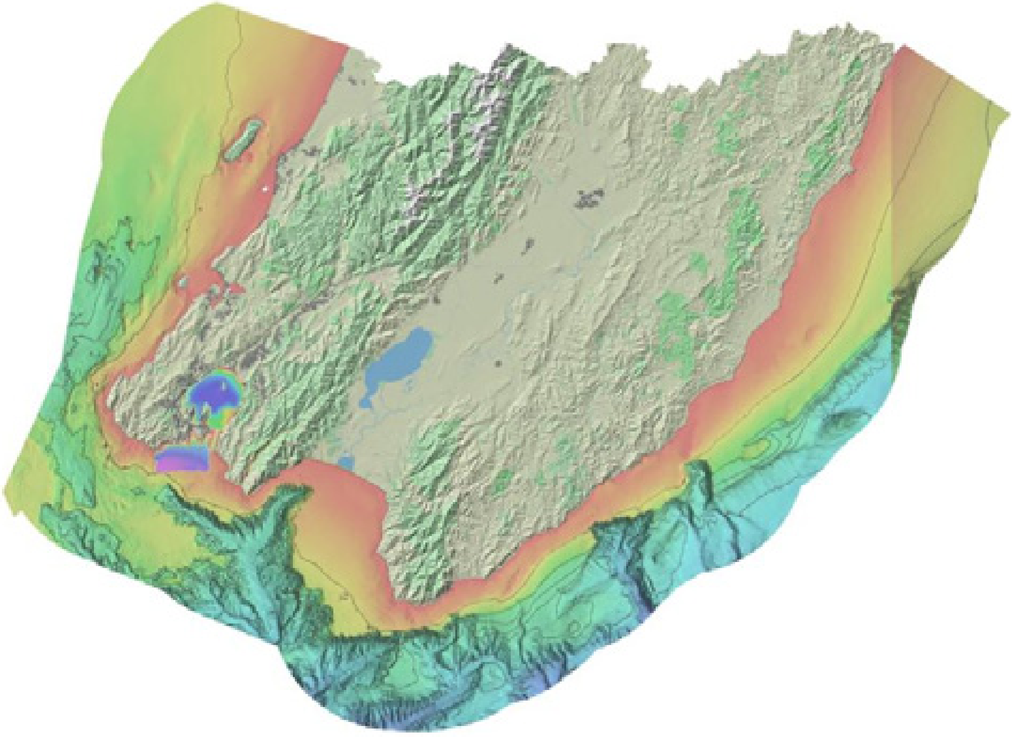
Sites of significance for indigenous marine biodiversity in the Wellington region

Prepared for Greater Wellington Regional Council

May 2012



Authors/Contributors:
Alison MacDiarmid, Wendy Nelson, Dennis Gordon, David Bowden, Joshu Mountjoy, Geoffroy Lamarche

For any information regarding this report please contact:

Neville Ching
Contracts Manager
Contracts
+64-4-386 0300
n.ching@niwa.co.nz

National Institute of Water & Atmospheric Research Ltd
301 Evans Bay Parade, Greta Point
Wellington 6021
Private Bag 14901, Kilbirnie
Wellington 6241
New Zealand

Phone +64-4-386 0300
Fax +64-4-386 0574

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Cover Image: Wellington regional bathymetry. Isobaths are at 100 m intervals to 500 m and thereafter at 500 m intervals.

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Reviewed by	Approved for release by
David Thompson	Julie Hall
David Thompson	Julie Hall

Executive summary

Regional councils have specific management responsibilities over coastal waters and habitats which lie within New Zealand's territorial seas out to 12 nm offshore. This responsibility has been expressed in the draft Wellington Regional Policy Statement (GWRC 2010) by a policy which directs regional and district plans to identify ecosystems and habitats with *significant indigenous biodiversity values* (Policy 22) that meet one or more of the criteria for 1) Representativeness, 2) Rarity, 3) Diversity, 4) Ecological context, 5) Tangata whenua values. NIWA was requested to:

- Identify the key rare and diverse sites for biodiversity in the Wellington Region's coastal marine environment (MHWS to 12 nm), and the present and future activities that could impact these sites.
- Identify representative examples of the habitat types that occur in the Wellington coastal marine area (including deep water), worthy of protection.
- Identify the coastal marine areas that are important as migration routes for sea birds and marine mammals or supply/dispersal routes for marine invertebrates and fish, and describe existing and future activities that threaten the species using these areas.
- Produce a report that includes a detailed table summarising the location of each site, habitat or area, describes the biodiversity values of each site, describes the features that address the relevant criteria, describes the present and future activities that threaten these sites and indicates the present level of protection.

Seven sites of significant marine biodiversity and five habitats of significant marine biodiversity have been identified in the territorial seas within the Wellington Region. The sites range from the shallow Porirua Harbour to methane seeps lying in 1100 m of water on Opouawe Bank at the south-east extremity of the region.

The Wellington Region has been previously divided into two distinct bioregions, at least for the shallow coastal fauna and flora; the warmer Abel Bioregion north of Cape Terawhiti and the cooler Cook Bioregion east of Cape Terawhiti (Shears et al. 2008). Two of the sites and three of the habitats occur in the Abel Bioregion, while five of the sites and all the habitats occur in the Cook Bioregion.

Just one of the sites (Kapiti Island rhodolith beds) lies at least partly inside an existing protected area. All other sites are currently unprotected. Exposed rocky reef habitat and kelp beds are partly protected within the existing marine reserves around Kapiti Island and along Wellington's south coast. However, the other three habitats are currently unprotected except the cable zone around the Cook Strait DC power cable does protect a small proportion of the habitat corridor between the east and west coasts.

The identified sites and habitats are threatened by a range of human activities. Those nearest land are typically threatened by a greater number of activities and many of these stem from activities within catchments or from activities such as dredging or spoil dumping that are under the direct jurisdiction of the GWRC. However, some of the more pressing threats to deepwater habitats, such as the methane seeps on Opouawe Bank, are from the effects of bottom trawling. In these instances the GWRC will need to work with the Ministry for Primary Industries to effect protection.

The sites and habitats identified as containing significant marine biodiversity are located in either shallow coastal areas or deep water areas. Only one habitat occurs in part on the shelf. This reflects our poor knowledge of shelf ecosystems in the Wellington region rather than indicating that shelf habitats are any less important.

The sites and habitats identified as containing significant marine biodiversity in the Wellington region vary widely in the amount of information available to define their habitat features relevant to the biodiversity evaluation criteria. While Porirua Harbour and the Opouawe Bank methane seeps are well studied, many of the other sites and habitats are very poorly known. Focused research efforts at these locations or habitats are likely to reveal much relevant information.

1 Introduction

1.1 Background

Regional councils have specific management responsibilities over coastal waters and habitats which lie within New Zealand's territorial seas out to 12 nm offshore. In the face of increasing use of coastal resources, regional councils must recognise and provide for the matters of national importance listed in Section 6 of the Resource Management Act 1991 (RMA). In particular regional councils must provide for the preservation of natural character (which includes an ecological element) (Section 6a) and protection of indigenous vegetation and fauna (Section 6c). They also must give effect to the policies on natural character in the New Zealand Coastal Policy Statement 2010 (NZCPS). Additionally regional councils need to take into consideration the New Zealand Biodiversity Strategy 2000 (NZBS) to halt the decline in New Zealand's indigenous biodiversity, maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments; and do what else is necessary to protect a full range of natural marine habitats and ecosystems to effectively conserve marine biodiversity. These are statutory obligations, not just a commitment.

This requirement has been expressed in the proposed Wellington Regional Policy Statement (GWRC 2010) by a policy which directs regional and district plans to identify ecosystems and habitats with *significant indigenous biodiversity values* (Policy 22) that meet one or more of the following criteria:

(a) Representativeness: high representativeness values are given to particular ecosystems and habitats that were once typical and commonplace in a district or in the region, and:

- i. are no longer commonplace (less than about 30% remaining); or
- ii. are poorly represented in existing protected areas (less than about 20% legally protected).

(b) Rarity: the ecosystem or habitat has biological physical features that are scarce or threatened in a local, regional or national context. This can include individual species, rare and distinctive biological communities and physical features that are unusual or rare.

(c) Diversity: the ecosystem or habitat has a natural diversity of ecological units, ecosystems, species and physical features within an area.

(d) Ecological context of an area: the ecosystem or habitat:

- i. enhances connectivity or otherwise buffers representative, rare or diverse indigenous ecosystems and habitats; or
- ii. provides seasonal or core habitat for protected or threatened indigenous species.

(e) Tangata whenua values: the ecosystem or habitat contains characteristics of special spiritual, historical or cultural significance to tangata whenua, identified in accordance with tikanga Maori.

In 2007 Boffa Miskell Ltd was engaged by the Greater Wellington Regional Council (GWRC) to review the sites of national /regional significance then identified in the Wellington Regional Policy Statement (WRPS) and evaluate their significance. Boffa Miskell identified 180 coastal sites with at least one of the following values (landscape, historic heritage, ecology and geology) in the coastal environment (Boffa Miskell 2007). However, the review of marine sites was restricted. The Boffa Miskell report was reviewed internally by GWRC (Park 2008) and the Department of Conservation also provided some feedback (Luke 2008). This review and feedback resulted in an amended table of sites and descriptions (copy supplied by GWRC).

1.2 Project focus

On 17 October 2011, Dr Megan Oliver and Jo Beaglehole from the GWRC met with NIWA to discuss NIWA involvement in a project to identify marine areas of significant biodiversity value in the Wellington region. Consequently NIWA was requested, by building upon the work done to date by GWRC and its advisors, and based on the best available information (held by NIWA or provided by GW) and the opinion of relevant experts, and taking a precautionary approach to:

- Identify the key rare and diverse sites for biodiversity in the Wellington Region's coastal marine environment (MHWS to 12 nm), and the present and future activities that could impact these sites (this attempts to address criteria b) and c) of policy 22 of the RPS).

- Identify representative examples of the habitat types that occur in the Wellington coastal marine area (including deep water), worthy of protection (this attempts to address criterion a) of policy 22 of the RPS).

- Identify the coastal marine areas that are important as migration routes for sea birds and marine mammals or supply/dispersal routes_for marine invertebrates and fish, and describe existing and future activities that threaten the species using these areas (this attempts to address criterion d) of policy 22 of the RPS).

- Produce a report that includes a detailed table summarising the location (latitude and longitude) of each site, habitat or area, describes the biodiversity values of each site, describes the features that address the relevant criteria, describes the present and future activities that threaten these sites and lists any supporting literature, documentation and/or data-sets. The report would also include any relevant GIS layers.

This report would then be used by GWRC to assist in the review of its Regional Plans.

It was agreed that the project would be entirely a desktop collation and assessment exercise utilising existing data sets and information. There would be no new data gathering, modelling or complex analysis. It was agreed that there would be three steps to the identification of sites of significant ecological value within the Wellington region.

1. Collation of available data;
2. Workshop with GWRC staff to discuss quality and relevance of data and classification of each site;
3. Finalisation of site specific assessments and production of deliverables.

2 Methods

2.1 Collation of relevant information

Sites of significant ecological value have been identified using a variety of data and information that describe features of the marine ecosystem in the Wellington region. The territorial seas within the Wellington region encompass a very wide range of marine habitats, from sheltered harbours to the deep waters and canyons of Cook Strait. Consequently, the task of collating and reviewing relevant information has been very broad, involving a number of experts and a wide variety of information sources. Information is widely scattered in published scientific journal articles, published and unpublished maps and charts, public reports, unpublished client reports, student theses and databases held by a variety of institutions, independent research providers and private individuals. The information and data collated from these disparate sources were carefully examined because they were collected over decades using a variety of approaches and methods ranging from quantitative surveys employing acoustic methods, grabs, cores, remote cameras or diver transects to much more qualitative collection of specimens for faunal and floral analysis.

The Boffa Miskell report (2007) contained information about just a few estuarine and marine coastal sites. Where new information was available about these sites we updated the assessment carried out by Boffa Miskell (e.g. for Pauatahanui Inlet), but most of our effort was directed towards new sites across the whole range of marine habitats within the region.

For instance, we took advantage of new data about specialised cold seep faunas that lie in deep water just within the south-east boundary of the Wellington region, and are threatened by fishing activities and prospective exploitation of gas (methane) hydrate deposits (Baco et al. 2009, Greinert et al 2010). We also used emerging data based on sparse direct sampling and camera tows Lamarche et al (in press) that describe six benthic communities from the Cook Strait Canyon system, each associated with a distinct geomorphology (canyon walls, canyon floor, angular gullies etc.). Substrate classifications of acoustic backscatter will ultimately be used to indicate seabed biotopes over large areas (Lamarche et al. 2009a,b) but not until further validation is undertaken to correlate backscatter classes to metrics of biodiversity. As this validation is unlikely to be completed until 2012/13 we consider the initial descriptions of benthic fauna sufficiently robust for inclusion in this project. We also took advantage of new assessments of reef fish distribution that utilise environmental covariates to predict the spatial variation in overall species diversity (Leathwick et al. 2006, Smith 2008).

Varying amounts of information were available for different sites and habitats. Some sites were well supported by quantitative survey data while other sites had a greater reliance on qualitative or inferential (modelled) data. Some habitats within the region are particularly poorly sampled but their inclusion in this report is based on using the best available information and expert opinion.

Comprehensive multibeam bathymetry and backscatter survey of Cook Strait has been used to generate a new regional substrate classification map over a wide range of water depths, seafloor substrates and geological landforms (Lucieer & Lamarche 2011). We used this information along with other substrate information summarised by (MacDiarmid et al. 2011) to identify the relative areas of different marine habitats in the Wellington region for use in the regional policy statement.

2.2 Workshop with GWRC staff

Once the initial data collation phase was complete and results were available, a 1-day workshop was held on 3 April 2012 with GWRC marine scientists, policy advisors and planners who ultimately will be incorporating relevant information from the project into the regional policy statement. During the workshop the available information, the value descriptions, fit-to-assessment-criteria, and present and likely threats were assessed for each site or habitat in turn. This assessment led to agreement for additional effort in the third phase of the project to identify threats relevant to the jurisdiction of the GWRC and to split the results section into two schedules; one for defined sites that fit the criteria, the other for specific habitats that fit the criteria wherever they occur in the region. For instance, during the workshop it was agreed that kelp bed and reef fish habitat were habitats that needed to be included for consideration.

2.3 Finalisation of Site Assessments

Feedback from regional council staff during and after the workshop was particularly useful for the third phase of the project to finalise the site and habitat assessments. A clear separation was made between specific sites and more general habitats that contain significant marine biodiversity in the Wellington Region. Further information was sought on marine habitat corridors, on Mataikona reef, sunken wood habitats and freshwater springs in Wellington Harbour. The threats to each site or habitat were reviewed.

3 Marine habitats in the Wellington region

The total area included in Wellington's marine region is about 742,484 ha (Table 3-1). Of this about 10,727 ha (1.5%) occurs in harbours and estuaries, 429,853 ha (58%) occurs on the continental shelf, 299 896 ha (40%) is found on the continental slope, and about 2,008 ha (0.5%) occurs at depths below 2000 m.

The shallow inshore fauna and flora in the Wellington region have been classified by Shears et al. (2008) as belonging to two distinct bioregions Abel and Cook which respectively fall within two different biogeographical provinces (Northern and Southern). The division between the bioregions and biogeographical provinces occurs approximately between Cape Terawhiti on the south-west tip of North Island and Perano Head on Arapawa Island on the western side of Cook Strait (see Figure 3-1).

Table 3-1: Areas of marine habitats in the Wellington Region.

Geophysical feature	Habitat	Area (ha)	% of geophysical feature
Harbours and estuaries	Seagrass beds	270	2.5%
	Intertidal reefs 0-9 m	89	0.8%
	Subtidal reefs 2-9 m	482	4.5%
	Subtidal reefs 10-29 m	518	4.8%
	Mud	2,867	26.7%
	Sand	1,895	17.7%
	Unclassified sediments	4,606	42.9%
	Total	10,727	
Exposed coasts	Intertidal reefs	1,410	0.3%
	Subtidal reefs 2-9 m	14,792	3.4%
	Subtidal reefs 10-29 m	10,008	2.3%
	Subtidal reefs 30-200 m	3,696	0.9%
	Mud 2-9 m	209	<0.1%
	Mud 10-29 m	8,042	1.9%
	Mud 30-200 m	87,476	20.4%
	Sand 2-9 m	1214	0.3%
	Sand 10-29 m	9,925	2.3%
	Sand 30-200 m	193,119	44.9%
	Gravel, pebble, shell hash 10-29 m	47	<<0.1%
	Gravel, pebble, shell hash 30-200 m	39,456	9.2%
	Unclassified sediments	60,459	14.1%
	Total	429,853	
Slope habitats	Mud 200m-2000m	243,729	81.3%
	Sand 200m-2000m	27,412	9.1%
	Gravel, pebbles, shell hash 200m-2000m	26,162	8.7%
	Unclassified sediments 200m-2000m	2,593	0.9%
	Total	299,896	
Deep habitats	Seamount 200-2000 m	2,008	100%
Total		742,484	

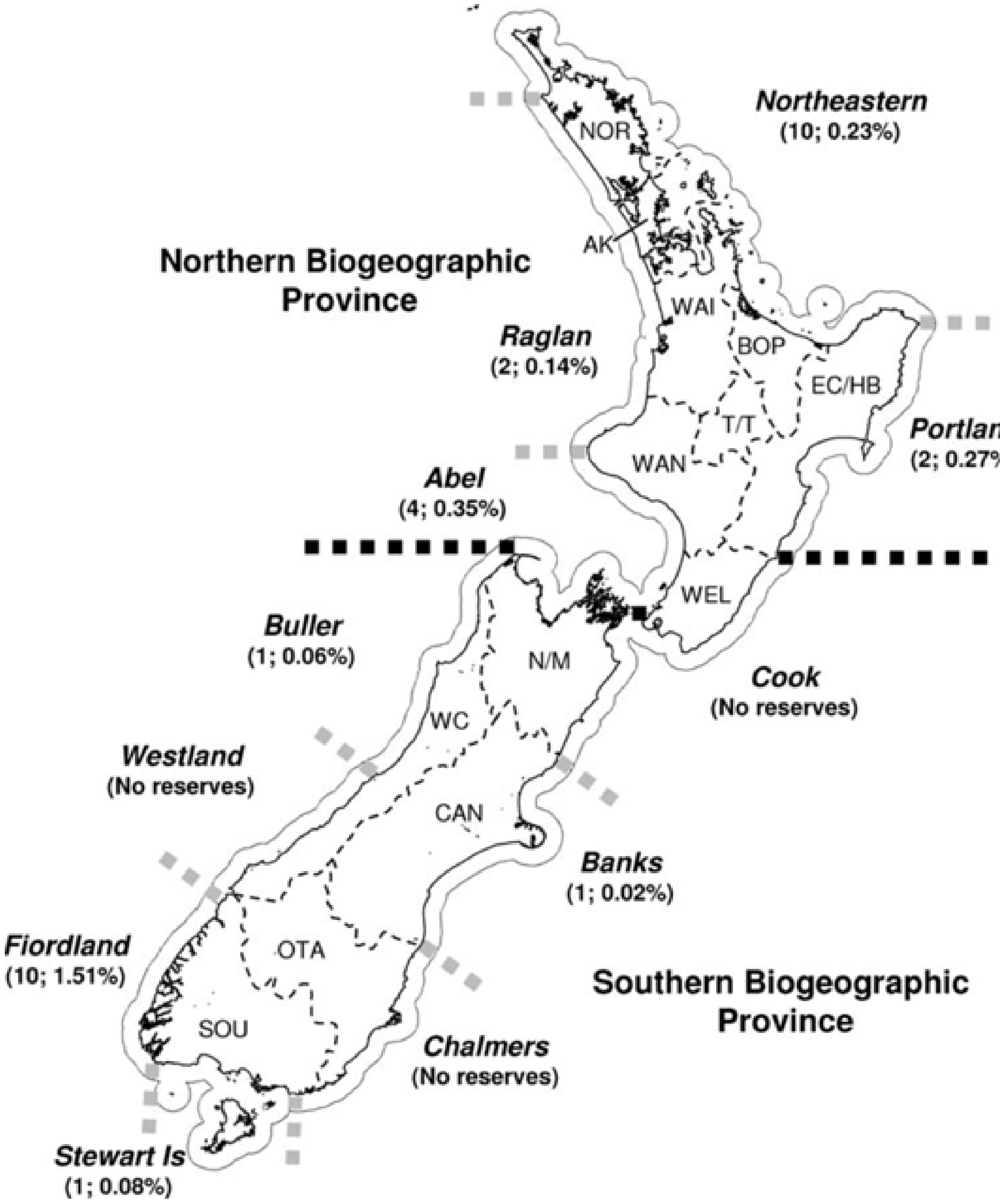

Figure 3-1: Biogeographic provinces (northern and southern) and bioregions for mainland New Zealand. These were developed by Shears et al. (2008) on the basis of groupings of locations with macroalgal species presence–absence as a surrogate. Dashed black line indicates a proposed biogeographic province break, and dashed gray lines indicate proposed boundaries between bioregions. Positions of boundaries between bioregions were approximated on the basis of previous studies, especially where sampling density from this study was sparse. Numbers in parentheses indicate the number of existing no-take marine reserves and the percentage of the mainland territorial sea currently protected in no-take MPAs within each bioregion Three-letter abbreviations are Department of Conservation's management areas. Note that since publication of Shears et al. (2008) the Taputeranga Marine Reserve has been established on Wellington's south coast in the Cook Bioregion.

