilton, Westport (Chairperson)
Ian McKenzie, Westport
Stuart Thomson, Greymouth
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Geoff Rowling, Motueka
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APPENDIX 1

Glossary of Terms

Most of the words used in this West Coast Marine and Coastal Environment Report can be found in a standard dictionary. However, this appendix explains some of the more technical words from the report that might be less familiar to some readers. Definitions are drawn from a variety of sources[1].

12 Mile limit – an administrative line around New Zealand marking the edge of the territorial sea, generally measured as 12 nautical miles from the nearest dry land (including islands).

Adventive species – an introduced (i.e. not native) plant or animal.

Aotea stone – New Zealand kyanite, a blue/green and white stone that is found in the vicinity of the Makawhio River.

Basin [Tasman Basin] – a broad area of ocean floor, at least partly enclosed by the continental slope or other raised areas of seabed.

Back peg – a marker to indicate the upper limit of whitebait fishing, as defined in the Whitebait Fishing (West Coast) Regulations 1994.

Bathymetry – information derived from the measurement of depths in water.

Beach – a zone of unconsolidated material on the coastline, usually extending from the low water line or the surf zone, up to the vegetation line or some other marked change in substrate.

Bedrock – rock that is part of the original underlying geological formation.

Benthic – living on or within the seabed.

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

Biosecurity – the protection of people and natural resources, including biodiversity, from unwanted organisms capable of causing harm. In this report, the term is especially related to the effects of introduced pests.

Boulder – see 'Texture'.

Calcareous – of or containing calcium carbonate.

Canyon/Submarine canyon – a relatively narrow, deep depression with steep slopes, the bottom of which grades continuously downward.

Coastal marine area (CMA) – an area of New Zealand generally extending from MHWS (including tidal limits up rivers) out to the 12 Mile limit, as defined under the Resource Management Act 1991.

Cobble – see 'Texture'.

Continental shelf – the zone bordering a continental landmass (including New Zealand) and extending from low water line to the depth where there is a marked or rather steep descent toward a greater depth.

Continental slope – a zone of moderate to steep slope, dropping away from the edge of the continental shelf, towards the greater depths of the ocean floor.

Deep nearshore zone – a zone in the coastal marine area between the 30 metre depth contour and the 12 mile limit.

Demersal – living on or close to the sea floor.

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

Endangered species – a species listed as such according to Hitchmough et al 2007.

Endemic Species – an indigenous (native) species which breeds only within a specified region or locality and is unique to that area.

1 e.g. DOC & MFish 2005, Concise Oxford English Dictionary, DOC & MfE 2000, Kingsford & Battershill 1998, US Army 1984

Environmental domains – areas with similar physical environmental conditions, as defined by factors (including solar radiation, temperature, moisture and geological substrate) that have been demonstrated to have high correlations with plant and animal distributions.

Estuarine/ estuary –

1. the part of a river that is affected by the tides.
2. the region near a river mouth in which the fresh water of the river mixes with the salt water of the sea.

On the West Coast, estuarine environments are all enclosed parts of the nearshore environment that are connected to the open sea by a channel mouth, and include tidal flat estuaries, river mouths and tidal lagoons.

Erosion – the wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action or currents.

Exclusive economic zone (EEZ) – an area between the 12 and 200 nautical mile limits, as defined by the Territorial Sea, Contiguous Zone, and Exclusive Economic Zone Act 1977.

Exposure – refers to the degree to which a site or feature is exposed to sources of natural energy, such as waves, tides, currents, wind, episodic or catastrophic events.

Foul ground – areas that are regarded as unable to be fished by bottom trawling, due to the risks of the nets getting caught or snagged ('fouled') by rocky outcrops, sunken timber or similar hazards.

Fyke net – a long cone-shaped net that is staked in freshwater and estuarine areas to catch eels.

Geomorphology – that branch of both physiography and geology which deals with the form of the Earth, the general configuration of its surface and the changes that take place in the evolution of landforms.

Geopreservation Inventory – an inventory that identifies sites and features in New Zealand that are of significance to the earth sciences (geology, geography, hydrology, etc).

Gravel – see 'Texture'.

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

Hapua lagoon – a name derived from a traditional Maori word that refers to this sort of wetland, which consists of a brackish to freshwater channelised coastal wetland with a mobile outlet. Hapua lagoons are influenced by tides, but mostly indirectly as they are usually enclosed in a backshore dune swale protected from the sea by a barrier beach and low dune system.

Hydrography – a configuration of an underwater surface including its relief, bottom materials, coastal structures, etc.

Hydrology – the science of water, and its movement on, under and above land, and in the sea.

Internal waters – an area defined by the Territorial Sea, Contiguous Zone, and Exclusive Economic Zone Act 1977.

Intertidal zone – the zone between the lines of mean high water spring tide (MHWS) and mean low water spring tide (MLWS).

Invertebrate – An animal without a backbone or spinal column. Insects, spiders, worms, slaters and many marine animals such as corals, sponges and jellyfish are examples of invertebrates. Invertebrates make up the vast majority of all animal species; only fish, amphibians, reptiles, birds and mammals are not invertebrates.

Maataitai – a fishing or shellfish ground.

Mahinga kai – the customary gathering of food and natural materials and the places where those resources are gathered.