4 Schedule 1: Sites of significance for marine biodiversity

4.1 Porirua Harbour

4.1.1 Description

Porirua Harbour comprises two shallow drowned river valleys, the southern Porirua or Onepoto Arm and the northern Pauatahanui Inlet, meeting at a deep narrow confluence which opens to the west coast of the lower North Island opposite Mana Island. Porirua Harbour at 807 ha (524 ha in the Pauatahanui Inlet and 283 ha in the Onepoto Arm) is moderate in size compared to other New Zealand estuaries (Stevens and Robertson 2008) but is the largest estuary system in the Wellington region.

Stevens and Robertson (2008) undertook broad-scale habitat mapping of the harbour in 2007/08 and Discovery Marine Limited (DML 2009) undertook a bathymetric survey of the harbour in March and April 2009. Unlike other similar sized estuaries which largely drain at low tide, Porirua Harbour remains largely filled and is comprised of mainly subtidal habitats (65%), particularly the Onepoto Arm. At the confluence of the two arms water depth reaches at least 13 m. This characteristic is important as it influences the range of habitats and species occurring within the harbour.

Figure 4-1: Aerial view of the entrance and both arms of the Porirua Harbour (Onepoto Arm in foreground, Pauatahanui Inlet behind). Photograph by Aidan Wojtas. This image, which was originally posted to Flickr.com, was uploaded to Commons using Flickr upload bot on 04:21, 9 July 2010 (UTC) by Avenue (talk).

Stevens and Robertson (2008) found that the majority of the intertidal area in both arms was dominated by unvegetated, poorly sorted firm muddy sands (122 ha in the Pauatahanui Inlet and 33 ha in the Onepoto Arm). Firm and mobile sands occupied a total of 32.4 ha, while soft muds occupied only 3.4 ha in total. Subtidal sediments are poorly characterised.

4.1.2 Biodiversity values

General values:

New Zealand's shallow harbours and estuaries are important centres of diversity for shore and wading birds, coastal fish and invertebrates, as well as a variety of marine algae and flowering plants such as seagrass and saltmarsh species. Harbours and estuaries are key breeding, nursery and foraging areas for many species. Porirua Harbour is typical in this general sense but because of the limited size of most estuaries within the Wellington region the biodiversity value of Porirua Harbour is considerably elevated. The specific values associated with Porirua Harbour are discussed below.

Site specific values:

Saltmarsh

Stevens and Robertson (2008) found that saltmarsh was virtually absent in the Onepoto Arm (0.8 ha) of the harbour due to historical modification and hardening of the foreshore and extensive reclamation along its eastern side to create railway and motorway embankments. In the Pauatahanui Inlet Stevens and Robertson (2008) reported that saltmarsh occupied 51 ha where it was dominated by wide beds of rushland (searush - *Juncus maritimus var australiensis,* and jointed wire rush - *Apodasmia similis*) bounded inshore by saltmarsh ribbonwood (*Plagianthus divaricatus*) and fescue grasses. This is likely to be the third largest area of saltmarsh in the Wellington region. Robertson and Stevens (2007a, b & c) estimated areas of salt marsh for the 34 estuaries in the Wellington region. These total 261 ha of which that occurring in Porirua Harbour represents 20%. Only the low saline Lake Onoke and adjacent Poinui Lagoon contain higher percentages (23% and 38% respectively) of the regional total area of saltmarsh.

Seagrass

Stevens and Robertson (2008) also noted that extensive areas of intertidal seagrass (*Zostera capricorni*) occurred in both arms of the harbour (41.2 ha in Pauatahanui Inlet; 17.3 ha in the Onepoto Arm). According to the MarHADs tool (MacDiarmid et al. 2011), the total area of seagrass in the two arms is about 79% of the regional total of this habitat and 15% of the total in the Abel Bioregion that stretches from Cape Egmont in the north to Farewell Spit in the southwest and a line between Cape Terawhiti and Perano Head on Arapawa Island in the southeast (Shears et al. 2008). This suggests that Porirua Harbour is of particularly high value for this habitat.

Macroalgae

Robertson and Stevens (2007c) surveyed the intertidal macroalgae of the Porirua Harbour, principally as a possible indicator of nutrient enrichment. Recent work by Neill et al. (2012) questions the assumption that the presence of algal beds is automatically a threat indicator and point out that macroalgae can provide spatial complex microhabitats that support additional biodiversity. In the Pauatahanui Inlet the main species encountered by Robertson and Stevens (2007b) was *Gracilaria* with small areas of *Ulva.* In the Onepoto Arm *Ulva* (blade forming species) dominated with smaller areas of *Gracilaria and Ulva* (tubular, formerly known as *Enteromorpha*). Note that *Ulva* and *Enteromorpha* are now placed in a single genus, *Ulva* (Hayden et al. 2003). Heesch et al. (2009) recently undertook a genetic survey of this genus in New Zealand and discovered 24 distinct taxa belonging to three genera – *Ulva* (19 species), *Umbraulva* (four species) and *Gemina* (one species). Of these nine species (all in the genus *Ulva*) occur in harbours and embayments in the Wellington region and may occur in the Porirua Harbour. The introduced Asian kelp *Undaria pinnatifida* also occurs in the harbour. Detailed surveys of the species present in the Porirua harbour have not been conducted, but based on recent research in other New Zealand harbours, it is likely that the macroalgal biodiversity has been significantly under-collected and is poorly documented.

Fish

Jones and Hadfield (1985) described the fish fauna of the two arms of Porirua harbour from set nets set monthly over the course of a year. They caught 24 species of fish, bringing the total number of species known from the two inlets to 43 based on their study and the previous records of Healy (1980). Jones and Hadfield (1985) concluded that the inlets are a nursery area for juvenile elephant fish (*Callorhynchus milii),* rig *(Mustelus lenticulatus),* sand flounder *(Rhombosolea plebeia),* and kahawai (*Arripis trutta).*The importance of the Porirua Harbour as a pupping and nursery area for rig in a national context has been further explored by Francis et al. (in press). They found that of 14 harbours and inlets sampled nationwide, Porirua Harbour had the 4th highest catch rates of small juvenile rig behind two arms of Kaipara Harbour and Raglan Harbour. Francis (unpublished data) tracked juvenile rig in each arm of Porirua Harbour using acoustic tags and an array of receivers. He found that juveniles were largely confined to one arm or the other with little mixing until they left the harbour through the deep entrance in May. There are no historical records of juvenile rig from Wellington Harbour or any of the smaller inlets in the Wellington region (Francis et al. in press), suggesting that both arms of Porirua Harbour are key for this species regionally and of high value nationally.

Benthos

According to Bell et al. (1969 cited in Blaschke et al. 2010) Porirua Harbour is the most southerly habitat for some benthic species. Blaschke et al. (2010) noted that eight species of invertebrates (a polychaete, a snail and six copepod species) were first described and identified in Porirua Harbour.

Of the meiofaunal species, copepods dominate within the Pauatahanui Inlet with the highly abundant *Parastenheli megarostrum* occurring at a density of around 263,000 individuals per m^2 (PICT 2001). Kinorhynchs (mud dragons), also meiofaunal, are well represented in the inlet. At Ration Point, Coull and Wells (1981) found densities of 80 individuals of an unnamed *Echinoderes* per 10 square centimetres of surface mud, the second-highest kinorhynch abundance ever recorded anywhere in the world. A related phylum – Priapulida or penis worms – is also found in the inlet, which is the shallowest known and most accessible locality for collecting these zoologically interesting creatures (Storch et al. 1995).

Blaschke et al. (2010) recently reviewed the available information on the benthic communities in Porirua Harbour. They concluded that of the macro-faunal species, polychaete worms dominated numerically (>50%), then bivalve molluscs, crustaceans, and gastropod molluscs. Stevens and Robertson (2008) described this as ‘unbalanced’ as it was dominated by species tolerant of moderate sedimentation and enrichment.

Because of its size and moderately healthy status (Stevens and Robertson 2008), the Porirua Harbour is likely to be the most significant area for estuarine invertebrates in the Wellington region.

Cockles

Porirua Harbour and Pauatahanui Inlet in particular contains regionally significant numbers and biomass of cockles (*Austrovenus stutchburyi*). Other estuaries on the Wairarapa Coast, Wellington’s south coast, and the Kapiti coast contain few shellfish beds (Robertson and Stevenes 2007a, b). Blaschke et al. (2010) reviewed the information on cockles in Pauatahanui Inlet from numerous surveys undertaken since 1976. Since 1992 the population has been relatively stable at around 220 million individuals though the proportion of juveniles in the population has varied widely among years and sites within the inlet. In Pauatahanui Inlet in 1976, cockles comprised about 80% by number of the living macrofauna, excluding fish and birds (Healy 1980; PICT 2001, Blaschke et al. 2010). It is unknown whether this proportion has since changed.

Birds

Blaschke et al. (2010) reviewed the available information on birds in the Porirua Harbour and immediate environs. They noted that for some years birds associated with the Harbour have been documented by the Ornithological Society of New Zealand, with a focus on the wide variety of wading and shore birds at Pauatahanui Wildlife Reserve. The number of species has increased from 37 in the 1970s to 53 at present. Many of the birds are migratory and visit the inlet on an occasional or seasonal basis.

4.1.3 Habitat features relevant to criteria

Representativeness – The Porirua Harbour contains habitats (saltmarsh, seagrass meadows, shellfish beds) that are no longer commonplace in the region and are poorly represented in existing protected areas (e.g. Kapiti Marine Reserve, Taputeranga Marine Reserve). Porirua Harbour contains 20% of the regional total area of saltmarsh and 79% of the regional total area of seagrass. It is likely to contain the largest area of cockle beds but comparable data are lacking from other harbours and estuaries. The Pauatahanui Wildlife Reserve was established at the eastern end of the inlet in the mid-1980s.

Rarity – Porirua Harbour is the largest moderately intact shallow harbour ecosystem in the Wellington region. Unlike most other estuarine ecosystems in the Wellington region its mouth is permanently open to the sea and large areas remain subtidal at low tide, so retains a strong marine influence.

Diversity – Porirua Harbour contains a diverse range of habitats ranging from deep channels, subtidal mud flats, intertidal mud, algal beds, sand flats, seagrass meadows, shellfish beds, and saltmarsh. This diversity of habitats supports a corresponding richness in the assemblages of fish, invertebrates and shore and wading avifauna.

Ecological context – Porirua Harbour provides regionally important pupping/ spawning and nursery areas for rig, elephant fish, sand flounder and kahawai. It provides regionally important roosting and feeding areas for a number of shore and wading birds.

4.1.4 Threats – Present and future

Blaschke et al. (2010) summarised the present threats to Porirua Harbour. They noted that Porirua Harbour may be the most completely hard-edged estuary in New Zealand; i.e. the most completely ringed by road, rail and walkway/cycleway embankments. They suggest that there may be many actual and potential effects of this situation, including pollution from vehicle emissions, brake pads, tyres and road wash, wave refraction, estuarine erosion and loss of the absorptive capacity of the Harbour edges from storm surges, direct coastal habitat loss, and loss of potential habitat for estuarine species retreating from rising sea levels.

Sedimentation is also a continuing and major issue. Swales et al. (2005) estimated the present sediment accumulation rates in the Pautanui Inlet average 4.6 mm yr^{-1}, well above the pre-European rates of ~1 mm yr^{-1}. At present rates of deposition Gibbs and Cox (2009) calculated that sediments will infill the Pauatahanui Inlet and turn it into saline swamp by 2180 (± 25 years) and the Onepoto Arm by 2350 (± 50 years).

Blaschke et al. (2010) noted concentrations of heavy metals have been reported as elevated in the subtidal sediments of Onepoto Arm to just below low trigger guideline levels for copper, lead and zinc. They also indicated there is a likelihood of faecal contamination of edible shellfish species, due to the high faecal coliform counts frequently encountered in water quality tests. Several studies have looked at the contamination effects of the biota (Stephenson 2003, Milne 2008).

Robertson and Stevens (2008) concluded that Porirua Harbour was low to moderately enriched with nutrients leading to a moderate eutrophic state.

Sea level rise, acidification, increases in sea temperature and other consequences of increasing levels of greenhouse gases in the atmosphere are the major new threats confronting Porirua Harbour (MacDiarmid et al. 2012). These threats are largely outside the control of the GWRC but actions taken to mitigate the effects of existing threats may lessen the impact of the these more generic threats.

4.1.5 Existing status and levels of protection

The Pauatahanui Inlet is classified by the Department of Conservation (DoC) as a site of national significance under its Site of Special Wildlife Interest (SSWI) criteria. The Pauatahanui Inlet was listed as a site of national significance for indigenous vegetation (saltmarsh and seagrass) and significant habitats for indigenous fauna in the Regional Policy Statement (WRC, 1995). The inlet was also classified in the Wellington Regional Coastal Plan as an Area of Significant Conservation Value based on the natural, conservation, geological and scientific values (GRWC, 2000). The 50-hectare Pauatahanui Wildlife Management Reserve lies at the head of the Inlet. Four hectares are owned by the Royal New Zealand Forest and Bird Protection Society (Forest and Bird) and protected under a covenant with the Queen Elizabeth II Trust. The rest of the reserve is owned by DoC. All plants and wildlife are protected within the reserve but not fish and invertebrates. Dogs are banned.

4.1.6 Site relevant references

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4.2 Wellington Harbour freshwater seeps

4.2.1 Description

Submarine freshwater seeps occur where onshore aquifers discharge through porous rocks, and because of lower density than the surrounding seawater, seep up through seafloor sediments and into the water column. The input of freshwater may alter the salinity near the seafloor, influencing the character of the local ecosystem in those places where freshwater flows are sufficiently high (Moore 1999). Some freshwater seeps may carry a methane gas component from fossil sources or contemporary biogenic decomposition (e.g. Jensen et al. 1992).

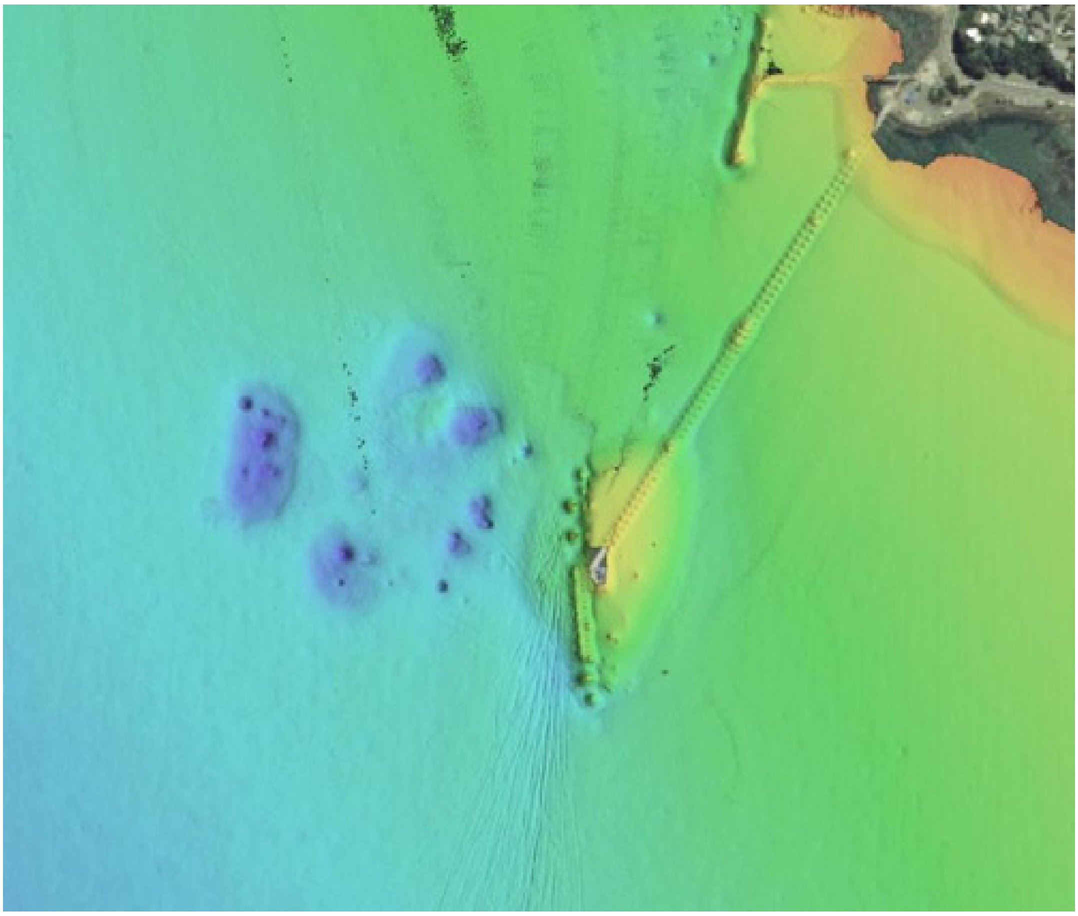

Figure 4-2: Depressions (purple coloured area) in the seafloor west of the long Seaview Wharf in Wellington Harbour. These depressions in 12-18 m of water, caused by freshwater discharges eroding sediments, are up to 80 m across and 5 m deep.

Discharges of artesian water from the Hutt Valley aquifer occurs in Wellington Harbour from near the eastern end of Petone Beach to Falcon Shoal off Seatoun (Stevens 1974, EHEA 1998 and references therein). Acoustic soundings of the water column taken across Wellington Harbour, show plumes up to 12 m high arising from the harbour floor. The highest concentration of springs occurs off the long Point Howard Wharf and off the eastern end of the Petone Beach at a depth about 12-18 m where the flow of freshwater has eroded the surrounding sediments forming circular depressions up to 80 m across and 5 m deep (Pallentin et al. 2009).

A recent analysis of backscatter data from the multibeam bathymetric survey of Wellington Harbour carried out in 2007-08 indicates several more sites in this area and offshore of the Hutt motorway (Pallentin unpublished data).

4.2.2 Biodiversity values

General values:

There are few published studies to draw upon. Freshwater seeps in Eckernförde Bay, western Baltic are well described and have an associated fossil, freshwater fauna but present day fauna are not described (Jensen et al. 2002). Jensen et al. (1992) described shallow (10-12 m) submarine landscapes of carbonate cemented rocks that support a diverse ecosystem at methane seeps in the Kattegat. In the Adriatic Novosel et al. (2005), found one species of bryozoan to only occur in submarine freshwater springs where it formed large (>1m diameter) colonies.

Site specific values:

There is no reliable information about the biodiversity associated with the freshwater seeps in Wellington Harbour. Jim Mikoz in an article published in *Fishing Coast to Coast New Zealand* reports seeing schools of mysid shrimps (species unknown) in close proximity to the seeps and catching groper and large bags of snapper in the vicinity.

4.2.3 Habitat features relevant to criteria

Representativeness – As far as is known, this habitat is not represented in existing protected areas in the Wellington region

Rarity – This habitat is presumed to be rare within the Wellington region but comparable information from other parts of the region is not available

Diversity – The associated fauna and flora is undescribed.

4.2.4 Threats – Present and future

Internationally, freshwater seep ecosystems are thought to be threatened by increasing amounts of nutrients or pollutants in the water arriving via the land aquifers (e.g. Corbett et al. 2000).

Freshwater seeps may also be impacted by draw-down of artesian water inland of the seeps or by engineering in the near-shore zone. In Wellington Harbour the water bearing gravels are overlain by a cap of 2m of clay and 10 m of silty sediments. The greater pressure of the artesian water keeps the seawater from entering the aquifer. This thin cap can be disturbed by dredging and pile driving allowing great quantities of artesian water to be released, thereby lowering pressures in the artesian system and threatening not only the harbour seeps but also land artesian well supplies. According to Stevens (1974) two such events took place in the mid-20th century. In 1939 when it was decided to build a port at the Hutt Estuary, dredging removed the cap, allowing artesian water to break through and lowering artesian pressures throughout the Hutt Valley. Rapid replacement of the dredged material resealed the cap and artesian pressures were gradually restored. A second, very similar, event occurred in 1953 during construction of the Hutt Estuary bridge, when quick setting cement was used to plug the cap. According to Jim Mikoz, a third event may have occurred during construction of the Seaview marina (see fishingcoasttocoast.com).

4.2.5 Existing status and levels of protection

None

4.2.6 Site relevant references

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4.3 Soft sediment *Adamsiella* algal beds in Wellington Harbour

4.3.1 Description

Meadows of the red algae *Adamsiella* sp. attached to small shells or pebbles occur over substantial areas of muddy sediment at the southern end of Evans Bay, Wellington Harbour. These meadows were discovered during routine biosecurity surveys of yachts and motor launches in the Evans Bay marina (Inglis et al. 2006) but have not been surveyed to determine their full extent. Typically during biosecurity surveys 2 minute dredge tows at 2 knots would be full of this species (Kate Neill, NIWA, personal comment).

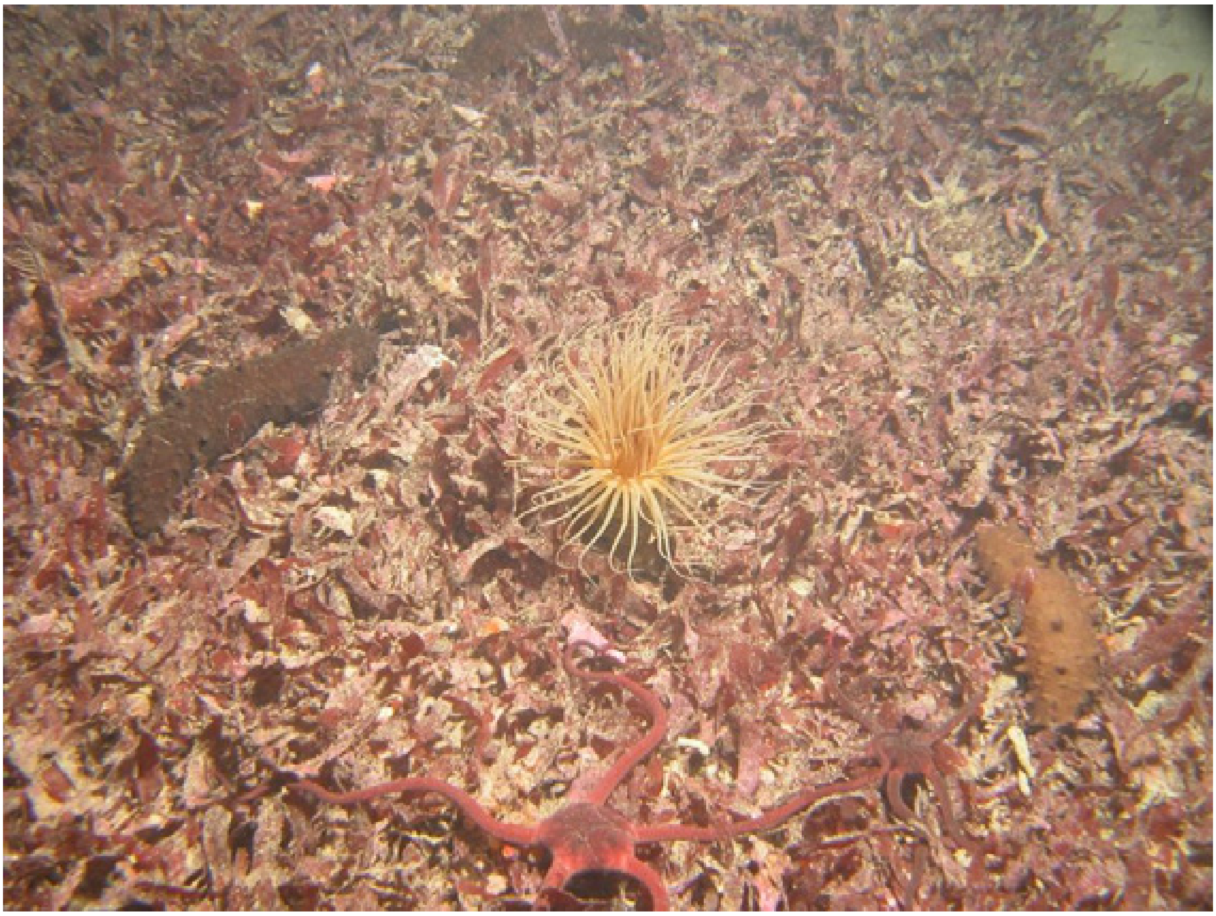

Figure 4-3: *Adamsiella* meadow and some of the associated species in Big Glory Bay, Stewart Island. Photo Lou Hunt, MAF, NZ.

4.3.2 Biodiversity values

General values:

Macroalgae are known to be important structural and functional components of marine ecosystems, contributing through provision of products of photosynthesis, as well as providing structure and surfaces for other organisms. However, their function in soft sediment ecosystems has received little attention in New Zealand.

There is very limited information about the soft sediment environments within the Wellington Region in terms of macroalgae (Adams 1972, Nelson 2008). Based on recent research in other New Zealand harbours, it is likely that the macroalgal biodiversity has been significantly under-collected and is poorly documented.

Site specific values:

Adamsiella meadows have been observed at the southern end of Evans Bay, in Wellington Harbour but have not been systematically surveyed to determine their spatial extent or co-occurring species. In other areas of New Zealand *Adamsiella* beds are known to harbour a range of associated species (Hare 1992). Rainer (1981) examined soft-bottom benthic communities in Otago Harbour and Blueskin Bay and noted that the presence of shell or macroscopic algae was usually associated with elevated species diversity. Rainer (1981) concluded that the presence of macroscopic algae, principally *Adamsiella* had affected sediment composition in some areas by favouring the deposition of silt and organic detritus, with resulting differences in the fauna. On Stewart Island Roper et al. (1988) concluded that the *Adamsiella* meadows in Big Glory Bay "probably play an important role in stabilising the muddy bottom and provide a refuge for animals".

4.3.3 Habitat features relevant to criteria

Representativeness – Macroalgae on soft sediments are poorly protected within the Wellington region with few such habitats occurring within the existing marine reserves.

Rarity – Algal assemblages on soft sediments are rare regionally, probably only occurring in Wellington and Porirua Harbours but there is a lack of systematic data on regional and national distribution.

Diversity – *Adamsiella* beds have been observed at the southern end of Evans Bay. *Adamsiella* beds are known to harbour a range of associated species in other areas of New Zealand. No studies have been undertaken on the Wellington Harbour beds.

Ecological context – role unknown.

4.3.4 Threats – Present and future

These beds may be presently impacted by invasive species, boat anchoring, sedimentation and pollution. Future threats may include marina expansion, reclamation, and general effects of climate change.

4.3.5 Existing status and levels of protection

None

4.3.6 Site relevant references

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4.4 Kapiti Island rhodolith beds

4.4.1 Description

Rhodoliths are free-living calcified red algae that occur in localised habitats worldwide, over wide latitudinal and depth ranges, forming structurally and functionally complex habitats. The complex morphology of rhodoliths provides a very heterogeneous habitat. Rhodolith beds form a unique ecosystem with a high benthic biodiversity supporting many rare and unusual species. The branching or rounded thalli collectively create a fragile, structured biogenic matrix over coarse or fine carbonate sediment. Productive fisheries are often coincident with rhodolith beds and it is thought that the high level of functional diversity that they provide may be an important driver in maintaining productivity. The complex habitat structure also provides refugia for juvenile fish and settlement habitat for shellfish larvae. Internationally rhodolith beds have been identified as critically important biodiversity hotspots, harbouring high diversity and abundance of marine animals and algae in comparison with surrounding habitats (see review by Nelson 2009). Rhodolith beds have also been identified as important nursery areas for commercial species such as scallops, crabs, and fish, and are home to high densities of broodstock bivalves (Nelson 2009).

Figure 4-4: Examples of rhodoliths collected from the Kapiti region.

Very little information exists about the location, extent or ecosystem functioning of rhodolith beds in New Zealand.

Kapiti Island is the largest island lying off the west coast of the North Island, approximately 50 km north of Wellington and 5 km offshore. In April 1992 the Kapiti Marine reserve was gazetted and formally established in May 1992. Kapiti Island has been a focus of marine recreational activities including fishing, diving, as well as commercial fishing.

To the east of the island there are rhodolith beds. In a baseline survey of the marine habitats and communities of Kapiti Island Battershill et al. (1993) reported:

"At 200 m offshore [20-25 m depth], a rhodolith bed is encountered… Rhodoliths were very dense in patches of the bed and layered to over 25 cm deep. The bed extended over 200 m due east. The eastern limit was not found, nor were the northern and southern extensions of the bed (extended over 200 m north and south of Station 9)."

Although side scan sonar mapping of the beds was attempted in 2004, this was unsuccessful owing to both gear problems (failure of equipment) and weather conditions. In the limited data that were obtained it was not possible to distinguish between cobbles and rhodoliths. Observations were made that the rhodolith beds consisted of a soft bottom with an armour of cobbles and rhodoliths, and that rhodoliths were present from at least 6 – 20 m depth, that there appeared to be "shallow" and "deep" forms, and that all the rhodoliths collected were all identified as *Sporolithon durum*.

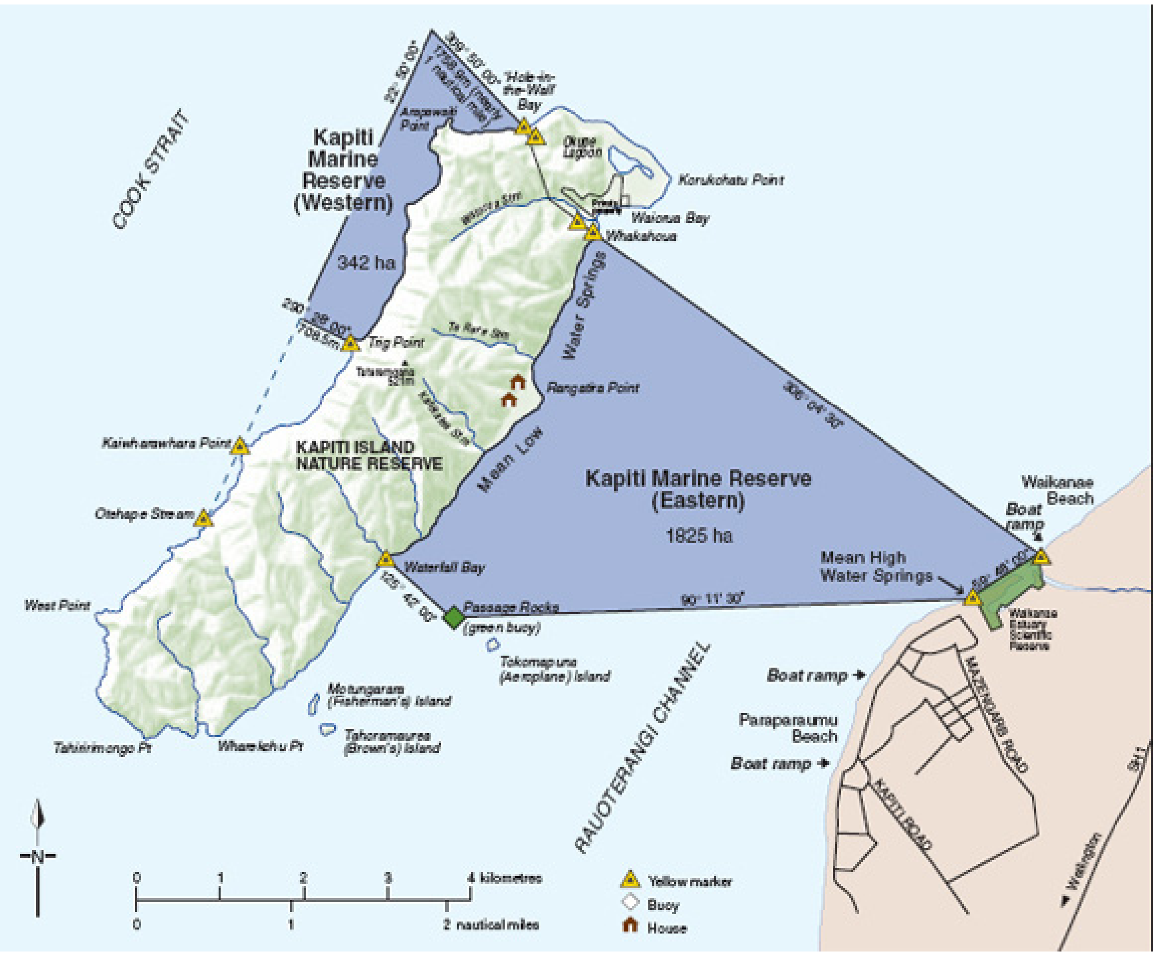

Figure 4-5: Map showing boundaries of the Kapiti Marine Reserve. Source DoC.

4.4.2 Biodiversity values

General values:

Rhodolith beds typically support an unusual suite of organisms that rely on the three dimensional space provided. Around the world, rhodolith beds have been documented as biodiversity hotspots.

Site specific values:

The Kapiti Island rhodolith beds are the only ones known in the lower North Island, and apparently the largest aggregations anywhere in the country. Complete characterization of the Kapiti Island rhodolith beds has not been undertaken – so the full physical extent and abundance of rhodoliths remains unknown, and there have been no surveys of the associated flora and fauna. However, opportunistic collections have shown the occurrence of:

- Isopod *Mexicope sushara* sp. nov. (only other record off SE South I.)
- Bryozoan *"Schizoporella" spectabilis* (only record outside Foveaux Strait, southern South I.)
- Bryozoan *Celleporaria* sp. nov.
- Bryozoa *Celleporaria agglutinans* (NZ endemic) & *Parasmittina delicatula* (Pacific).
-

4.4.3 Habitat features relevant to criteria

The Kapitit Island rhodolith beds clearly fit the GWRC biodiversity criteria for rarity and diversity.

Rarity – The only known site with rhodoliths in the region. The largest aggregations reported to date in the country.

Diversity – The opportunistic invertebrate collections available to date give a glimpse of the potential diversity associated with these beds, but surveys and documentation remain to be carried out.

4.4.4 Threats – Present and future

Present

Recent international studies show that these fragile and slow growing (0.05-2 mm/yr) algae are at risk from the impacts of a range of human activities e.g., physical disruption (trawling, dredging, anchoring) (Hall-Spencer & Moore 2000), reduction in water quality (siltation and coastal runoff, anoxia, eutrophication, effluent discharges, offshore dumping) (e.g. Wilson et al. 2004, Riul et al. 2008), alterations to water movement (breakwaters, quays, sea-walls, causeways, marinas, bridges), aquaculture installations (shellfish rafts and lines, fish cages) (Hall-Spencer et al. 2003, 2006). Impacts of fragmentation may be critical in terms of biodiversity and abundance associated with rhodolith beds; the diversity and abundance of organisms supported by a rhodolith significantly increase with complexity (branching density) and the space available (thallus volume) (Steller et al. 2003).

Future

Like other calcified macroalgae, rhodoliths will be impacted by acidification of the oceans resulting from global climate change. Although the potential impacts are not yet fully understood, they are likely to be complex and variable between species (Doney et al. 2009, Hall-Spencer et al. 2008, Kuffner et al. 2008), and it is thought that sensitive reef-building species such as coralline algae may be pushed beyond their thresholds for growth and survival within the next few decades (Anthony et al. 2008). A recent study has shown that rhodoliths are profoundly adversely affected by acidification, and show a much greater impact than exhibited by other coralline algae or corals (Jokiel et al. 2008).

4.4.5 Existing status and levels of protection

An unknown proportion of the rhodolith beds fall within the eastern portion of the Kapiti Marine Reserve where they are completely protected from exploitation and direct human disturbance. The proportion of the beds outside the reserve has no protected status.