Marine Protected Area – An area of the marine environment especially dedicated to, or achieving through adequate protection, the maintenance and/or recovery in a healthy functioning state of biological diversity at the habitat and ecosystem level.

Marine Protected Area Policy and Implementation Plan (MPA Policy or MPA PIP) – a policy produced by the New Zealand government relating to the creation and management of marine protected areas in New Zealand.

Marine Protection Forum MPF [West Coast MPF] – a forum set up with the primary aim of contributing to the implementation of the NZ MPA Policy within the West Coast region.

Mataitai reserves – areas where the Tangata Whenua manage all non-commercial fishing by making bylaws. Bylaws apply equally to all individuals. Reserves can only be applied for over traditional fishing grounds, and must be areas of special significance to the Tangata Whenua. Generally there is no commercial fishing within these reserves.

Matauranga Maori – Maori traditional knowledge and its associated teachings.

Mean High Water Spring (MHWS) – the average height of the high waters occurring at the time of spring tide.

Mean Low Water Spring (MLWS) – the average height of the low waters occurring at the time of spring tide.

Metamorphic rock – rock that has been changed by intense heat and pressure underground over millions of years.

Moraine – a pile of rock fragments carried by glacial ice. The rocks are generally not sorted or rounded, but dumped in vast piles of all shapes and sizes, from finest dust to enormous blocks.

Mud – see 'Texture'.

Nearshore – a zone extending from MHWS (including tidal limits up rivers) out to the 12 Mile limit.

Ngai Tahu whanui takiwa – the area and boundaries of influence of Te Runanga o Ngai Tahu, as defined by Te Runanga o Ngai Tahu Act 1996 and the Ngai Tahu Claims Settlement Act 1998.

Nohoanga – areas adjacent to lakes and rivers to facilitate the gathering of food and other natural resources. More specifically, those sites listed as nohoanga in the Ngai Tahu Settlement Act 1998.

Offshore – that area beyond the nearshore zone, from the 12 Mile limit out to the 200 Mile limit.

Pelagic – living in open water, away from the seabed.

Phytoplankton – small, free-drifting plants that live in the sea.

Plankton – small (often microscopic) plants and animals that live in the sea, normally free-drifting and with limited powers of locomotion. Often includes many larval stages.

Plateau [e.g. Challenger Plateau] – an area (in this case beneath the sea) having a relatively level surface raised sharply above adjacent land on at least one side.

Pounamu – New Zealand greenstone or nephrite jade, a stone that is found in parts of the central and southern West Coast.

Quota Management System (QMS): means the quota management system established under Part 4 of the Fisheries Act 1996.

Riparian – pertaining to the banks of a body of water.

Salinity – relating to the saltiness of water (i.e. the concentrations of dissolved salt).

Sand – see 'Texture'.

Sedimentation – relating to the processes and patterns by which sediments (mineral or other particles) move and settle within the environment.

Shallow subtidal zone – a zone of the marine environment, as defined by the Marine Protected Areas Policy and associated documents, extending from MHWS (excluding tidal limits up rivers) out to the 30 metre depth contour.

Shelf – see continental shelf.

Shelf break – the line or zone marking the boundary between the continental shelf and slope.

Silt – see 'Texture'.

Slope [see continental slope].

Subtidal – any area beneath the level of the sea.

Substrate – underlying layer or surface of the seabed.

Subtropical convergence – a zone encircling the temperate latitudes of the southern hemisphere, where ocean currents cause the convergence of warm subtropical and cool subantarctic waters.

Tai Poutini – this refers to a similar (though not identical) area to 'West Coast'.

Takiwa – area boundary. See also 'Ngai Tahu whanui takiwa'.

Taonga – treasure.

Tectonic – relating to deformation of the earth's crust (e.g. by seismic activity such as earthquakes) and the resulting changes.

Temperate – of mild temperature. New Zealand's position on the globe is regarded as being with the temperate zones of the southern hemisphere, about half way between the hot tropical and cold polar regions.

Terrestrial – pertaining to areas of land not covered by water.

Territorial sea – a zone of the open sea out to the 12 nautical mile limit, as defined by the Territorial Sea, Contiguous Zone, and Exclusive Economic Zone Act 1977.

Texture – refers to the size range of a sediment particle: a standard measure is the Wentworth scale, which identifies (in decreasing order of size) [bedrock], boulder (>256mm), cobble (>16mm), gravel (>4mm), sand (>2mm), silt (>1mm), mud (<1mm).

Threatened species – a species listed as such according to Hitchmough et al 2007.

Tidal flats – marshy, sandy or muddy land areas which are covered and uncovered by the rise and fall of the tides.

Tipuna – ancestors.

Topography – the configuration of a surface, including its relief and the positions of its streams, roads, buildings, etc.

Topuni – an area of high cultural importance to Ngai Tahu listed in the Ngai Tahu Claims Settlement Act 1998. Literally, a topuni is a traditional cloak.

Total allowable catch (TAC) – in relation to any quota management stock, means a total allowable catch as set or varied for that stock by notice in the Gazette under section 13 or section 14 of the Fisheries Act 1996.

Turbidity – refers to the degree of muddiness or lack of clarity in the water.

West Coast – unless otherwise stated, the coastal marine area between Kahurangi Point and Awarua Point, on the west coast of the South Island.