4.4.6 Site relevant references

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4.5 Mataikona Reef - mixed algal assemblages

4.5.1 Description

The Mataikona reefs extend about 8 km along the coast between Wakataki and Matiakona in the north-east of the region. They are comprised of alternating bands of hard and softer sedimentary rock that have been tilted 90^{o} so that the layers sit vertically. The softer layers have been eroded away forming channels between the harder layers that emerge like long rows of spines (Figure 4-6). These unusual reefs extend into the subtidal.

This habitat is not only visually dramatic but has a rich algal flora (Adams 1972, Wendy Nelson, NIWA personal observation). The invertebrate fauna is poorly documented (Dennis Gordon, NIWA, personal comment).

Figure 4-6: Tilted reef structures at Mataikona. Image courtesy H. Nelson.

4.5.2 Biodiversity values

General values:

Within the Wellington Region there are many different types of habitats with associated characteristic assemblages of macroalgae. On rocky reefs these range in exposure to wave and wind climate, geology, and also vary in steepness of slope, aspect and physical extent (e.g., extensive near-horizontal reef platforms exposed at low tide through to near vertical cliff faces extending into the subtidal).

Macroalgae ranging from small foliose red and green algae to large brown algae extend from the intertidal to beyond the depths of kelp beds, with their maximum depth affected by water clarity which is in turn influenced by sediment run-off from land and shading caused by phytoplankton growth. Although the major biogenic habitat structure in near-shore reefs is provided by large brown algae, a great deal also goes on in the understorey vegetation in terms of biomass production, as well as provision of food and shelter for a range of herbivorous fish and invertebrates as well as for filter feeding species consuming particulate and dissolved organic compounds from macroalgae.

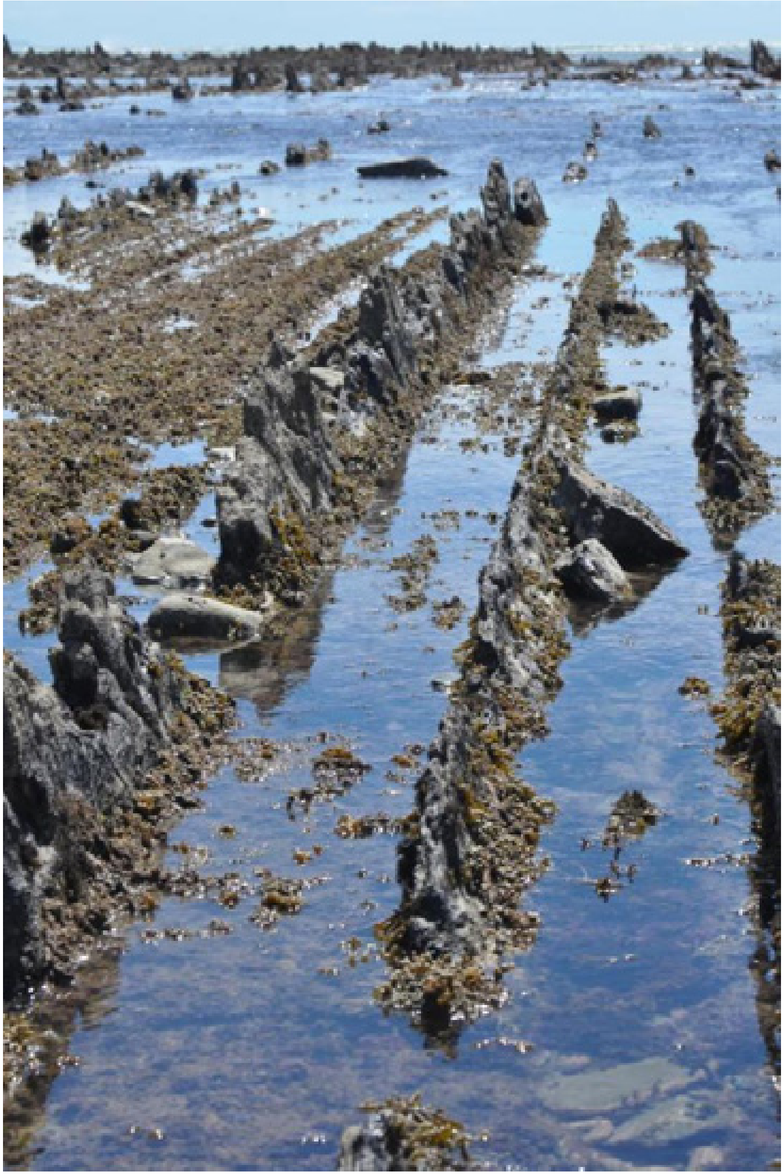

Figure 4-7: Alternating channels and 'spines' of emergent harder rock at Mataikona. Image courtesy of H. Nelson.

Drift macroalgae can become beach-cast or form subtidal deposits and/or accumulations. Research on nearshore systems suggests that accumulations of beach-cast macroalgae are a source of dissolved and particulate carbon and nutrients - "The carbon supports detrital based nearshore foodwebs that include benthic suspension feeders, nearshore fishes, seabirds and beach waders. Detrital biomass in the surf-zone can exceed the offshore production by a factor of four" (Lavery 1993). Beachcast material apparently also plays a role in coastal geomorphological processes and the formation and stability of dunes (Kirkman & Kendrick 1997).

Site specific values:

Maitaikona has very extensive and complex reef areas and a rich algal flora.

4.5.3 Habitat features relevant to criteria

Representativeness – Algal assemblages of southern and western rocky coasts are represented in the existing two marine reserves. Assemblages from the cooler, more turbid eastern coast are not protected. A potential outstanding site occurs at Mataikona at the northern end of the eastern part of the region (Wendy Nelson, NIWA, personal observation).

Rarity – The intertidal rock formations of tilted sedimentary rock rotated 90^{o} are visually dramatic and harbours a particularly rich algal flora.

Diversity – The alternating channels and rows of plate-like rock 'spines' form a diversity of microhabitats over small spatial scales. At low tide, one side of the rock spines may be shaded, cool and moist while the other can be hot and dry offering substantially different environments for a variety of flora and fauna. The permanent channel pools support a rich mixed assemblage of marcroalgae with an associated fish and invertebrate community that remains poorly documented.

Ecological context – Unknown.

4.5.4 Threats – Present and future

MacDiarmid et al. (2012) judged that generally intertidal reefs on exposed coasts were affected by 47 threats. They were assessed as being extremely vulnerable to the effects of increased storminess with impacts deriving from increased intertidal temperatures, ocean acidification, increased sea temperature, sea level rise, sedimentation, change in currents, and UV increase. Seven of the top ten threats to this habitat were derived from the global threat of climate change, another was associated with human activities in catchments (sedimentation), one was derived from activities in the marine environment itself and one was derived from a mixture of catchment and marine based activities.

Though located on a remote part of the Wellington region the public road from Wakataki to Mataikona provides easy access to the rock platforms thus exploitation of reef species is potentially higher for these reefs than most other reefs on the Wairarapa coast.

The reefs are bounded to the north and south by the Mataikona and Wakataki Rivers respectively that provide a ready conduit for sediments to impact on this reef system. Management of land use patterns in the catchments is thus important in reducing this threat.

4.5.5 Existing status and levels of protection

Algal assemblages of southern and western rocky coasts are represented in the existing two marine reserves. Assemblages from the cooler, more turbid eastern coast are not protected. The foreshore between Wakataki and Mataikona reefs is designated an area of important conservation value (AICV) in the current Regional Plan (Figure 4-8) but is not specifically protected by this designation.

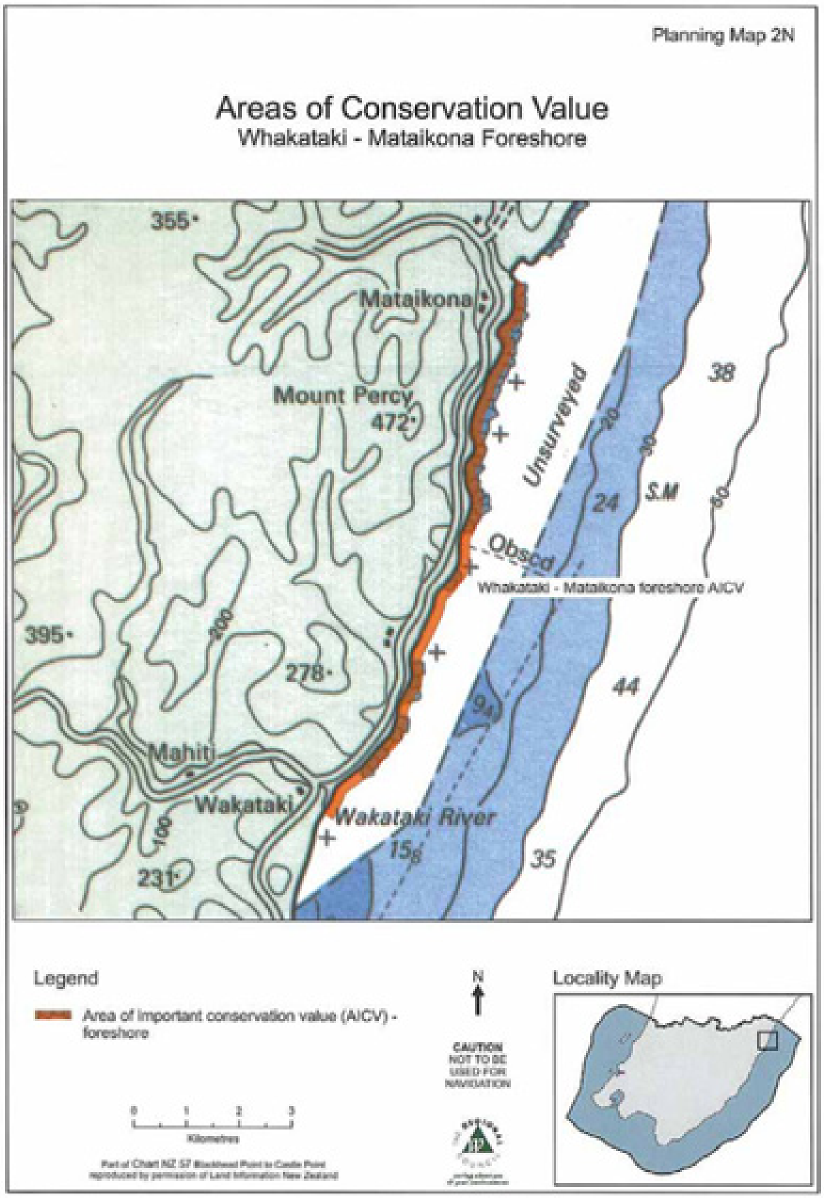

Figure 4-8: The Wakataki-Mataikona Foreshore Area of Conservation Value. Figure from Appendix 3 of the Wellington Regional Plan.

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4.6 Shelf edge canyons

4.6.1 Description

Submarine canyons are narrow valleys cut into the continental shelf and slope, usually having steep, sometimes near vertical rocky walls. They are found along most continental slopes around the world being more frequent on landmasses with active margins. New Zealand has approximately 72 canyons (De Leo et al. 2010) but most lie in the Exclusive Economic Zone outside the Territorial Sea. Shelf incising canyons occur within only the Wellington, Canterbury and South Westland regions.

Seven canyons lie fully or partly within territorial waters in the Wellington Region (Figure 4-8). From east to west these are Honeycomb, Pahaua, Opouawe, Palliser, Wairarapa, Nicholson and Cook Strait Canyon. The northern wall of the Cook Strait Canyon lies only partly within the Wellington region. Palliser, Wairarapa and Nicholson Canyons can be considered as major branches of Cook Strait Canyon that runs over 100 km from 120 m water depth on the shelf to 2,700 m in the Hikurangi Trough (De Leo et al. 2010, Lamarche et al. 2012).

Two of the canyons are highly unusual in a global sense. Nicholson Canyon lies within a few (~10 km) kilometres of a major city (Wellington) and can be considered as part of Wellington's seascape in much the same way as the Rimutaka Range is considered to be part of the city's landscape. Wairarapa Canyon runs within 2-3 km of land adjacent to a protected mountain forest habitat (Rimutaka Forest Park). Thus in this part of Wellington's region, within the space of just a few kilometres, the environment spans an enormous range from forested mountain peak to submarine canyon. This close juxtaposition of mountain range and canyon environments does not occur anywhere else in New Zealand, and is rare globally. For instance, the distance between the Kaikora canyon and the seaward Kaikoura Range is much greater (~20 km).

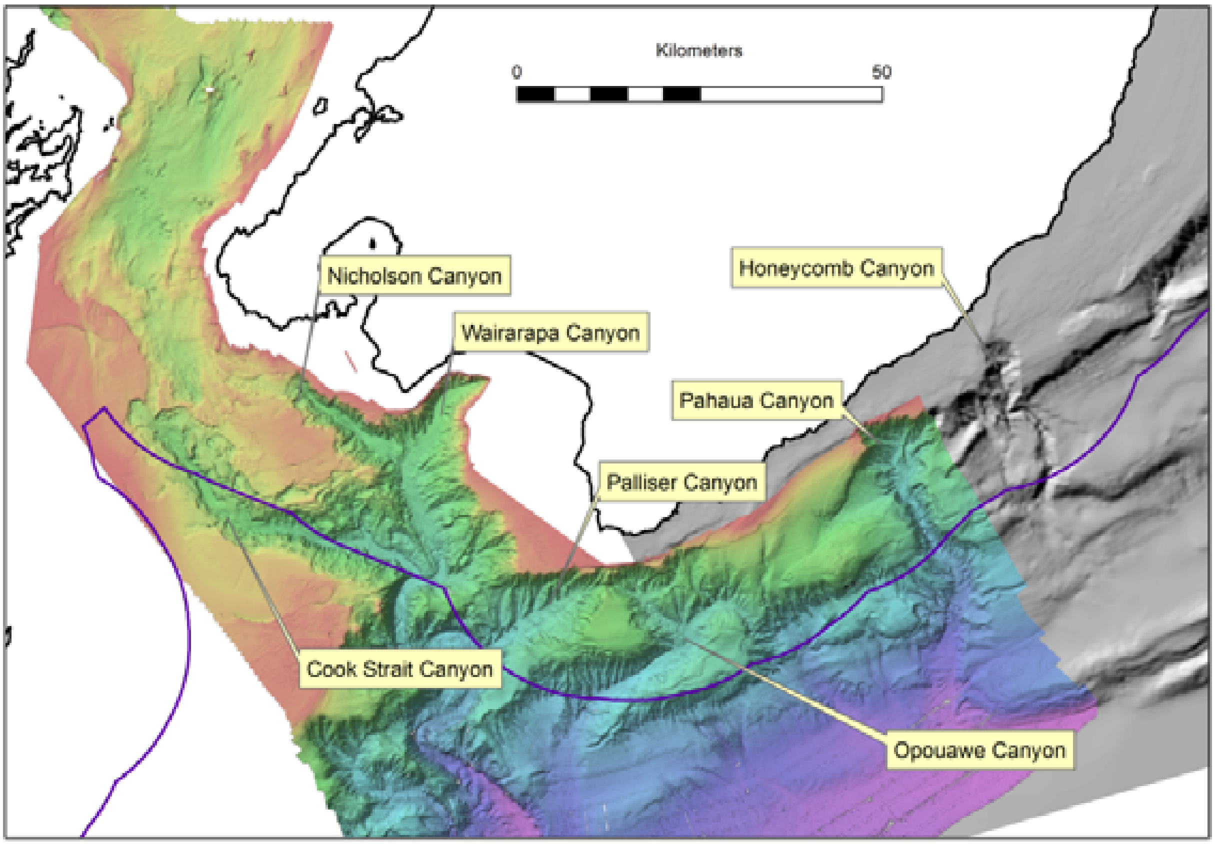

Figure 4-9: Location of canyons within the territorial waters of the Wellington Region. The seaward limit of the New Zealand territorial sea is defined by purple line.

For the purposes of habitat analysis Lamarche et al. (2012) recognised seven geomorphic domains within the Cook Straight region; continental shelf, angular gullies, smoothed gullies, canyon walls, canyon floor, bank crests, continental slope and trough. Excluding the continental shelf, slope and trough areas, over half of the canyon areas were made up of smoothed gullies (30%) and canyon walls (27%). Canyon floors (21%), angular gullies (16%) and bank crests (6%) formed the remainder (based on areas provided in Table 53.1 in Lamarche et al. 2012).

4.6.2 Biodiversity values

General values:

As canyons contain a variety of distinct habitats the associated fauna is usually very different from adjacent shelf and slope habitats. For example, steep rocky canyon walls often harbour corals and other specialised filter feeders that otherwise are uncommon on the adjacent sediment flats on the shelf and slope (e.g. Iacono et al. 2012). Moreover, canyons are often sites of enhanced flux of organic matter through channelling of coastal and terrestrial detritus, down-welling of dense shelf waters, upwelling, and sediment deposition that in some canyons may sustain biomasses and levels of production far greater than in adjacent habitats of similar depth (De Leo et al. 2010).

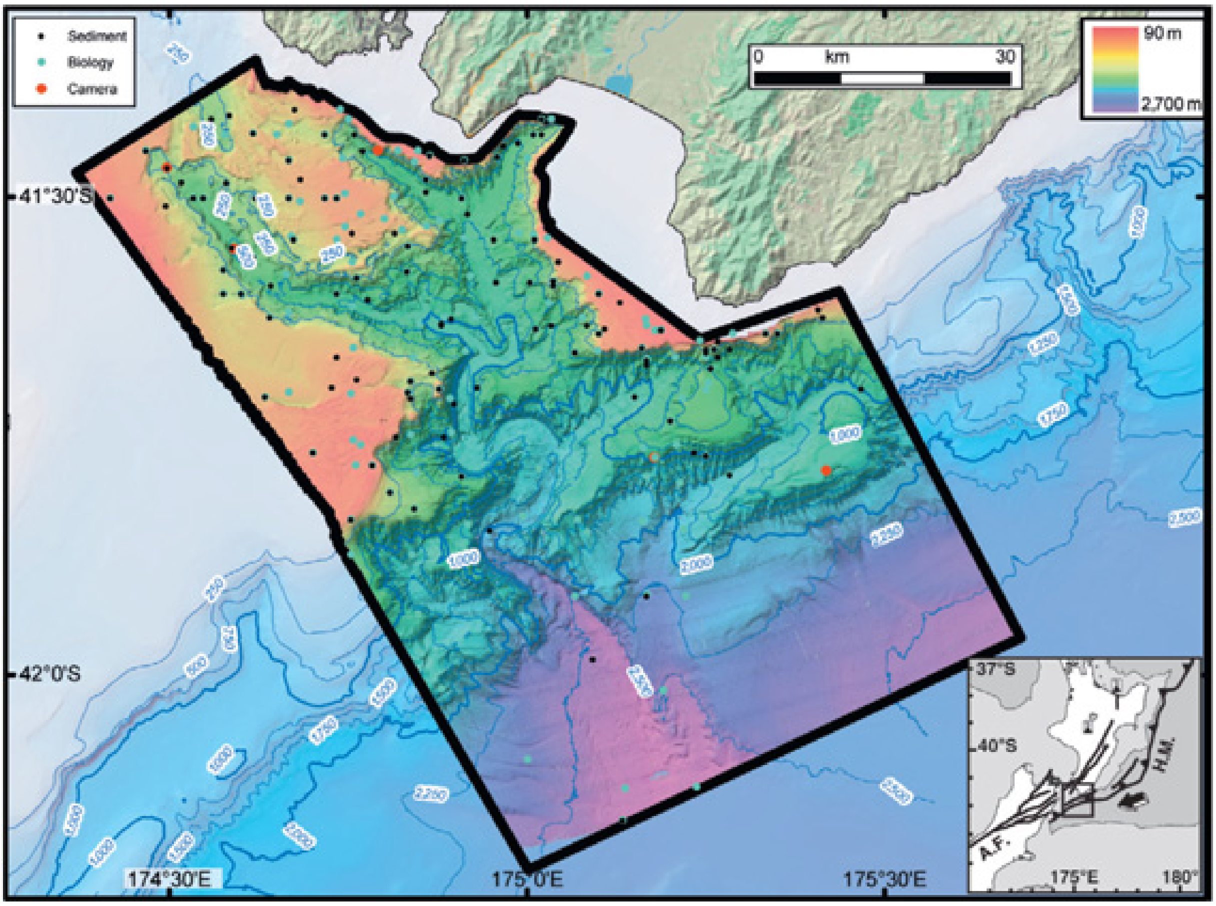

Figure 4-10:Cook Strait Canyons. The location of sediment and biological samples, and camera stations are shown. From Lamarche et al. (2012).