APPENDIX 2

Common, Maori and Scientific Names

Wherever possible, the text throughout this report has used common plant and animal names in preference to scientific names. Where a species has no common English or Maori name, the scientific name is used in the text of this report. The various respective names (where known) for each species mentioned in the report are listed below.

Algae[2]		
Bull kelp	rimurapa	*Durvillaea antarctica & D. willana*
Flapjack		*Carpophyllum maschalocarpum*
Oak leaf weed		*Landsburgia quercifolia*
Paddle kelp		*Ecklonia radiata*
Sea lettuce	karengo	*Porphyra spp. and Ulva spp.*
Zigzag weed		*Cystophora spp.*
Vascular plants[3]		
Coastal cress	nau	*Lepidium flexicaule*
Glasswort		*Sarcocornia quinqueflora*
Golden sand sedge	pingao	*Desmoschoenus spiralis*
Half-flower	remuremu	*Selliera radicans*
Jointed rush	oioi	*Leptocarpus similis*
Kahikatea	kahikatea	*Dacrycarpus dacridioides*
Manuka	manuka	*Leptospermum scoparium*
Nikau palm	nikau	*Rhopalostylis sapida*
Noded sedge		*Scirpus nodosus*
Rimu	rimu	*Dacrydium cupressinum*
Saltmarsh ribbonwood		*Plagianthus divaricatus*
Sand tussock		*Austrofestuca littoralis*
Seal cress	nau	*Lepidium naufragorum*
Sea rush	wiwi	*Juncus krausii*
Shore pimpernel		*Samolus repens*
Shore spurge		*Euphorbia glauca*
Invertebrates		
Biscuit star		*Pentagonaster pulchellus*
Blue mussel	kutai	*Mytilus galloprovincialis*
Bubble shell		*Haminoea zelandica*
Cancer crab		*Cancer novaezelandiae*
Cockle		*Austrovenus stutchburyi*
Fiordland black coral		*Antipathes fiordensis*
Greenlip mussel	kutai	*Perna canaliculus*
Kina	kina	*Evechinus chloroticus*
Littoral spider		*Amaurobioides* spp.
Marine caddisfly		*Philanisus plebeius*
New Zealand sea daisy		*Xyloplax medusiformis*
Octopus		*Octopus maorum*
Open Bay Islands leech		*Hirudobdella antipodum*
Red rock crab		*Plagusia chabrus*
Red rock lobster	koura	*Jasus edwardsii*
Reef star		*Stichaster australis*
Seven armed star		*Astrostole scabra*
Snakestail star		*Pectinura maculata*
Toheroa	toheroa	*Paphies ventricosa*
Triangle shell		*Spisula aequilateralis*
Tuatua	tuatua	*Paphies donacina* and *P. subtriangulata*
Venus shell		*Dosinia* spp

2 Adams 1994
3 Gunson 1983

Fish[4]

Albacore tuna		*Thunnus alalunga*
Barracouta	mangaa	*Thyrsites atun*
Basking shark	reremai	*Cetorhinus maximus*
Black flounder	patikimohoao	*Rhombosolea retiaria*
Blue cod	rawaru	*Parapercis colias*
Blue-eyed triplefin		*Notoclinops segmentatus*
Brown mudfish	hauhau	*Neochanna apoda*
Estuarine stargazer		*Leptoscopus macropygus*
Freshwater eel	tuna	*Anguilla* spp.
Frostfish	tiikati	*Lepidotus caudatus*
Giant stargazer		*Kathetostoma giganteum*
Giant triplefin		*Blennodon dorsale*
Hake	tiikati	*Merluccius australis*
Hoki	hoki	*Macruronus novaezelandiae*
Lamprey	kanakana/ute	*Geotria australis*
Ling	hokarari	*Genypterus blacodes*
Long finned eel	tuna	*Anguilla dieffenbachii*
Lookdown dory		*Cyttus traversi*
Mottled brotula		*Bidenichthys consobrinus*
Mottled clingfish		*Gastroscyphus* sp. cf hectori
Olive rockfish	taumaka	*Acanthoclinus fusca*
Orange roughy		*Hoplostethus atlanticus*
Orange clingfish		*Diplocrepis puniceus*
Pygmy sleeper		*Thallaseleotris iota*
Red cod	hoka	*Pseudophycis bacchus*
Red gurnard	kumukumu	*Chelidonichthys kumu*
Rig		*Mustelus lenticularis*
Rockling		*Gaidropsarus novaezelandiae*
Scorpionfish		*Scorpaena papillosa*
Scarlet wrasse	puwaiwhakarua	*Pseudolabrus miles*
Sea perch	pohuiakaroa	*Helicolenus percoides*
Seahorse	kiore manaia	*Hippocampus abdominalis*
Sevengill shark (broadnose)	tuatini	*Notorhynuchus cepedianus*
Short finned eel	tuna	*Anguilla australis*
Sixgill shark	tatera	*Hexanchus griseus*
Snapper	tamure	*Pagrus auratus*
Spiny dogfish	koinga	*Squalus acanthias*
Tarakihi	tarakihi	*Nemadactylus macropterus*
Thornfish		*Bovichtus variegatus*
Turbot		*Colistium nudipinnis*
White pointer shark	mangoo-taniwha	*Carcharodon carcharias*
Yellow-eyed mullet	aua	*Aldrichetta forsteri*
Whitebait/ native trout	- inanga	*Galaxias maculatus*
	- koaro & kokopu	*Galaxias* spp.
	- giant kokopu	*Galaxias argenteus*
	- shortjaw kokopu	*Galaxias postvectis*

Reptiles

Open Bay Islands gecko	*Hoplodactylus* sp. 'Open Bay Islands'
Open Bay Islands skink	*Oligosoma* sp. 'Open Bay Islands'

4 Paulin et al 1989

Birds[5]

Australasian bittern	matuku	*Botaurus poiciloptilus*
Australasian gannet	takapu	*Morus serrator*
Banded dotterel	tuturiwhatu	*Charadrius bicinctus*
Blackbacked gull	karoro	*Larus dominicanus*
Black shag	kawau	*Phalacrocorax carbo*
Caspian tern	taranui	*Hydroprgne caspia*
Crested grebe	puteketeke	*Podiceps australis*
Eastern bar-tailed godwit	kuaka	*Limosa lapponica*
Fairy prion	titi-wainui	*Pachyptila turtur*
Fiordland crested penguin	tawaki	*Eudyptes pachyrhynchus*
Grey duck	parera	*Anas superciliosa*
Marsh crake	koitareke	*Porzana pusilla*
Okarito brown kiwi	rowi	*Apteryx* sp.
Red billed gull	tarapunga	*Larus novaehollandiae*
Reef heron	matuku moana	*Egretta sacra*
Royal spoonbill	kotuku ngutu-papa	*Platalea regia*
Salvin's mollymawk		*Thallasarche salvini*
Sooty shearwater	titi	*Puffinus griseus*
Southern little blue penguin	korora	*Eudyptula minor*
South Island fernbird	matata	*Bowdleria punctata*
Spotted shag	parekareka	*Phalacrocorax punctatus*
Spotless crake	putoto	*Porzana tabuensis*
Spur-winged plover		*Lobibyx novaehollandiae*
Variable oystercatcher	torea	*Haemotopus unicolour*
Welcome swallow		*Hirundo neoxena*
Western weka	weka	*Gallirallus australis*
Westland petrel	taiko	*Procellaria westlandica*
White-fronted tern	tara	*Sterna striata*
White heron	kotuku	*Egretta alba modesta*

Mammals[6]

Andrews' beaked whale	hakura	*Mesoplodon bowdoini*
Blue whale		*Balaenoptera musculus*
Bottlenose dolphin	aihe	*Tursiops truncatus*
Common dolphin	aihe	*Delphinus delphis*
Dusky dolphin	aihe	*Lagenorhynchus obscurus*
Goose-beaked whale	hakura	*Ziphius cavirostris*
Gray's beaked whale	hakura	*Mesoplodon grayi*
Humpback whale	paikea	*Megaptera novaeangliae*
Long-finned pilot whale		*Globicephala melas*
Minke whale		*Balaenoptera acutirostrata*
NZ fur seal	kekeno	*Arctocephalus forsteri*
Orca / killer whale		*Orcinus orca*
Pygmy sperm whale		*Kogia breviceps*
Shepherd's beaked whale	hakura	*Tasmacetus shepherdi*
Southern elephant seal	ihupuku	*Mirounga leonina*
Southern right whale	tohora	*Eubalaena australis*
South Is. Hector's dolphin	aihe	*Cephalorhynchus hectori hectori*
Sperm whale	paraoa	*Physeter macrocephalus*

Adventive (introduced) species

Clubbed tunicate sea squirt	*Styela clava*
Cord grass	*Spartina* spp.
Gorse	*Ulex europaeus*
Japanese kelp	*Undaria pinnatifida*
Marram grass	*Ammophila arenaria*
North Pacific sea star	*Asterias amurensis*

5 Parkinson 2000, Falla et al 1983

6 Baker 1999

APPENDIX 3

Ranking and Evaluation Systems

A summary of some ranking and evaluation systems used on the West Coast.

The following information is drawn from several references of relevance to the West Coast Marine Protection Forum process and the content of this report.

Introduction – Evaluation for Nature Conservation[7]

"The identification and comparison of the conservation values of natural areas and natural features are among the hardest tasks for the person working in nature conservation. It is not difficult to describe a natural area, its biota and physical features, and the ecosystem they comprise. To evaluate it for nature conservation, and to assess the degree to which it warrants protection is another question incorporating both social and scientific values.

The application of the text is restricted to terrestrial, freshwater and brackish ecosystems. The general goal and criteria of nature conservation apply equally to marine ecosystems, but their application there will require the work of marine specialists.

Seven criteria form the scientific basis of evaluation [of natural areas and in defining priorities for protection]:

1. Representativeness - the primary criterion
2. Diversity and pattern
3. Rarity and special features
4. Naturalness
5. Long-term viability
6. Size and shape
7. Buffering and surrounding landscape"

Sand dune and beach vegetation[8]

"RATING SYSTEM

Beach sites were ranked according to the following values (0 to 5 for each making a total out of 20).

Diversity – of communities and landforms. Systems that have extensive vegetation sequences and/ or diversity of dune landforms score highly.

Natives – number or proportion of native sand species, or good representation of characteristic or rare dune species.