Site specific values:

Lamarche et al. (2012) have summarised the existing biological knowledge of the benthos of the Cook Strait Canyon system. Although over 100 faunal samples and tens of seafloor images have been obtained (Figure 4-10), these were collected in an ad hoc manner for a variety of reasons over more than three decades and so limited the extent to which Lamarche et al. (2012) were able to formally analyse the benthic communities. Nonetheless, they identify different faunal assemblages associated with the seven geomorphic habitat features occurring in the region (Table 4-1).

Despite the inconsistent levels of taxonomic identification among the samples from the different geomorphic habitats, Lamarche et al. (2012) found it possible to make a preliminary estimate of taxon richness based on presence/absence at the faunal family level. They found that taxon richness was lowest for the two most disturbed habitats, angular and smooth gullies, and the canyon walls affected by mass failure. Taxon richness was estimated to be highest for the bank crests (including the cold seeps) and the continental slope. Soft sediments of the canyon floor and shelf had intermediate levels of taxon richness.

There is a definite need to better quantify the faunal distribution in these canyon habitats. Fortunately some additional faunal data may soon be available within the region. Two *RV Tangaroa* voyages in 2011 collected seafloor images, epibenthic sleds and dredge data from the canyons within the Wellington region. Data from these voyages requires analysis and were not available for this study.

Fish faunas associated with New Zealand canyons are less well known. Certain species occur in very high abundance within the Cook Strait Canyon system. For example, a very significant fishery is based on the winter spawning aggregations of hoki (*Macruronus novaezelandiae*) in Cook Strait Canyon. Demersal fish habitat modelling by Leathwick et al. (2006) suggests that particularly high species richness is associated with the Cook Strait canyons but the rather course spatial scale used cannot resolve within-canyon habitat distributions. However, Californian studies suggest that canyon fish fauna may discriminate based on depth and substratum (Yoklavich and Greene 2012).

DoC and Cawthorn sightings records (see Beaumont et al. 2008) indicate that many whale and dolphin species occurring in New Zealand have been sighted in the vicinity of the canyon systems in Cook Strait. These include blue whales (*Balaenoptera musculus*), minke whales (*Balaenoptera acutorostrata*), humpback whales (*Megaptera novaeangliae*), southern right whales (*Eubalaena australis*), sperm whales (*Physeter macrocephalus*), pilot whales (*Globicephala melas and G. macrorhynchus*), killer whales (*Orcinus orca*), bottlenose dolphins (*Tursiops truncatus*), dusky dolphins (*Lagenorhynchus obscurus*), and common dolphins (*Delphinus sp.*). Some of these species, especially the larger baleen whales, may be in transit between northern calving and breeding grounds and Southern Ocean feeding grounds while the toothed whales and dolphins probably find prey in the surface waters over the canyons or within the canyons themselves.

Similarly, Bartle (1974) has described the seabird fauna of eastern Cook Strait which includes the surface waters over the canyons. He described an inshore belt extending from the coast to eight kilometres offshore, that is characterised by the presence of fluttering shearwaters and diving petrels with little blue penguins (*Eudyptula minor*), gulls, terns and gannets (*Morus serrator*) are almost entirely confined to this region with little overlap of the canyon system in Cook Strait. Bartle (1974) also described an offshore belt, which extends further than eight kilometres offshore, that is characterised by fairy prions (*Pachyptila turtur*) and sooty shearwaters (*Puffinus griseus*). The large albatrosses, mollymawks and petrels are largely confined to this region which overlaps with the canyon system in Cook Strait. Buller's shearwaters (*Puffinus bulleri*) occur throughout both zones.

Table 4-1: Benthic faunal assemblages and number of taxa found at seven different geomorphic habitats in the Cook Strait Canyon region. Descriptions and data are sourced from Lamarche et al. (2012).

Geomorphic habitat	Associated faunal assemblage	Number of taxa
Continental shelf	Decapod crustaceans are conspicuous members of this assemblage, particularly majid crabs and pagurid hermit crabs. Asteroids (sea stars) and ophiuroids (snake stars) also occur frequently. Pecten bivalves and buccinid gastropods are among the reasonably well represented mollusc taxa. Polychaetes and other burrowing fauna such as sipunculids and small bivalve species occur in the soft sediments.	67
Angular and smoothed gullies	Echinoids (sea urchins) are the dominant echinoderms of the angular gullies, with at least five species. Asteroids and ophiuroids also occur. Mollusc representatives such as bivalves and gastropods occur frequently in these gullies. Filter feeders such as sponges, brachiopods, and scleractinian corals (e.g., *Caryophyllia profunda* and *Flabellum apertum*) are found attached to exposed rock. Few samples have been obtained from the smoothed gullies, but assemblages appear to be similar to that described above.	27, 14
Canyon walls	On exposed hard substrates occur at least four species of scleractinian corals, as well as other filter feeders such as sponges, ascidians, hydrozoans, brachiopods, and bryozoans. Decapod crustaceans occur relatively frequently, in particular galatheid squat lobsters. Serolid isopods also occur among the crustacean fauna. Soft sediment fauna also occur in places within this general habitat, including polychaetes, echinoids and bivalves.	42
Canyon floor	This sandy habitat appears to have sparse fauna, i.e., relatively few taxa in low frequency of occurrence among samples. However, the few samples and seafloor images obtained from this habitat show that ophiuroids can occur in high abundances. Among the more common fauna are some small-sized crustaceans such as amphipods (belonging to the Lysianassidae family) and isopods (Serolidae and Cirolanidae), as well as decapods. Pycnogonids (sea spiders) are also reasonably well represented. Burrowing polychaetes, echinoids, and bivalves occur in canyon floor substrates	25
Bank crests	This assemblage appears to be taxon rich. A number of cold seeps are located on the Opouawe Bank (see sectionXX), characterized by carbonate structures and a particular seep fauna, either associated with the biogenic substrate or the soft sediment surrounding these features. Over 20 species of polychaete have been sampled, including members of Siboglinidae typically found at chemosynthetic habitats such as seeps. Other seep-associated taxa are found among the frequently occurring bivalve mollusc fauna. Corals, sponges, actinarians, and hydrozoans are among the fauna found attached to the carbonate structures at the seep sites. Decapod crustaceans, ophiuroid and holothurian echinoderms, and gastropod molluscs occur among the "background" assemblage of the bank crest habitat.	82
Continental slope and Hikurangi Trough	On the continental slope area of the Cook Strait canyon system many different taxonomic groups occur, but no particular faunal group or species dominates. The decapod crustaceans are represented by species of majids, galatheids, pagurids, and pasiphaeids. Echinoid, ophiuroid, and asteroid echinoderms also occur. Among the mollusc groups, which include the gastropods and scaphopods, the bivalves are particularly well represented by at least 11 species. The latter include epi- as well as infaunal species (belonging to the orders Nuculoidea and Veneroida). Some fauna associated with hard substrates, such as sponges, gorgonian and scleractinian corals, and hydrozoans, are also found on the continental slope. Only one sample has been obtained from the Hikurangi Trough adjacent to the Cook Strait canyon; it contained an unidentified polychaete and bivalve.	34

4.6.3 Habitat features relevant to criteria

Representativeness – The Cook Strait canyons contain habitats and species poorly represented in existing protected areas. The two marine reserves in the Wellington Region are both shallow water reaching depths of less than 50 m and few if any of the benthic species occurring in these reserves overlap with those in canyon habitats.

Rarity – Canyon habitats and associated biological communities are rare within New Zealand territorial seas existing only within the Wellington (7 canyons), Canterbury (Kaikoura Canyon) and South Westland regions. New Zealand is particularly rich in shelf edge canyons with 72 known to date (De Leo et al. 2010) but these occur well outside territorial waters. Two of the Wellington region canyons are rare and unusual on a global scale. Nicholson Canyon lies within a few (~10 km) kilometres of a major city (Wellington) and can be considered as part of Wellington's seascape in much the same way as the Rimutaka Range is considered to be part of the cities landscape. Wairarapa Canyon runs within 2-3 km of land adjacent to a protected mountain forest habitat (Rimutaka Forest Park) thus within the space of just a few kilometres, the environment spans an enormous range from forested mountain peak to submarine canyon.

Diversity – Because of their evolution and structure shelf edge canyons have a diversity of geomorphic habitat types ranging from rocky vertical rock walls, angular and smoothed gullies, canyon floors and in some places bank crests, as well as the shelf and slope features into which they are incised. Each of these habitats has associated distinct assemblage of benthic organisms. The distribution and diversity of demersal and pelagic fish within the different canyon habitats is less well known in New Zealand but based on Californian studies these may discriminate based on depth and substratum (Yoklavich and Greene 2012).

Ecological context – Cook Strait canyons provide important breeding habitat for hoki that spawn in this locality each winter gathering from a wide area of the east coast of both the North and South Islands and the Chatham Rise (Ministry of Fisheries 2011). The broader Cook Strait region is an important migration corridor for numerous species of fish, marine mammals and seabirds (see section 4.5).

4.6.4 Threats – Present and future

Unintended consequences of bottom trawling and dredging are currently the main threat to seafloor fauna in canyon habitats. Unquantified threats may exist related to terrestrial contaminant sources, e.g. the close proximity of the Nicholson Canyon to Wellington and Hutt cities with discharges via sewer outfalls and stormwater pipes; runoff from farmland draining into the Wairarapa Canyon.

A potential future threat relates to the development of hydrocarbon resources in the region. Exploration licences are about to be tendered for the southern East Coast region (outside territorial waters) and threats related to this and other future gas/oil/gas hydrate development include drilling rig siting; installation of pipe/cable infrastructure; and contamination due to spills.

Emerging threats identified by MacDiarmid et al. (2012) include acidification, increases in sea temperature and other consequences of increasing levels of greenhouse gases in the atmosphere.

4.6.5 Existing status and levels of protection

None. Fish stocks are managed under existing fisheries legislation and regulations.

4.6.6 Site relevant references

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4.7 Opouawe Bank methane seeps

4.7.1 Description

Opouawe Bank, only 16 km offshore from the southern tip of New Zealand's North Island, is a ENE-striking, 16 km long kidney-shaped plateau (approximately 70 km^2) at a depth of about 1100 m with a northern hill that rises up to 815 m water depth (see Figure 4-11). A total of 13 active methane seeps and one probable extinct seep have been identified on the Opouawe Bank using remote imaging and/or bathymetric and side-scan data (Greinert et al. 2010). The seep sites are relatively small features, each about 10 ha or less in extent. The seven seeps shown in Figure 4-11 have the best information available and of these, Tui, North Tower, South Tower and Piwakawaka seeps have the best developed seep faunas (Baco et al. 2010, Greinert et al. 2010).

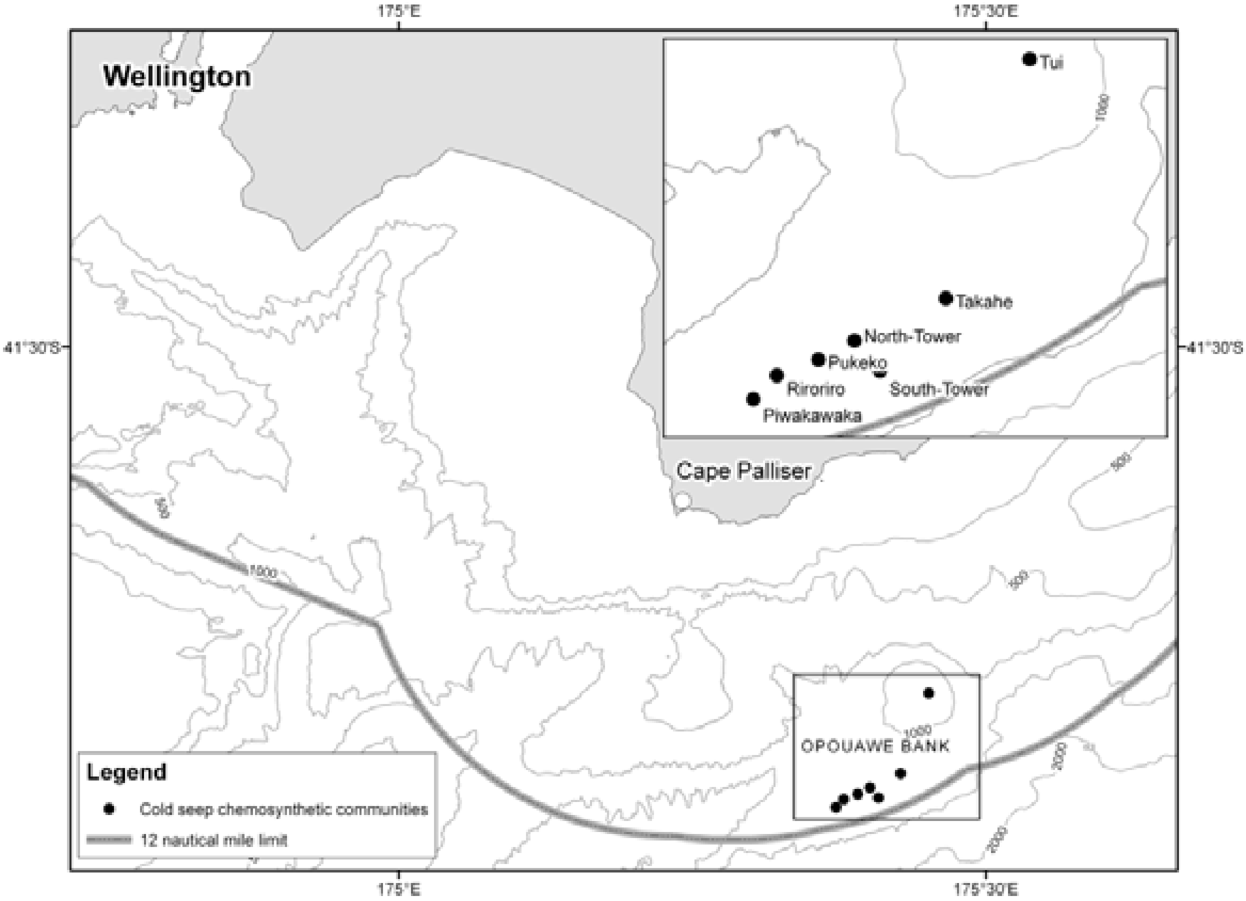

Figure 4-11: Map showing the location of methane seeps with well-developed seep fauna on Opouawe Bank offshore of Cape Palliser.

Seafloor methane seeps occur where methane escapes into the water column from (frozen) gas hydrate deposits within the underlying sediment. Gas hydrates occur in specific pressure-temperature conditions. Offshore, these conditions are met within the upper 500 m of sediments beneath the seafloor and in water depths of at least 500 m. Most usually the free gas is contained within a stability zone well beneath the seafloor by the layer of solid gas hydrates which acts as a "seal" (Pecher and Henrys 2003). Rupture of the gas hydrate stability zone, by e.g. geological faulting or large landslides may result in gas hydrates and free gas reaching the seafloor forming cold (methane) seeps. Such seeps are associated specialised and distinctive fauna.

Cold seep systems have been documented at many places in the northern hemisphere (e.g., North Sea, Baltic Sea, Black Sea, North Atlantic, Gulf of Mexico, NW Pacific, Indian Ocean; Judd and Hovland, 2007; Suess, 2010). Research cruises in 2006 and 2007 confirmed that a significant part of the Hikurangi Margin along the east coast of the North Island has locally intense methane seepage at present, with the widespread occurrence of dead seep faunas and knoll forming carbonate precipitations offshore and on the adjacent land indicating previous past activity (Greinert et al. 2010) (see Figure 4-12). Only on the Opouawe Bank in the south-west of the Hikurangi Margin and at two small sites near the head of the Nicolson Canyon do methane seeps occur within the territorial sea. No other methane seeps are known to occur with the territorial sea around any other part of New Zealand though some are suspected to occur off Fiordland.

The two small sites in Cook Strait were identified by Lewis and Marshal (1996). One site, LM4, was identified on the basis of a single fresh valve of the bivalve *Maorithyas* species. The other site, LM11, was identified from a photograph of a chimney emerging from the sediment but no seep fauna was observed. Subsequently, site LM4 has been explored using a remote imaging system and while there is evidence of small areas of bacterial mats on the seafloor no specialist seep macro-fauna was observed (David Bowden, unpublished data and images).