Modification – degree of human or animal interference in the system.

Weeds – degree of invasion by weed species. Those without weeds score highly.

[The sites] having total ratings of 15 or more, are considered to be of national priority for conservation.

Low ratings for botanical values [with ratings less than about 10] for most sites along the Karamea to Greymouth section of coast reflect the general low diversity of landforms and the high degree of modification and weed presence. But these ratings do not negate the fact that pockets of intact vegetation are still to be found here, and that some of them are particularly important for conservation because they form part of vegetation sequences which extend inland to the coastal hill country."

7 O'Connor et al 1990

8 Johnson 1992

Wildlife[9] [10]

(a) Morse (1981)

VALUATION OF HABITATS

Since one of the objectives of this survey was to assist planners in deciding the most appropriate use for an area of land, a wildlife value was assigned to each 'habitat of note'.

In general terms, this value is a measure of the priority for preserving a given habitat. A variety of factors are used to assess this value. They include size, proximity to adjacent similar areas, extent of modification, species diversity, and presence of rare or endangered species, diversity of vegetation and other feature of the habitat, and the uniqueness or representativeness of the habitat type nationally or regionally.

The following criteria, modified from Imboden (1978), were used as guidelines for the allocation of a conservation value.

OUTSTANDING

(a) Presence of a breeding population of a highly endangered or rare endemic species

(b) A population of an endemic species of very restricted distribution and which could become endangered

(c) Areas essential to species from (a) or (b) for purposes other than breeding

(d) Areas of vital importance to internationally uncommon species (breeding and/or migratory)

(e) Areas of vital importance to internally migratory species with very limited distribution or abundance

(f) Largely unmodified ecosystem or example of original habitat type not represented elsewhere in the country, of large size and containing viable populations of all or almost all species which are typical of the ecosystem or habitat type.

HIGH

(a) Habitat containing an indigenous species which has declined significantly due to man's influence.

(b) One of few or the only breeding area for a non-endemic indigenous species of limited abundance.

(c) Habitat of an uncommon, discontinuously distributed species not adequately represented in the ecological region or only represented in a particular ecological region.

(d) Example of a largely unmodified habitat which is not represented to the same extent elsewhere in the ecological region and is used by most species which are typical of the habitat type for the region.

(e) Presence of a species of an endemic family which is of limited abundance throughout the country although adequately represented in one ecological region but whose habitat is at some risk.

MODERATE – HIGH

(a) Presence of a species which is still quite widely distributed but whose habitat has been and still is being significantly reduced or modified due to man's influence.

(b) Areas containing high numbers of breeding or moulting birds or where breeding or moulting areas are of interregional significance to wildlife.

(c) A large and fairly unmodified habitat or ecosystem which is represented elsewhere in the ecological region and contains all or almost all species typical of that habitat type for a particular region.

9 Morse 1981

10 Coker & Imboden 1980

(d) An area where any particular species is exceptional in terms of, say, abundance or behaviour but which is otherwise widespread.

MODERATE

All habitats supporting good numbers of species which are typical of that particular habitat within an ecological region and which have not been heavily modified by man's influence.

POTENTIAL

All areas of some wildlife significance which are limited by size, heavy modification or other reasons, but are of potential wildlife value if left to regenerate or re managed or developed for wildlife. (May include habitat which functions as a corridor or is sub-optimal habitat which is necessary for maintaining genetic diversity.)

It should be noted that there is no 'low' category. There are several reasons for this. Firstly, only a selection of habitats is recorded in our surveys; habitats of no known significance remain unclassified. Secondly, as a result of the severe reduction of forests and wetlands through man's activities, all remaining wetlands and forests, particularly lowland forests, are important for the conservation of communities adapted to these habitat types. Thirdly, the term 'low' is often equated with lack of value (see Imboden 1978)."

(b) Coker P M & Imboden C (1980)

This report uses rating criteria that are very similar to Morse (1981).

THE VALUATION OF HABITATS

Since one of the objectives of making such an inventory is to enable planners to decide on the most appropriate use of a particular piece of land, a value was assigned to each habitat recorded. This value depends on a variety of factors such as the uniqueness or representativeness of the whole biotic community on a local, regional, national and international scale, its size and proximity to adjacent similar areas, extent of modification, species diversity, and list of individual species it supports (e.g. the presence of rare or endangered species).

The following criteria were used as guidelines for the allocation of a conservation value Imboden (1978).

OUTSTANDING

Presence of an endangered species

- Presence of an isolated, viable population of an endemic species restricted in distribution and low in numbers
- A largely unmodified habitat type not represented to the same extent elsewhere in the country and large enough to support self-sustaining populations of all plant and animal species which are part of this community.

HIGH

- Presence of an uncommon, discontinuously distributed species, not adequately or safely represented elsewhere in the region.
- Presence of an endemic species whose abundance and distribution has elsewhere significantly declined due to man-induced habitat alteration.
- Large example of a largely unmodified habitat type which is typical of the region and has been much reduced through human influence.

MODERATE

- Areas supporting good numbers of the common wildlife species typical of the region.
- All forest and wetland habitats not otherwise classified, either unaltered by man or only slightly modified.

POTENTIAL

- Habitat which has been moderately to heavily modified but capable of regenerating into a more natural habitat (with a consequent increase in wildlife value) if some basic conservation measures were introduced, e.g. fencing to exclude stock.

It should be noted that there is no category 'low'. There are several justifications for this (see detailed explanation in Imboden 1979). Firstly, only a selection of habitats, those which have some value to wildlife, are recorded in our surveys; habitats of no known significance remain unclassified. Secondly, as a result of the severe reduction of forests and wetlands through man's activities, all remaining wetlands and forests, particularly lowland forests, are important for the conservation of communities adapted to these habitat types. Thirdly, the term 'low' is too easily equated with valueless and no area can be of no value to wildlife. In all these kind of surveys, emphasis is laid on the positive information, i.e. the confirmation of a species' presence rather than its absence."

Archeaeology[11]

The report by Hooker (1990) rates certain coastal areas of the West Coast as being either nationally or regionally significant, based on expert opinion. While the region's archaeological values are described in the report, the actual criteria for the ratings are not specified.

Geopreservation Sites[12]

The report by Hayward & Kenny (1999) and some associated ones are collectively referred to as 'The Geopreservation Inventory'.

The inventory 'aims to list the best examples of the wide diversity of natural physical features and processes that together characterise each part of New Zealand and document its long and complex geological history, the formation of its landforms and evolution of its unique biota.' It also 'aims to identify and list information about all the internationally, nationally and many of the regionally important earth science sites throughout New Zealand, irrespective of their current protected status.'

"ASSESSMENT OF IMPORTANCE AND VULNERABILITY

IMPORTANCE

Sites are listed in this inventory under three levels (A-C) of significance. The importance assessment given to each site has been assessed by those informants familiar with the site.

A. International – site of international scientific importance
B. National – site of national scientific, educational or aesthetic importance
C. Regional – site of regional scientific, educational or aesthetic importance

VULNERABILITY

Each site has been given a vulnerability classification (1-5) depending on its perceived vulnerability to human activities.

1. Highly vulnerable to complete destruction or major modification by humans
2. Moderately vulnerable to modification by humans
3. Unlikely to be damaged by humans
4. Could be improved by human activity
5. Site already destroyed (not necessarily by human activity)."

11 Hooker 1990
12 Hayward & Kenny 1999

Islands[13]

The West Coast Islands Inventory uses a significance rating system, but identifies those rock stacks and islands that support threatened and protected species, as well as describing the habitat and communities occurring there. Some of the islands are ranked in other reports (e.g. Coker & Imboden 1980).

The overall rating given for each island or stack summarises its ecological value. The rating system is partly based on criteria adapted from Morse 1981 and Johnson 1992, and described in the table below. The overall rating for a site is judged by the column in which the site best falls in the table.

The ratings allocated should be considered with careful regard to the level of survey undertaken. For example, the many sites not yet surveyed in the field could contain threatened species that are not evident from a distant view or analysis of air photos. Ratings for unsurveyed sites are based mostly on their size and broad habitat structure. Because of this, the ratings are subject to review if further information is obtained.

Criterion	Outstanding	High	Moderate	Potential
Size & viability (area of vegetated land)	More than one hectare	1000 to 10 000m^2 Several terrestrial and marine habitat types	100 to 1000m^2	Less than 100m^2
Habitat diversity marine and terrestrial)	Highly diverse habitats	Several terrestrial and marine habitat types	Simple habitat structure	Very simple habitat structure - little vegetation, little reef
Species: threatened, endemic or protected species; native wildlife (birds, seals); breeding or other important sites; species diversity	Self-sustaining population or breeding site of several threatened and endemic species	Several such species present, or one highly threatened species.	At least one such species present	None recorded but suitable habitat present.
Biosecurity: introduced & pest species, modification	Little or no identified biosecurity threat	Low – moderate risk of pest invasion	High risk of pest invasion	Mostly dominated by pests

West Coast Coastal Resource Inventory (CRI)[14]

The Coastal Resource Inventory (CRI) was a programme "to provide information for the maintenance, enhancement and restoration of natural character and qualities of coasts and their sensitive use." Information was collated for each Dept of Conservation conservancy, including the West Coast. A rating system was developed for the CRI document, but this was not used in the present Marine Protection Forum report. The present report has instead drawn information from the original source documents where relevant.

Threatened Species[15]

This DOC report classifies species according to their threat status. Of particular interest to the present report are the "threatened" classes: Nationally Critical, Nationally Endangered, Nationally Vulnerable, Serious Decline, Gradual Decline, Range Restricted, and Sparse. Other classes include those that are not evaluated, or not threatened: Introduced and Naturalised, Vagrant, Coloniser, Migrant, Data Deficient, Extinct, or Not Threatened. The basis for these ratings is described according to a variety of criteria.

The definitions displayed below briefly outline the criteria for the "threatened" categories. For a full explanation of all categories you can view pages 17 to 21 of the publication.

13 Neale 2006e

14 Neale 1990

15 Molloy et al 2002

1 Nationally critical

Very small population or a very high predicted decline.

2 Nationally endangered

Small population and moderate to high recent or predicted decline or

Small to moderate population and high recent or predicted decline.

3 Nationally vulnerable

Small to moderate population and moderate recent or predicted decline.