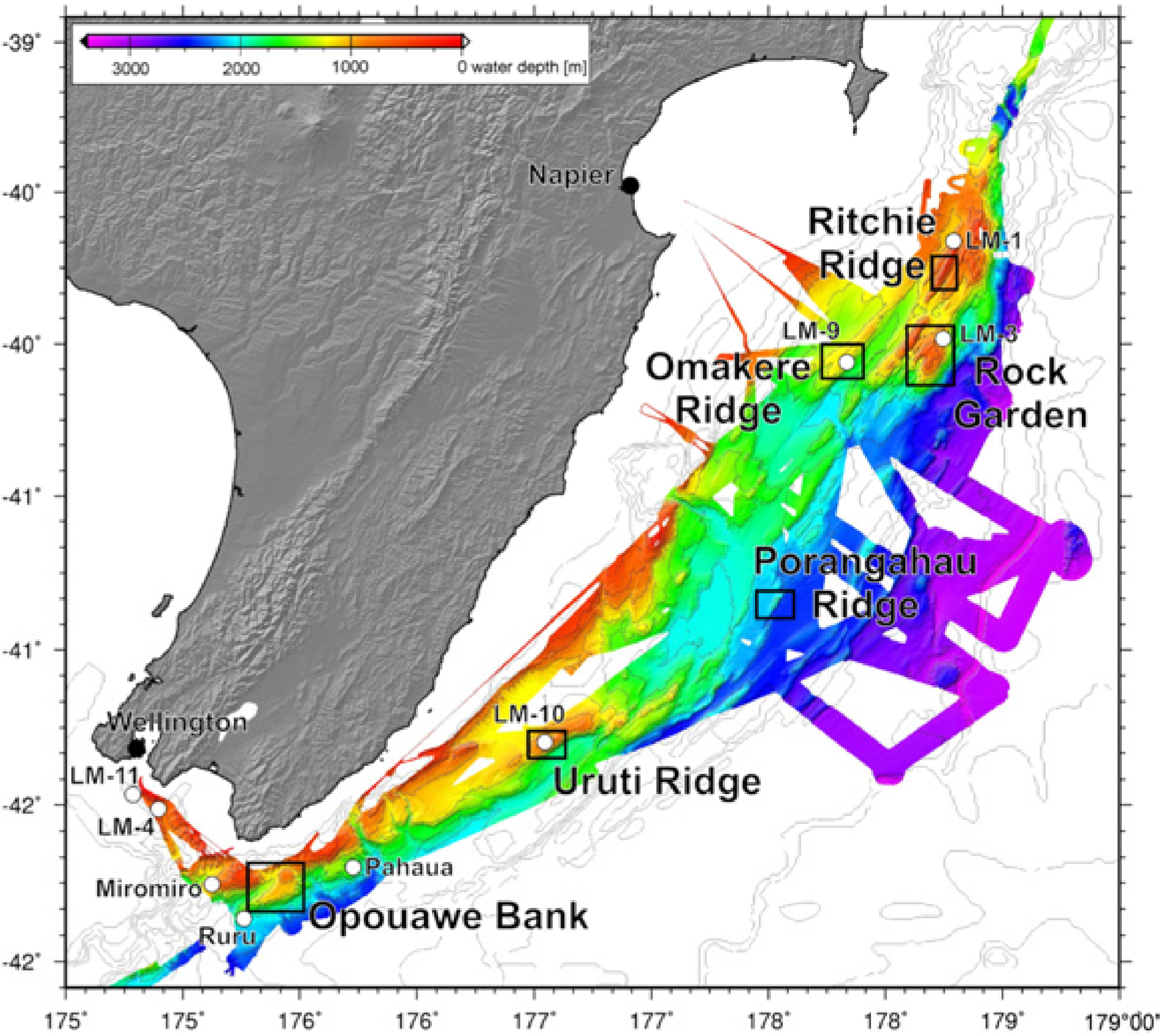

Figure 4-12:Bathymetric map based on data recorded during the voyages TAN0607, TAN0616 and SO191. Indicated are six working areas of which zoomed in maps are presented in Greinert et al. (2010). The white dots indicate numbered seep sites identified by Lewis and Marshal (1996). Note that Lewis and Marshal mis-numbered sites LM 10 and 11 on their Figure 1. The contour lines outside the gray shaded bathymetry are based on a NIWA data set. Map from Greinert et al. (2010).

4.7.2 Biodiversity values

General values:

Cold seeps typically support an unusual suite of suite of organisms that rely on chemosynthetic production at the base of their food chain. Around the world, seep fauna commonly include vestimentiferan tube worms in the polychaete Family Siboglinidae, vesicomyid clams, and bathymodiolin mussels (Baco et al. 2010). Other abundant taxa may include siboglinid pogonophorans, thyasirid, solemyid and lucinid bivalves, trochid and buccinid gastropods, cladorhizid and hymedesmid sponges, bresiliid shrimp, amphipods, galathaeoid crustaceans, and polynoid, dorvilleid, hesionid, and ampharetid polychaetes. Many of the taxa associated with cold seeps rely on chemosynthetic production fueled by the reduced compounds methane and hydrogen sulphide emanating from the seep sediments (Levin, 2005).

Site specific values:

Initial characterization of the faunal communities at the North and South Tower methane seep sites on the Opouawe Bank and six other sites along the Hikurangi Margin by Baco et al. (2010), indicated a fauna that is associated with particular sub-habitats but which varies in abundance between sites. Community composition is typical, at higher taxonomic levels, of cold seep communities in other regions. The dominant, symbiont-bearing taxa include siboglinid (tube) worms, vesicomyid clams and bathymodiolin mussels.

At the species level, much of the seep-associated fauna identified so far appears either to be new to science, or endemic to New Zealand seeps, suggesting the region may represent a new biogeographic province for cold-seep fauna. Some overlap at the species and genus level is also indicated between the sampled seep communities and the fauna of hydrothermal vents on the Kermadec Arc in the region.

Most sites have extensive cover of carbonate precipitates forming large boulders, pavements, crusts or chimneys with diverse epibiota, including bathymodiolin mussels (*Bathymodiolus* spp and *Gigantidas* sp.), aggregations of vestimentiferan worms (*Lamellibrachia* sp.) (Figure 4-13a), sponge mats (*Pseudosuberites* sp.) (Figure 4-13b), and/or coral thickets. Vast beds (up to 70,000 m2 in area) of vesicomyid clam shells and smaller live aggregations of at least three *Calyptogena* species of living clams (Figure 4-13 c) occur near carbonate outcrops. Commonly occuring mobile megafauna include gastropods as well as pagurid, lithodid and brachyuran crabs. Soft-sediment seep habitats surround the carbonates and include fields of pogonophoran worms (three species of *Siboglinum*), solemyid clams (*Acharax clarifcata*), thalassinid shrimps (*Vulcanocallix* sp.), and ampharetid polychaetes (representing two undescribed genera) (Sommer et al. 2010) (Figure 4-13d). Core and grab samples indicate numerous additional undescribed species of peracarid crustaceans and polychaete worms. Bacterial mats are present on soft sediments primarily around the North Tower seep site.

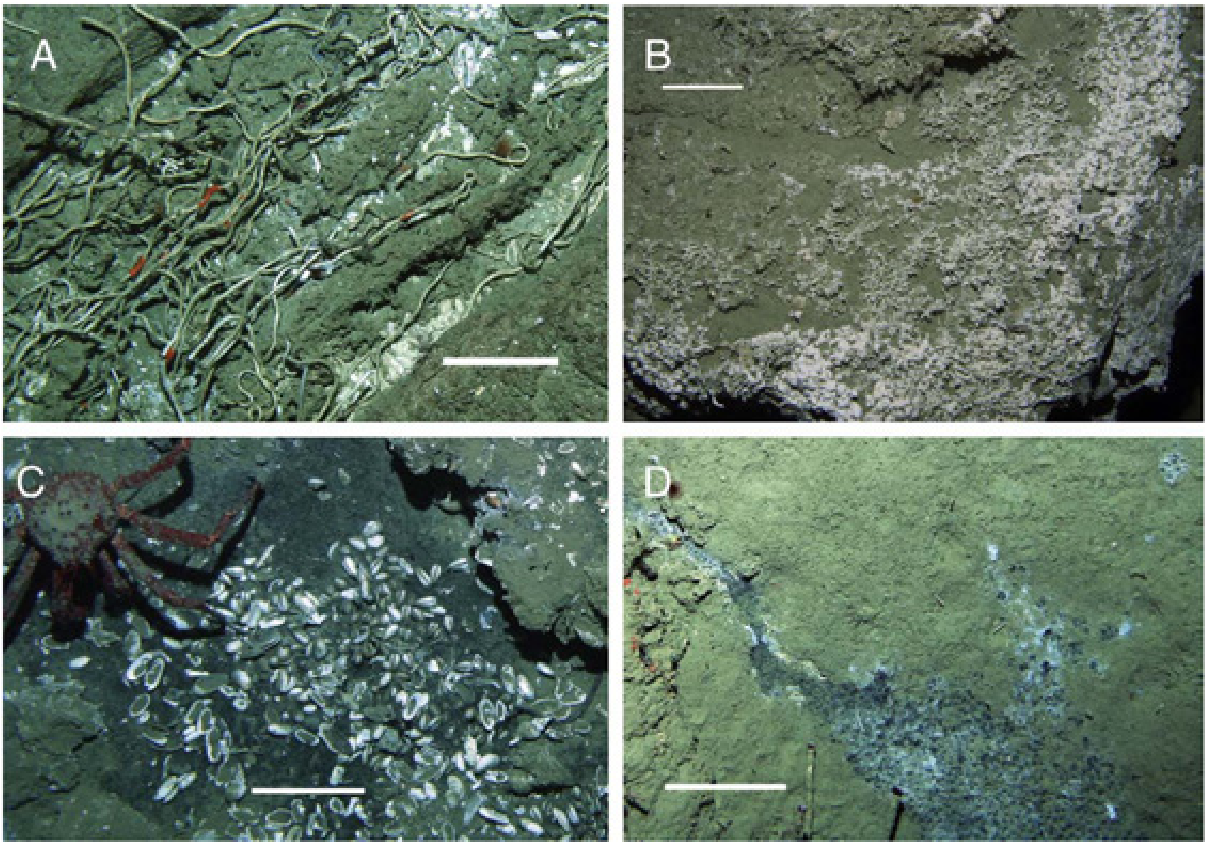

Figure 4-13:Representative cold-seep associated megafauna and microhabitats found at methane seeps on the NewZealand margin. . (A) *Lamellibrachia* sp. aggregation in moderate abundance on carbonate platform, Hihi; (B) Sponge mat (*Pseudosuberites* sp.) covering carbonate rock, North Tower (C) Live vesicomyid (*Calyptogena* sp.) clams and dead shells in a seepage-darkened sediment patch, North Tower; (D) Bacterial mat on suphidic sediment with pits made by ampharetid polychaetes, Hihi (from Baco et al. 2010).

4.7.3 Habitat features relevant to criteria

The Opouawe Bank methane seep sites clearly fit the GWRC biodiversity criteria for rarity, diversity and ecological context.

Rarity – Sites with a well-developed seep associated fauna are very rare within the region as a whole. Methane seep associated bacteria and a single seep bivalve species are known to occur elsewhere only at two small sites near the head of the Nicolson Canyon. No other methane seeps are known to occur with the territorial sea around any other part of New Zealand.

Diversity – The Opouawe methane seeps have a unique and diverse fauna unlike any other marine fauna in the Wellington region. They rely on chemosynthetic production at the base of their food chain rather than primary production via photosynthesis that is the base of all other food chains. The seep fauna includes faunal families, genera and species that do not occur elsewhere in the region including siboglinid (tube) worms, vesicomyid clams and bathymodiolin mussels. Much of the seep-associated fauna identified so far appears either to be new to science, or endemic to New Zealand seeps, suggesting the region may represent a new biogeographic province for cold-seep fauna. Some overlap at the species and genus level is also indicated between the sampled seep communities and the fauna of hydrothermal vents on the Kermadec Arc in the region. The seep site sites have relatively high productivity compared to the surrounding benthos and a variety of non-seep mobile megafauna including gastropods and echinoderms as well as pagurid, lithodid and brachyuran crabs typical of the depth occur at the seeps or in the near vicinity.

Ecological context – Some of the specialised fauna associated with methane seeps also occur on whale falls. The seep sites may provide an important source of larvae for the colonisation of the more temporary whale falls.

4.7.4 Threats – Present and future

The seep fauna may be long-lived making them vulnerable to disturbance. Very similar siboglinid (tube) worms at seep sites in the Gulf of Mexico have been estimated to reach a maximum of 250 years old (Fisher et al. 1997; Bergquist et al. 2000). Present threats to the seep sites arise solely from bottom trawling with the marks of trawl doors, lost trawl gear, and damaged fauna at New Zealand seep sites reported by Baco et al. (2010) (see Figure 4-14). GWRC will need to work with the Ministry for Primary Industries to affect any level of protection.

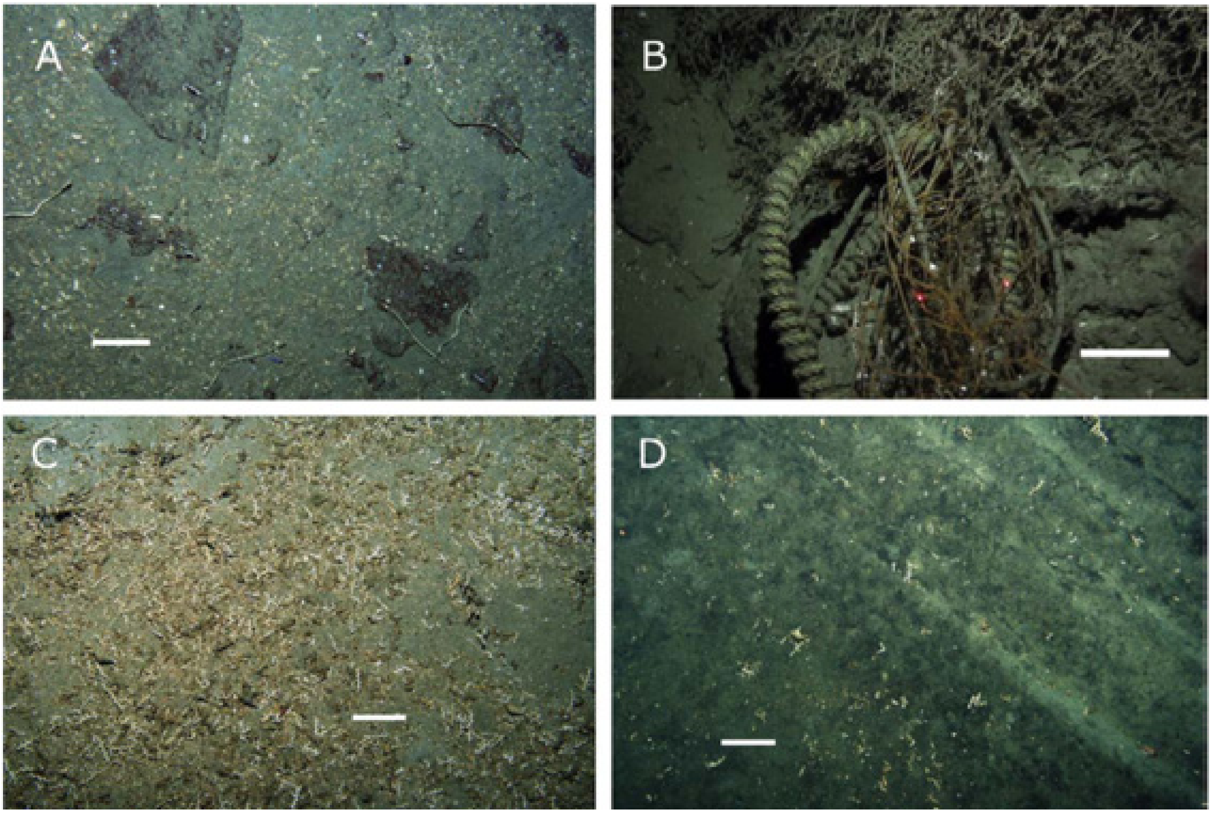

Figure 4-14:Observation of trawling damage on or adjacent to seep sites . Six of the seep sites visited exhibited evidence of bottom trawling including (A) apparently recently trawled seep fauna, Builder's Pencil; (B) lost trawl gear, Hihi; (C) coral rubble, Hihi; and (D) trawl drag marks in sediments, Kereru; trawl marks and coral rubble were also observed adjacent to several additional sites (see text). Scale bars show 20 cm. (From Baco et al. 2010).

Future threats stem from growing interests in the exploitation of the gas hydrate resources. Seeps could be directly affected during the placement of exploration and production rigs and their anchoring systems. Indirect effects could occur through methane extraction decreasing or altering the flow of methane to seep sites (Baco et al. 2010).

4.7.5 Existing status and levels of protection

The Opouawe methane seep site currently has no special status or protection.

4.7.6 Site relevant references

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Table 4-2: Sites of significant marine biodiversity in the Wellington region. Location, biodiversity values, features relevant to selection criteria, threats, and existing status and level of protection.

Site name	Location	Latitude & Longitude	Biodiversity values	Features relevant to criteria[1]	Threats - Present and future	Existing status and levels of protection
Porirua Harbour, comprising the Onepoto Arm and Pauatahanui Inlet	West coast	Entrance: 41°05.85'S 174°51.75'E	General: Shallow harbours and estuaries are important centres of diversity for shore and wading birds, coastal fish and invertebrates, as well as a variety of marine algae and flowering plants such as seagrass and saltmarsh species. Harbours and estuaries are key breeding, nursery and foraging areas for many species. Site specific: Contains the third largest area of saltmarsh, largest area of seagrass and probably the largest cockle beds in the Wellington region.	Representativeness – Contains habitats (saltmarsh, seagrass meadows, shellfish beds) that are no longer commonplace in the region and are poorly represented in existing protected areas (e.g. Kapiti Marine Reserve, Taputeranga Marine Reserve). Rarity – Is the largest moderately intact shallow harbour ecosystem in the Wellington region. Its mouth is permanently open to the sea and large areas remain subtidal at low tide, so retains a strong marine influence. Diversity – Contains a diverse range of habitats ranging from deep channels, subtidal mud flats, intertidal mud, algal beds, sand flats, seagrass meadows, shellfish beds, and saltmarsh. This diversity of habitats	Present – High % of perimeter hardened. Sedimentation rates 4-5 times that of pre-European period with danger of premature infilling. Heavy metal contamination especially in Onepoto Arm but still below trigger levels. High faecal coliform counts frequently encountered in water quality tests. Low to moderately enriched with nutrients leading to a moderate eutrophic state. Future - Sea level rise, acidification, increases in sea temperature and other consequences of	The Pauatahanui Inlet is classified by DoC as a site of national significance under its Site of Special Wildlife Interest (SSWI) criteria. The inlet also listed as a site of national significance for indigenous vegetation (saltmarsh and seagrass) and significant habitats for indigenous fauna in the Regional Policy Statement (WRC, 1995). The inlet was also classified in the WR Coastal Plan as an Area of Significant Conservation Value based on the natural, conservation, geological and scientific values (GRWC, 2000). The 50-hectare Pauatahanui Wildlife Management Reserve lies at the head of the Inlet. Four

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[1] Criteria

(a) Representativeness: high representativeness values are given to particular ecosystems and habitats that were once typical and commonplace in a district or in the region, and:

(i) are no longer commonplace (less than about 30% remaining); or

(ii) are poorly represented in existing protected areas (less than about 20% legally protected).

(b) Rarity: the ecosystem or habitat has biological and/or physical features that are scarce or threatened in a local, regional or national context. This can include individual species, rare and distinctive biological communities and physical features that are unusual or rare.

(c) Diversity: the ecosystem or habitat has a natural diversity of ecological units, ecosystems, species and physical features within an area.

(d) Ecological context of an area: the ecosystem or habitat:

(i) enhances connectivity or otherwise buffers representative, rare or diverse indigenous ecosystems and habitats; or

(ii) provides seasonal or core habitat for protected or threatened indigenous species.