4 Serious decline

Moderate to large population and moderate to large predicted decline, or

Small to moderate population and small to moderate predicted decline.

5 Gradual decline

Moderate to large population and small to moderate decline.

6 Sparse

Taxa with very small, widely scattered populations.

7 Range restricted

These taxa either occur in a small geographic area, are restricted to a particular habitat, or require very specific substrates, and for colonial breeders, have fewer than 10 subpopulations.

The species that are considered to be threatened according to these criteria are listed by Hitchmough et al 2007.

Wetlands[16] [17] [18]

Cromarty & Scott (1996) compiled a directory of selected wetlands in New Zealand considered to be internationally important.

"The criteria used in the selection process are those developed for the identification of wetlands of international importance for designation under Article 2 of the Ramsar Convention [a United Nations convention for the conservation and wise use of wetlands and their resources]. A wetland is suitable for inclusion in this directory if it meets any one of the criteria set out below:

1) Criteria for representative or unique wetlands: A wetland should be considered internationally important if:
   a. It is a particularly good representative example of a natural or near-natural wetland, characteristic of the appropriate biogeographical region; or
   b. It is a particularly good representative example of a natural or near-natural wetland, common to more than one biogeographical region; or
   c. It is a particularly good representative example of a wetland which plays a substantial hydrological, biological or ecological role in the natural functioning of a major river basin or coastal system, especially where it is located in a trans-border position; or
   d. It is an example of a specific type of wetland, rare or unusual in the appropriate biogeographical region.

16 Cromarty & Scott 1996
17 Partridge 2004
18 Davis 1987

2) General criteria based on plants or animals. A wetland should be considered internationally important if:

   a. It supports an appreciable assemblage of rare, vulnerable or endangered species or subspecies of plant or animal, or an appreciable number of individuals of any one or more of these species; or

   b. It is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna; or

   c. It is of special value as the habitat of plants or animals at a critical stage of their biological cycle; or

   d. It is of special value for one or more endemic plant or animal species or communities.

3) Specific criteria based on waterfowl. A wetland should be considered internationally important if:

   a. It regularly supports 20 000 waterfowl; or

   b. It regularly supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity or diversity; or

   c. Where data on populations are available, it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl."

The following text summarises the system used by Partridge (2004) to allocate rankings for wetlands on the West Coast based on the available information.

Seven parameters were used as a tool to produce composite rankings for the wetlands. The parameters are on a 5-level scale from 0 to 4 (or in the case of 'wetland size', from 1 to 5), with a high score indicating low wetland modification and high natural values. The parameters are:

- degree of catchment modification,
- modification of environmental functioning,
- connectivity barriers,
- alien species,
- alien impacts,
- habitat diversity and
- wetland size.

A mean score for each wetland was calculated using these seven parameters. Only those wetlands with four or more parameters were included, resulting in 234 wetlands being ranked. Correlation coefficients were calculated between each pair of parameters, and all were found to be highly significant ($P<.001$). This clearly indicates that if a wetland has high values for a parameter, then it tends to have high values for all. This however, does give the opportunity to examine situations in which parameters are higher or lower than would be expected from the mean. There are however risks and limitations to this technique that arise from a number of sources:

- effects of missing data,
- observer bias and different priorities,
- auto-correlation,
- factors not taken into account.

Davis (1987) "identified those wetlands which are known to have significant fisheries values" and used the following ranking system.

"In order to identify wetlands of outstanding importance for fisheries, or for any other value, it is essential to develop selection criteria. The criteria used here (Table 1) include features of the habitat, species composition, and use of the fisheries resource. These criteria are not mutually exclusive, and most wetlands qualified for inclusion on several counts."

Table 1. Criteria for selecting nationally important wetlands for fisheries

1. A habitat for a rare or endangered fish species.
2. A unique or diverse assemblage of fish species.
3. A habitat for a fish species with limited national distribution and/or declining numbers.
4. A biologically or scientifically important fishery or fish habitat.
5. An unmodified wetland habitat with significant endemic fisheries values.
6. A particularly good example of a specific type of fishery or fish habitat.
7. A remnant or regionally representative wetland with significant fisheries values.
8. A nationally important non-salmonid fishery, including commercial or traditional Maori fisheries.
9. A nationally important salmonid fishery.
10. A wetland which is particularly important as a water retention or riparian buffer zone for fisheries in the catchment.

"Once the list of nationally important wetlands was compiled... the wetlands identified for their fisheries values were ranked on a subjective scale:

A = outstanding, and must be included in the Schedule [a Schedule of Protected Waters announced by the NZ Government in 1985] if at all possible;

B = significant, and should be included in the Schedule if non-fisheries values are also high

C = important, and inclusion in the Schedule would be desirable, but it may be necessary to resort to other measures of protection."