			Benthic invertebrates are diverse but dominated by species tolerant of moderate sedimentation and enrichment. Fish are diverse- 43 species are known. Shore and wading birds are diverse and increasing – 53 species known, up from 37 in 1970s.	supports a corresponding richness in the assemblages of fish, invertebrates and shore and wading avifauna. Ecological context – Provides regionally important pupping/ spawning and nursery areas for rig, elephant fish, sand flounder and kahawai. It provides regionally important roosting and feeding areas for a number of shore and wading birds.	increasing levels of greenhouse gases in the atmosphere.	ha are owned by the Forest and Bird and protected under a covenant with the Queen Elizabeth II Trust. The rest of the reserve is owned by the DOC. All plants and wildlife are protected within the reserve. Dogs are banned.
Wellington Harbour freshwater seeps	Northern and western parts of Wellington Harbour	41°15.40'S 174°53.75'E	General: depending on flow rates the seep may lower salinity locally presumably favouring estuarine species. No NZ studies to draw upon. Specific: No information is available.	Representativeness – As far as known this habitat is not represented in existing protected areas in the Wellington region Rarity – This habitat is presumed to be rare within the Wellington region but comparable information from other parts of the region is not available Diversity – The associated fauna and flora is undescribed.	Internationally, freshwater seep ecosystems are thought to be threatened by increasing amounts of nutrients or pollutants in the water arriving via the land aquifers	None
Soft sediment *Adamsiella* algal beds	Evans Bay, Wellington Harbour	41°18.83'S 174°48.10'E	General: Macroalgae are known to be important structural and functional components of marine ecosystems, contributing through provision of products of photosynthesis, as well as providing structure and surfaces for other organisms. However, this function in soft sediment ecosystems has received little attention in NZ.	Representativeness – Macroalgae on soft sediments are poorly protected within the Wellington region with few such habitats occurring within the existing marine reserves. Rarity – There are no species assemblages that have been identified as nationally rare in the Wellington region, but there are examples of assemblages which are represented by only one or two examples within the region. Algal assemblages on soft sediments are rare	These beds may be presently impacted by invasive species, anchoring, sedimentation and pollution. Future threats may include marina expansion, reclamation, and general effects of climate change.	None

			Specific: *Adamsiella* beds are known to harbour a range of associated species in other areas of New Zealand but Wellington studies are lacking	regionally, probably only occurring in Wellington and Porirua Harbours but there is a lack of systematic data on regional and national distribution. Diversity – *Adamsiella* beds have been observed at the southern end of Evans Bay. *Adamsiella* beds are known to harbour a range of associated species in other areas of New Zealand. No studies have been undertaken on the Wellington Harbour beds. Ecological context – role unknown		
Kapiti Island Rhodolith Beds	East of Kapiti Island	40°52.76'S 174°55.45'E	General: Associated biota usually highly diverse. Site specific: This bed remains unstudied so specific biodiversity values are unknown	Rarity – Only rhodolith beds known in the Wellington region. Largest rhodolith aggregations reported from throughout the NZ region. Diversity – These beds are likely to harbour a unique fauna unlike any other in the Wellington region.	Present & future: Strong evidence for vulnerability to a range of stressors	An unknown proportion of the rhodolith beds fall within the eastern portion of the Kapiti Marine Reserve where they are completely protected from exploitation and direct human disturbance. The proportion of the beds outside the reserve has no protected status.
Mixed algal assemblages	Mataikona	40°46.98'S 176°15.96'E	General: Within the Wellington Region there are many different types of habitats with associated characteristic assemblages of macroalgae. On rocky reefs these range in exposure to wave and wind climate, geology, and also vary in steepness of slope, aspect and physical	Representativeness – Algal assemblages of southern and western rocky coasts are represented in the existing two marine reserves. Assemblages from the cooler, more turbid eastern coast are not protected. A potential outstanding site occurs at Mataikona at the northern end of the eastern part of the region. Rarity – The intertidal rock formations of tilted sedimentary	MacDiarmid et al. (2012) assessed intertidal reefs as being extremely vulnerable to the effects of increased storminess with impacts deriving from increased intertidal temperatures, ocean acidification, increased sea temperature, sea level rise, sedimentation, change in currents, and UV increase. The public road from Wakataki to Mataikona	Algal assemblages of southern and western rocky coasts are represented in the existing two marine reserves. Assemblages from the cooler, more turbid eastern coast are not protected. The foreshore between Wakataki and Mataikona reefs is designated an area of important conservation value (AICV) in the current

			extent. Macroalgae extend from the intertidal to beyond the depths of kelp beds, with their maximum depth affected by water clarity which is in turn influenced by sediment run-off from land and phytoplankton growth. Specific: Maitaikona has very extensive and complex reef areas and a rich agal flora.	rock rotated 90^{o} are visually dramatic and harbours a particularly rich algal flora. Diversity – The alternating channels and rows of plate-like rock ‘spines’ form a diversity of microhabitats over small spatial scales. Ecological context – Unknown	provides easy access to the rock platforms thus exploitation of reef species is potentially higher for these reefs than most other reefs on the Wairarapa coast. The reefs are bounded to the north and south by the Mataikona and Wakataki Rivers respectively that provide a ready conduit for sediments to impact on this reef system.	Regional Plan but is not specifically protected by this designation.
Shelf edge canyons	South and SE coasts	Nicholson Canyon: 41°28.42’S 174°48.92’E Wairarapa Canyon: 41°27.95’S 174°58.47’E	General: Contain habitats and associated faunal assemblages distinct from coastal and shelf habitats. Are generally sites of enhanced organic flux. Specific values: Different benthic faunal assemblages associated with 7 geomorphic habitats. Canyon assemblages distinct from shelf and slope assemblages. Taxon richness lowest for the two most disturbed habitats, gullies and canyon walls. Taxon richness highest for the bank crests (including the cold seeps) and the continental slope. Soft sediments of the canyon	Representativeness –contain habitats and species poorly represented in existing protected areas. Rarity – Canyon habitats and associated biological communities are rare within NZ territorial seas existing only within the Wellington (7 canyons) and Canterbury (1 canyon) regions. Diversity – Because of their evolution and structure shelf edge canyons have a diversity of geomorphic habitat types ranging from rocky vertical rock walls, angular and smoothed gullies, canyon floors and in some places bank crests, as well as the shelf and slope features into which they are incised. Each of these habitats has associated distinct assemblage of benthic organisms. The distribution and diversity of	Present - Unintended consequences of bottom trawling and dredging. Unquantified threats may exist related to terrestrial contaminant sources, e.g. the close proximity of the Nicholson Canyon to Wellington and Hutt cities with discharges via sewer outfalls and stormwater pipes; runoff from farmland draining into the Wairarapa Canyon. Future- A potential future threat exists relating to the development of hydrocarbon and gas hydrate resources in the region include drilling rig siting; installation of pipe/cable infrastructure; and contamination due to spills. Other potential threats include ocean acidification,	None. Fish stocks are managed under existing fisheries legislation and regulations.

			floor and shelf have intermediate levels of taxon richness. Fish fauna is less well known but modelling suggests high species richness in Cook Strait canyons.	demersal and pelagic fish within the different canyon habitats is poorly known. Ecological context – Cook Strait canyons provide important breeding habitat for hoki from the east coast of NZ. The broader Cook Strait region is an important migration corridor for numerous species of fish, marine mammals and seabirds.	increases in sea temperature and other consequences of increasing levels of greenhouse gases in the atmosphere.	
Opouawe Bank methane seeps	16 km south-east of Cape Palliser in 815 m to 1100 m water depth	Tui (NE seep): 41:43.288 S 175:27.091 E Piwakawaka (SW seep): 41:47.664 S 175:22.348 E	General: Fauna characterised by an unusual suite of organisms that rely on chemosynthetic production by bacteria at the base of their food chain. Some vent species may be very long-lived (~250 yrs) based on overseas evidence. Site specific: The dominant, symbiont-bearing taxa include siboglinid (tube) worms, vesicomyid clams and bathymodiolin mussels. Non-seep mobile megafauna including gastropods and echinoderms as well as pagurid, lithodid and brachyuran crabs typical of the depth also occur at these sites. Many of the seep-associated species appear either to be new to	Rarity – Only field of methane seeps known in the Wellington region. Two other very small seeps known from Nicholson canyon. No others known from NZ territorial seas. Diversity – These sites harbour a unique fauna unlike any other in the Wellington region or other parts of the NZ territorial seas. Some species are new to science, while some species are probably endemic to NZ. There is some overlap at the species and genus level between the seep communities and the fauna of hydrothermal vents on the Kermadec Arc.	Present: Strong evidence for damage by bottom trawling. Published still and video images show the marks of trawl doors, lost trawl gear, and damaged fauna at NZ seep sites. Future: Gas hydrate exploration and production may cause direct damage and indirect effects through alteration of fluid flows through seeps.	The Opouawe methane seep site currently has no special status or protection.

science, or endemic to NZ seeps, suggesting the eastern NI region may represent a new biogeographic province for cold-seep fauna.

There is some overlap at the species and genus level between the seep communities and the fauna of hydrothermal vents on the Kermadec Arc.

5 Schedule 2: Habitats of significance for marine biodiversity

5.1 Giant kelp (*Macrocystis*) habitat

5.1.1 Description

Kelp beds are recognised worldwide as key contributors to coastal ecosystems through the energy captured via photosynthesis, the provision of highly structured three dimensional habitats, and also through the fixed carbon retained within, and exported from, coastal kelp forests (e.g., Graham 2004).

Giant kelp, *Macrocystis pyrifera,* occurs in the southern North Island around Cook Strait (from Kapiti Island on the west coast to Castlepoint on the east coast), South, Stewart, Chatham, Bounty, Antipodes, Auckland and Campbell Islands (Adams 1994). The distribution is patchy and there is both seasonal and interannual variation in abundance (Hay 1990, Pirker et al. 2000). *Macrocystis* thalli are perennial and grow to 20 m in length. *Macrocystis* frequently forms colonies or large populations in calm bays, harbours or in sheltered offshore waters. It can tolerate a wide range of water motion including areas where tidal currents reach 5-7 knots (Hay 1990). *Macrocystis* forests are characterised as being amongst the most productive marine communities in temperate waters. Schiel & Foster (1992) stated “the high productivity and habitat complexity of these plants contribute to the formation of diverse communities with considerable ecological, aesthetic and economic value. Moreover, food and habitat are exported from kelp forests to associated communities such as sandy beaches and the deep sea”.

Macrocystis beds in the Wellington region have been reported near Kapiti Island, at Makara, in Island Bay, in the entrance to the harbour (along the bays between Seatoun and Kau Bay and on the eastern shore from Point Howard to Hinds Point), near Petone, Whatarangi (Palliser Bay), Castlepoint. Adams (1972) noted “Marked changes in the local occurrence of *Macrocystis* have taken place since 1940.”

Macrocystis, like other members of the Laminariales, have a heteromorphic life history where the conspicuous kelp phase is the diploid stage (sporophyte) alternating with a microscopic benthic gametophyte phase that produce eggs and sperm.

5.1.2 Biodiversity values

General values:

Kelp beds are recognised as ecosystem engineers providing three dimensional habitat space and structuring to the environment in rocky reef habitats. Kelp beds are known to harbour high biodiversity and to be critical to food chains.

Habitat specific values:

Macrocystis beds are considered to sustain “one of the most diverse, productive and dynamic ecosystems of the planet” (Graham 2004). The beds in the Wellington region are patchily distributed and known to vary in size and position over time. Pérez-Matus and Shima (2010a, b) have explored the positive relationships between kelp structural complexity and the abundance of temperate reef fishes, and the potential indirect benefits for the giant kelp, *Macrocystis pyrifera* of fish predation on amphipod grazers.

Figure 5-1: Forest of giant kelp, *Macrocystis pyrifera*. Image courtesy of S.Schiaparelli.

Figure 5-2: Dense surface canopy of giant kelp, *Macrocystis pyrifera*. Image courtesy of S.Schiaparelli.

5.1.3 Habitat features relevant to criteria

Representativeness –*Macrocystis* beds are poorly represented in existing protected areas. A few beds do occur in Taputeranga Marine Reserve on Wellington's south coast and may sometimes occur in the eastern part of the Kapiti Marine Reserve but both places are marginal habitat for this species. Within the region, the densest beds occur in in the entrance to Wellington Harbour along the bays between Seatoun and Kau Bay and on the eastern shore from Point Howard to Hinds Point.

Rarity –*Macrocystis* is notable in this regard. The Wellington region is the northern distribution limit for this species. The position and extent of *Macrocystis* beds are known to vary inter-annually. Without monitoring it may be difficult to distinguish between natural variation and variations in bed size and extent occurring in response to human induced environmental changes.

Diversity – Within kelp beds a variety of microhabitats occur from holdfast to algal canopy, each with an associated community of epiphytes, fish and invertebrates. This diversity is great in *Macrocystis* beds because they occur over the greatest vertical extent from sea floor to sea surface in depths of 10 m or more.

Ecological context – *Macrocystis* beds provide a key habitat for a variety of fish and invertebrates, including commercially, recreationally and culturally important species such as paua (*Haliotis iris*), kina (*Evechinus chloroticus*), and rock lobsters (*Jasus edwardsii*). As a major primary producer *Macrocystis* also fuels the local reef ecosystem, while drift algae helps to sustain adjacent beach and deeper habitats. The strong shading provided by dense canopies of giant kelp allows deeper water sponges to grow in shallow water (Alison MacDiarmid, NIWA – personal observation).

5.1.4 Threats – Present and future

MacDiarmid et al. (2012) concluded that kelp forests on sheltered coasts were affected by 39 threats. No threat had extreme effects. Major threats included sedimentation, increased turbidity, ocean acidification, set netting, and increased storminess. Fourteen threats had moderate impacts and 21 threats had minor impacts Two of the top ten threats to this habitat derived from the global threat of climate change, another (sedimentation) was associated with human activities in catchments, six were derived from activities in the marine environment itself (set netting, invasive space occupiers/competitors, trapping/potting, line fishing, micro-algal blooms, anchoring), and one threat (turbidity) derived from a mixture of catchment and marine based activities.

Kelp forest ecosystems are generally vulnerable to potential climate changes because they are sensitive to (1) increased temperatures and associated decreases in nutrients, (2) increased storminess, (3) increased turbidity and resulting decreases in light penetration, and (4) outbreaks of herbivores due to depletions of predators (e.g. resulting from the combined effects of fishing and climate change), or due to invasions of herbivores (e.g. resulting from climate-related range shifts or human-facilitated transport) (Hobday et al. 2006). Declines in the *Macrocystis* populations off the coasts of Tasmania have been recently documented (Johnson et al. 2011). It is thought that in the Wellington region *Macrocystis* may be particularly vulnerable to climate change as it is already at the northern limit of its distribution. Ocean acidification may impact on associated species.

Macrocystis may be most directly threatened by harvesting under the Quota Management System (QMS) though a lack of research prevents firm conclusions about the safe level of harvesting.

A potential future threat relates to the development of hydrocarbon resources in the region. Exploration licences are about to be tendered for the southern East Coast region (outside territorial waters). The principal major threat from these activities is accidental oil spills.

5.1.5 Existing status and levels of protection

Macrocystis is able to harvested according to limits set using the QMS by the Minister for Primary Industries. At present there is no quota provided for the Wellington region.

Macrocystis beds are poorly represented in existing protected areas. A few beds do occur in Taputeranga Marine Reserve on Wellington’s south coast and may sometimes occur in the eastern part of the Kapiti Marine Reserve but both places are marginal habitat for this species.

5.1.6 Habitat relevant references

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5.2 Subtidal reef habitat

5.2.1 Description

Subtidal rocky reefs occur along the majority of shores in the Wellington region with the sandy beaches north of Paekakariki and in Palliser Bay the notable exceptions. Using the divisions of Shears et al. (2008), reef habitats should be divided into two bioregions with the division occurring at Cape Terawhiti on the south-west tip of North Island. Reef habitat to the north lies within the Abel Bioregion and is part of the Northern Biogeographical Province while reef habitat to the east lies within the Cook Bioregion and is part of the Southern Biogeographical Province (see Figure 3-1). The GWRC should consider reef and other habitats that span these divisions as being distinct entities from the point of view of identifying areas of significant biodiversity.

There have been no systematic surveys of the whole of the reef biota over the entirety of each bioregion to enable direct identification of areas of particular significance for biodiversity. Instead we have used the output of predictive models for reef fish species richness developed by Smith (2008) as a proxy for shallow subtidal reef species richness generally.

Predictions of the distributions and relative abundance of fishes on shallow subtidal reefs around New Zealand were produced by Smith (2008) by applying boosted regression trees (BRT: an ensemble method for fitting statistical models – see Elith et al. 2008) to diver surveys of fish abundance, using environmental and geographic variables as predictors. Smith's (2008) model predictions were produced as a grid of 1 km^2 cells. This grid was then overlain with a shape file that showed the positions of known and presumed subtidal reefs around New Zealand, and those grid cells that contained no reef were removed from the final output.

The 15 environmental variables consisted of a range of measures available at high spatial resolution including temperature, salinity, dissolved organic matter, tidal current, wind fetch, distance from coast and several variables defining the characteristics of each dive. BRTs were used to predict the abundance of each species in a 1 km^2 grid for 9,605 grid squares having shallow (< 50 m depth) rocky reefs. The most important variable for explaining variation in fish abundance was sea surface temperature, followed by average fetch and salinity. On average, 64% of the variation in reef fish abundance was explained by the models (Smith 2008). In south-eastern Australia similar modelling approaches concluded that strong environmental gradients related to temperature and exposure are the common drivers of temperate subtidal rocky reef macro-algal community change in this region (Leaper et al. 2011), thus supporting the use of Smiths modeling output as a proxy for other reef assemblages.

The model predictions produced by Smith (2008) for each fish species were re-plotted in a Geographical Information System for the region covered by the present study. The number of species predicted to occur within 1 km^2 grid squares was then calculated as an indication of the spatial distribution of species richness.

5.2.2 Biodiversity values

General values:

Subtidal rocky reefs generally have high levels of species richness because of the large number of microhabitats that occur on reefs which are frequently augmented by biogenic three-dimensional habitats created by various reef species such as macroalgae, turfing algae, filter feeding bryozoans, ascidians, cold-water corals and sponges, as well as high levels of biotic interaction such as grazing, predation, and competition (Gamfeldt and Bracken 2009).

Region specific values:

The spatial distribution of reef fish species richness divides at about Cape Terawhiti into two regions coinciding with the bioregions identified by Shears et al. (2008).

To the north-west, in the Abel Bioregion, reef fish species richness is predicted to be generally high especially around more exposed headlands between Cape Terawhiti to Pipinui Point, the north-western and south-western headlands of Mana Island, and the south-western tip of Kapiti Island (Figure 5-3).