APPENDIX 4

West Coast Species Listed in the Doc Threat Classification[19]

Threat status	Marine	Estuarine	Coastal terrestrial
Nationally critical	NZ sea daisy Southern elephant seal Orca	Kotuku	Open Bay Islands leech Open Bay Islands gecko Open Bay Islands skink
Nationally endangered	Southern right whale Hector's dolphin Fiordland crested penguin	Australasian bittern Crested grebe Grey duck	–
Nationally vulnerable	Salvin's mollymawk	Reef heron	Lepidium flexicaule Caspian tern
Serious decline	–	–	Western weka
Gradual decline	Sthn little blue penguin Sooty shearwater Red billed gull White-fronted tern White pointer shark Basking shark	Longfin eel Giant kokopu	Banded dotterel Sand tussock Pingao Speckled skink
Sparse	Sixgill shark Mottled brotula	South Island fernbird Black shag Marsh crake Spotless crake Shortjaw kokopu Lamprey Crassula ruamahanga	Seal cress
Range restricted	Westland petrel Bottlenose dolphin Giant triplefin Black coral (Mottled clingfish?)*	–	–
Data deficient (precise threat status remains uncertain)	Bangia spp. seaweed Porphyra spp. seaweed Pygmy sperm whale Pygmy right whale Andrews' beaked whale Gray's beaked whale Shepherd's beaked whale Goose-beaked whale	–	Littoral spiders
Coloniser**	–	Royal spoonbill Welcome swallow Spur-winged plover	–
Migrant**	Blue whale Minke whale Long-finned pilot whale Humpback whale	Bar-tailed godwit	–

* likely classification of a recently discovered species

** these two status classes are sourced from the same DOC threatened species dataset (Hitchmough, unpub DOC data), but are not listed in the cited publication

19 Hitchmough et al 2007

APPENDIX 5

Taonga Species Found in the West Coast Coastal Marine Area[20]

MAMMALS

Ihupuku (Southern elephant seal *Mirounga leonine*)

Kekeno (New Zealand fur seals *Arctocephalus forsteri*)

Paikea (Humpback whales *Megaptera novaeangliae*)

Paraoa (Sperm whale *Physeter macrocephalus*)

Tohora (Southern right whale *Balaena australis*)

BIRDS

Karoro (Black backed gull *Larus dominicanus*)

Koau (Black shag *Phalacrocorax carbo*, Pied shag *Phalacrocorax varius varius*)

Korora (Blue penguin *Eudyptula minor*)

Kotare (Kingfisher *Halcyon sancta*)

Kotuku (White heron *Egretta alba*)

Kuaka (Bar-tailed godwit *Limosa lapponica*)

Mata (Fernbird *Bowdleria punctata*)

Pakura/Pukeko (Swamp hen/Pukeko *Porphyrio porphyrio*)

Parera (Grey duck *Anas superciliosa*)

Poaka (Pied stilt *Himantopus himantopu*s)

Putakitaki (Paradise shelduck *Tadorna variegate*)

Tara (Terns *Sterna* spp.)

Tawaki (Fiordland crested penguin Eudyptes pachyrhynchus)

Titi (Sooty shearwater/Muttonbird *Puffinus griseus*, Hutton's shearwater *Puffinus huttoni*, Common diving petrel *Pelecanoides urinatrix*, South Georgian diving petrel *Pelecanoides georgicus,* Westland petrel *Procellaria westlandica*, Fairy prion *Pachyptila turtur*, Broad billed prion *Pachyptila vittata*, White-faced storm petrel *Pelagodroma marina*, Cook's petrel *Pterodroma cookii*, Mottled petrel *Pterodroma inexpectata*)

Toroa (Albatrosses and Mollymawks *Diomedea* spp.)

PLANTS

Harakeke (Flax *Phormium tenax*)

Pingao (*Desmoschoenus spiralis*)

Raupo (Bulrush *Typha angustifolia*)

Rimurapa (Bull kelp *Durvillaea antarctica*)

Wiwi (Rushes, all indigenous *Juncus* spp. and *J. maritimus*)

20 Ngai Tahu Settlement Act 1998

FISH & INVERTEBRATES

Koeke (Common shrimp *Palaemon affinis*)

Kokopu/Hawai (Giant bully *Gobiomorphus gobioides*)

Paraki/Ngaiore (Common smelt *Retropinna retropinna*)

Taiwharu (Giant kokopu *Galaxias argenteus*)

Pipi/Kakahi (Pipi *Paphies australe*)

Tuaki (Cockle *Austrovenus stutchburyi*)

Tuaki/Hakiari (Surfclam *Dosinia anus, Paphies donacina, Mactra discors*)

Kuhakuha/Purimu (*Mactra murchsoni, Spisula aequilateralis, Basina yatei*, or *Dosinia subrosa*)

Tuatua (*Paphies subtriangulata, Paphies donacina*)

Waikaka/Pupu *(*Mudsnail *Amphibola crenata, Turbo smaragdus, Zediloma* spp)

NON-COMMERCIALLY HARVESTED SPECIES

The Ngai Tahu Claims Settlement Act also amended the Fisheries (Challenger Area Commercial Fishing) Regulations 1986 to totally prohibit targeted commercial fishing for the following marine species:

Kanakana/Ute (Southern lamprey *Geotria australis*)

Karengo (Karengo/Nori *Porphyra columbina*)*

Karengo (Sea lettuce *Ulva* spp)

Rimurapa (Bull kelp *Durvillaea* spp)

Toheroa/Tupehokura (Toheroa *Paphies ventricosum*)

* Recent studies have shown there are many species of karengo closely related to *Porphyra columbina*.

APPENDIX 6

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Website links have been listed for some of the references to make it easier for readers to access these reports. Those website addresses are correct as at March 2007.

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Personal Communications and Unpublished Data

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