To the east of Cape Terawhiti, in the Cook Bioregion, reef fish species richness is generally lower, especially in Palliser Bay. The highest predicted reef fish species richness in this bioregion occurs to the west from Sinclair Head, at Baring Head, at Cape Palliser and around the major headlands northwards up the Wairarapa coast (Figure 5-3)

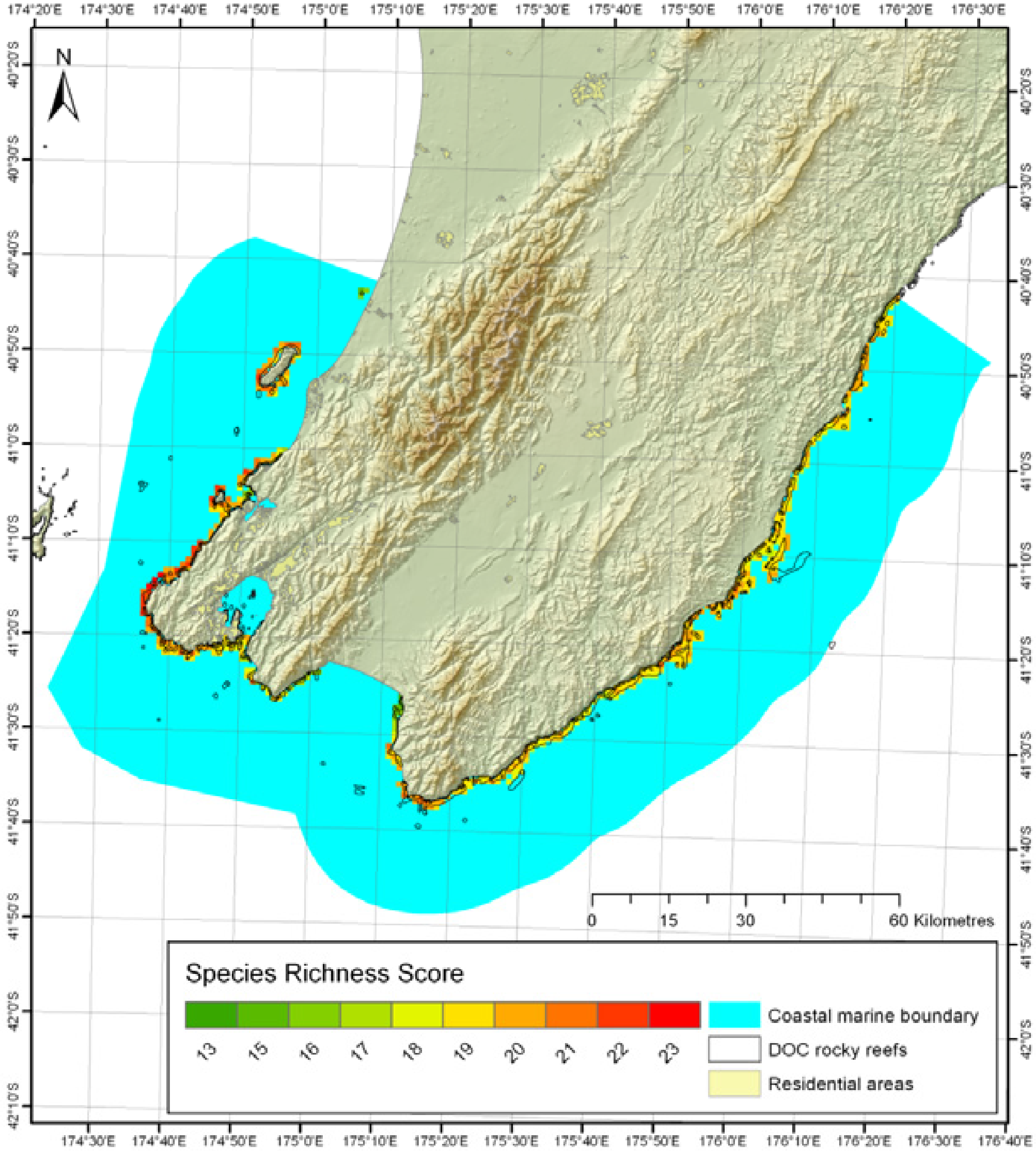

Figure 5-3: Predicted reef fish species richness in the Wellington region. Model output from Smith (2008).

5.2.3 Habitat features relevant to criteria

Representativeness – Subtidal rocky reef habitats, though represented within existing marine reserves in both the Able and Cook Bioregions, are poorly protected with less than 20% legally protected. The subtidal rocky reefs along the Wairarapa coastline are particularly poorly protected with no marine reserves along this coast.

Rarity – Not applicable

Diversity – Rocky reef ecosystems typically have high levels of biodiversity within a small spatial scale because of the large number of microhabitats, frequently augmented by biogenic three-dimensional habitats created by various reef species such as macroalgae, turfing algae, filter feeding bryozoans, ascidians, cold-water corals and sponges, as well as high levels of biotic interaction such as grazing, predation, and competition. In the Abel Bioregion, species richness is predicted to be generally high especially around more exposed headlands between Cape Terawhiti to Pipinui Point, the north-western and south-western headlands of Mana Island, and the south-western tip of Kapiti Island. In the Cook Bioregion, the highest species richness is predicted to occur to the west from Sinclair Head, at Baring Head, at Cape Palliser and around the major headlands northwards up the Wairarapa coast.

Ecological context – Rocky reefs provide important shelter and feeding habitat to a wide range of fish and invertebrates, many of which are highly valued as food species by humans.

5.2.4 Threats – Present and future

MacDiarmid et al. (2012) concluded that subtidal reef ecosystems on exposed coasts were affected by 46 threats. No threat was judged to have an extreme impact but the major threats (in descending order) were ocean acidification, fishing, increased storminess, increasing sedimentation, and increased turbidity. Two of the top ten threats to this habitat derived from the global threat of climate change, another (sedimentation) was associated with human activities in catchments, six were derived from activities in the marine environment itself and one threat (turbidity) was derived from a mixture of catchment and marine based activities. Threats associated with global climate change are expected to increase over the next 100 years.

A potential future threat relates to the development of hydrocarbon resources in the region. Exploration licences are about to be tendered for the southern East Coast region (outside territorial waters). The principal major threat from these activities is accidental oil spills.

5.2.5 Existing status and levels of protection

Extensive areas of subtidal rocky reefs occur in the Western and Eastern Kapiti Marine Reserves located in the Abel Bioregion. Rocky reef habitat is also present within the Taputeranga Marine Reserve located on Wellington’s south coast within the Cook Bioregion. There is no marine reserve along the Wairarapa section of the Cook Bioregion.

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5.3 Kelp bed habitat on exposed rocky subtidal reefs

5.3.1 Description

Kelp beds occur on shallow (< 50 m) rocky reefs throughout New Zealand. Though part of the reef community summarised in the previous section, kelps are of such importance they are the focus of this section.

Kelp beds are recognised worldwide as key contributors to coastal ecosystems through the energy captured via photosynthesis, the provision of highly structured three dimensional habitats critical for other species, and also through the fixed carbon retained within, and exported from, coastal kelp forests (e.g., Graham 2004).

The term 'kelp' is used for two different groups of large brown algae in New Zealand – the true kelps or members of the Laminariales, and bull kelp, or species of the genus *Durvillaea*, belonging to the Fucales. These two orders of brown algae have fundamentally different life histories. Members of the Laminariales have a heteromorphic life history where the conspicuous kelp phase is the diploid stage (sporophyte) alternating with a microscopic gametophyte phase that produce eggs and sperm. In contrast, the Fucales have a direct life history with the production of eggs and sperm and no alternate stage. Understanding life histories in brown algae is critical to understanding algal ecology and population dynamics (Schiel & Foster 2006).

Members of the Laminariales native to the exposed reefs of the Wellington region are *Ecklonia radiata, and Lessonia variegata*. (The introduced Asian kelp *Undaria pinnatifida* is also a true kelp.) The main species of bull kelp in the Wellington region is *Durvillaea antarctica*, although *D. willana* has also been reported from the Wairarapa coast.

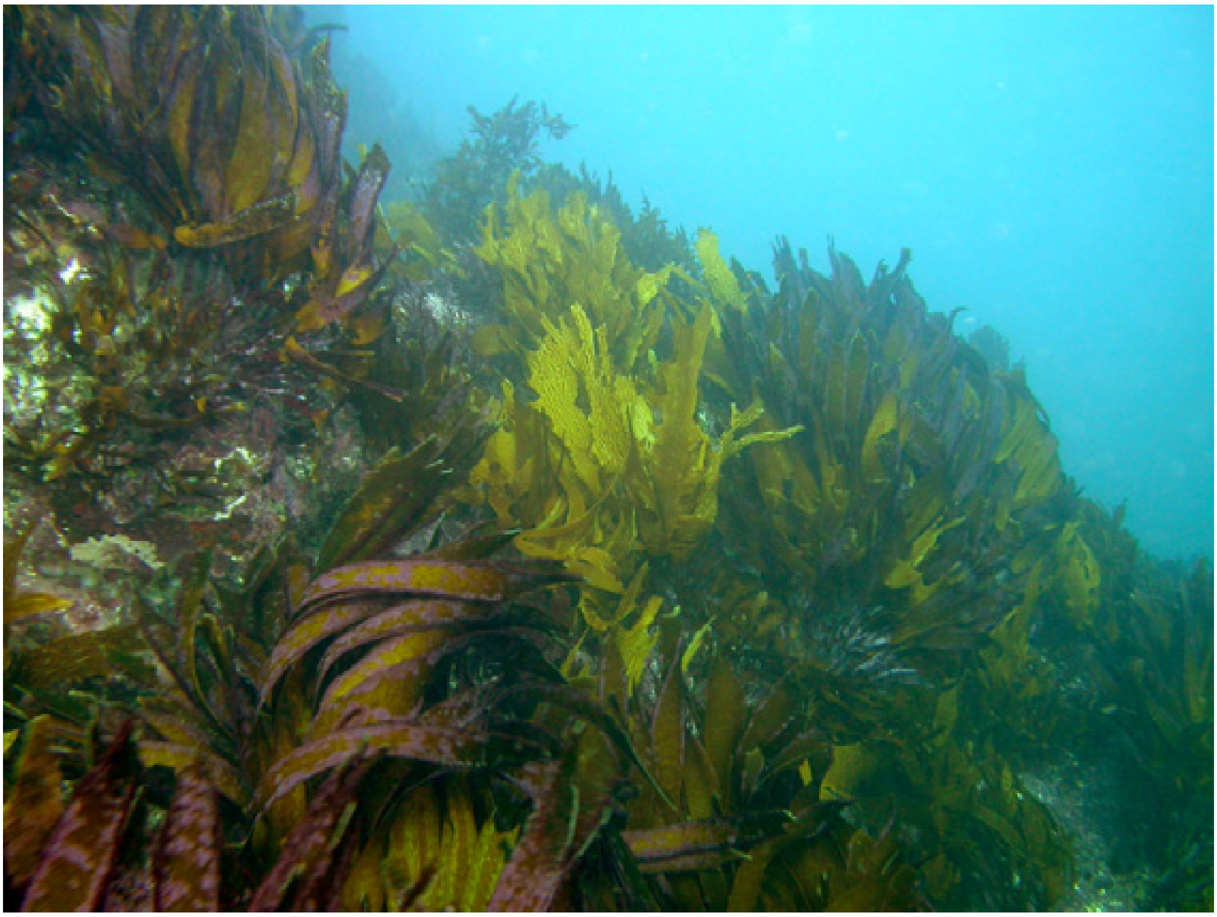

Figure 5-4: Mixed beds of *Lessonia variegata* (foreground and background) and *Ecklonia radiata* (middle). Photo courtesy of S.Schiaparelli.

Ecklonia: In New Zealand waters *Ecklonia radiata* is the ubiquitous kelp, found from the Three King Islands in the north to Stewart Island in the south (Adams 1994). *Ecklonia radiata* grows subtidally on rocky shores from moderate shelter through to exposed coasts and from the low intertidal zone to depths greater than 25 m (Schiel & Nelson 1990). The importance of *Ecklonia radiata* to marine communities is well documented. Jones (1984, 1988) showed that reef fishes such as wrasses and monocanthids recruit, some exclusively, among the fronds of *E. radiata* and feed exclusively on small invertebrates there. Choat & Ayling (1987) showed that the presence of *Ecklonia* beds affects the character of the fish fauna throughout northern New Zealand. Sea urchins do not recruit or survive well as juveniles in *Ecklonia* beds (Andrew & Choat 1985). The ecology and physiology of *Ecklonia* has been well studied in north eastern New Zealand and in Fiordland but equivalent work is not available for the Cook Strait region.

Ecklonia is abundant in the Wellington region on rocky reefs.

Figure 5-5: Two views of *Lessonia variegata* showing the range in colour and stipe length. Photos courtesy of S.Schiaparelli.

Lessonia: *Lessonia variegata* is reported from around the North, South and Stewart Islands, although recent work using molecular markers suggests that this species has a much more restricted distribution, and is found only in the lower North Island and northern South Island in the vicinity of Cook Strait (Martin, pers. comm.). Beds of *Lessonia* variegata are found subtidally on very exposed rocky reefs. It is not known how long lived individuals are although it is speculated that large clumps may exceed eight years in age. The sporophytes of *Lessonia* are fertile in winter (Schwarz et al. 2006).

Durvillaea: *Durvillaea antarctica* is the most commonly found species in the genus in New Zealand, occurring from the Three Kings Islands south to the subantarctic islands. It is found only on the most exposed headlands in the northern North Island, becoming more common from Cook Strait south. This species is confined to the low intertidal zone. It is the largest species in the genus with an unbranched stipe and blades which can grow to 10m in length. The blades float because there are gas-filled air sacs within the plant in a honeycomb-like network

Durvillaea willana is considered to be restricted to the South and Stewart Islands although it has been recorded on the Wairarapa coast. It grows in the upper subtidal zone at around 1-2 m depth. The thalli are shorter with longer and thicker stipes than *D. antarctica* and have side branches growing out of the main stipe. The blades grow to ca. 5m in length and the thalli are not buoyant. *D. willana* can co-occur with *D. antarctica*.

Figure 5-6: *Durvillaea antartica* on an unusually calm low tide. The short tough stipe and holdfast are shown front left with the long blades trailing through to the top centre of the image. Image courtesy of S.Schiaparelli. .

Durvillaea spp. are fertile from late autumn to early spring (April to September) with peak fertility in June-July (Hay 1994). Large *D. antarctica* thalli may be ten years old but more typically are 5-8 years. The life span of *D. willana* is longer; although the rigid stipe of this species is more vulnerable to snapping in severe storms, the holdfast of this species is not affected by burrowing animals as occurs in *D. antarctica.*

5.3.2 Biodiversity values

General values:

Kelp beds are recognised as ecosystem engineers providing three dimensional habitat space and structuring to the environment in rocky reef habitats. Each of the kelp species has unique features and occupies unique habitats. Kelp beds are known to harbour high biodiversity and to be critical to food chains.

Habitat specific values:

Lessonia:

Present on the exposed subtidal sites the thick beds of *Lessonia* provide shelter and habitat for a range of species. Some research is available on the growth of this species in the Wellington region but there have been no targeted studies of biodiversity associated with this kelp apart from the work by Pérez-Matus and Shima (2010a) who have explored the relationships between *Lessonia* (and other kelp) structural complexity and the abundance of temperate reef fishes in the Wellington region.

Ecklonia:

Common and abundant, *Ecklonia* is important because of its provision of habitat and the associated biodiversity. Pérez-Matus and Shima (2010a) have explored this relationship between *Ecklonia* (and other kelp) structural complexity and the abundance of temperate reef fishes in the Wellington region.

Durvillaea:

Durviillaea occupies a very specific niche in the low intertidal zone of the most exposed headlands. There is a suite of species typically associated with *Durvillaea* that have similar environmental requirements.

5.3.3 Habitat features relevant to criteria

Representativeness – Beds of *Lessonia, Ecklonia* and *Durvillaea* occur within both of the existing marine reserves in the Wellington region and so have protected populations within both the Able and Cook Bioregions. However the proportion of populations protected are < 20%, especially within the Cook Bioregion which has no protection along the whole of the Wiararapa coast.

Rarity – *Durvillaea willana* is notable in this regard. The Wellington region is the northern distribution limit for this species where it is only known from the Wairarapa coast .

Diversity – Each of the kelps occupies a distinct and different habitat/niche and is associated with different flora and fauna. *Ecklonia* occurs over a wide depth range but is generally absent from shallow very exposed sites. *Lessonia* occurs at exposed sites over a range of depths. *Durvillaea* occurs in a narrow depth zone in the shallow subtidal and low intertidal on very exposed headlands. Within each kelp bed a variety of microhabitats occur from holdfast to algal canopy, each with an associated community of epiphytes, fish and invertebrates.

Ecological context – Kelp beds provide a key habitat for a variety of fish and invertebrates, including commercially, recreationally and culturally important species such as paua, kina, and rock lobsters. As major primary producers kelps also fuel the local reef ecosystem, while drift algae helps to sustain adjacent beach and deeper habitats (see Kelly et al. 2012).

5.3.4 Threats – Present and future

Present threats to kelp beds on exposed coasts include sedimentation, indirect effects of fishing, and invasive species (MacDiarmid et al. 2012). Kelp forest ecosystems are generally vulnerable to potential climate changes because they are sensitive to (1) increased temperatures and associated decreases in nutrients, (2) increased storminess, (3) increased turbidity and resulting decreases in light penetration, and (4) outbreaks of herbivores due to depletions of predators (e.g. resulting from the combined effects of fishing and climate change), or due to invasions of herbivores (e.g. resulting from climate-related range shifts or human-facilitated transport) (Hobday et al. 2006). Ocean acidification may impact on associated species.

A potential future threat relates to the development of hydrocarbon resources in the region. Exploration licences are about to be tendered for the southern East Coast region (outside territorial waters). The principal major threat from these activities is accidental oil spills.

5.3.5 Existing status and levels of protection

Beds of *Lessonia, Ecklonia* and *Durvillaea* occur within one or both of the existing marine reserves in the Wellington region. There is no protection provide kelp along the whole of the Wiararapa coast.

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5.4 Deep-sea woodfall biogenic habitat

5.4.1 Description

General: The association of marine organisms with wood in the deep sea has been noted since the *Challenger* Expedition (1872–76) discovered deep-water relatives of shipworm (vermiform bivalved molluscs). But it was not until the results of the Danish *Galathea* expeditions in 1950–52 (Wolff 1979) that deep-sea wood came to be recognised as an important habitat with an associated exceptional biota. Deep-sea wood has been dredged in New Zealand in the Kermadec Trench, in the Bay of Plenty, and off the coast of Wairarapa, Kaikoura, Timaru and Hokitika, and on Mernoo Bank.

Regional: The woodfall habitat first came to prominence in New Zealand in the 1980s with the discovery, off the Wairarapa coast and in the Hokitika Canyon, at depths of 1100–1200 metres, of a new kind of organism – sea daisies, named *Xyloplax medusiformis*. These were an unusual type of echinoderm. Barely one centimetre in diameter, sea daisies look like small flat parachutes or medusae. They are circular and lack a mouth or arms. Their discovery made the pages of *Nature*, as it was believed they represented a sixth, new class of living echinoderms, Concentricycloidea (Baker et al. 1986). Further study of this group, based on the discovery of two more species – one off the Bahamas and one in the North Pacific – has given evidence that they are actually highly modified sea stars. Following an assertion that concentricycloids are only asteroids (Janies and Mooi 1998), Mah (2006) concluded that they nevertheless comprise members of a sister group to an infraclass Neoasteroidea, which represents all other living sea stars in the class Asteroidea, but Janies et al. (2011) disagreed. Using gene-sequence and developmental data from recently collected *Xyloplax* adults and embryos, they have shown that *Xyloplax* is simply a sea star that is closely related to the asteroid family Pterasteridae (order Velatida). Their unusual characters are progenetic, i.e., permanently juvenile, which accounts for their strange appearance.

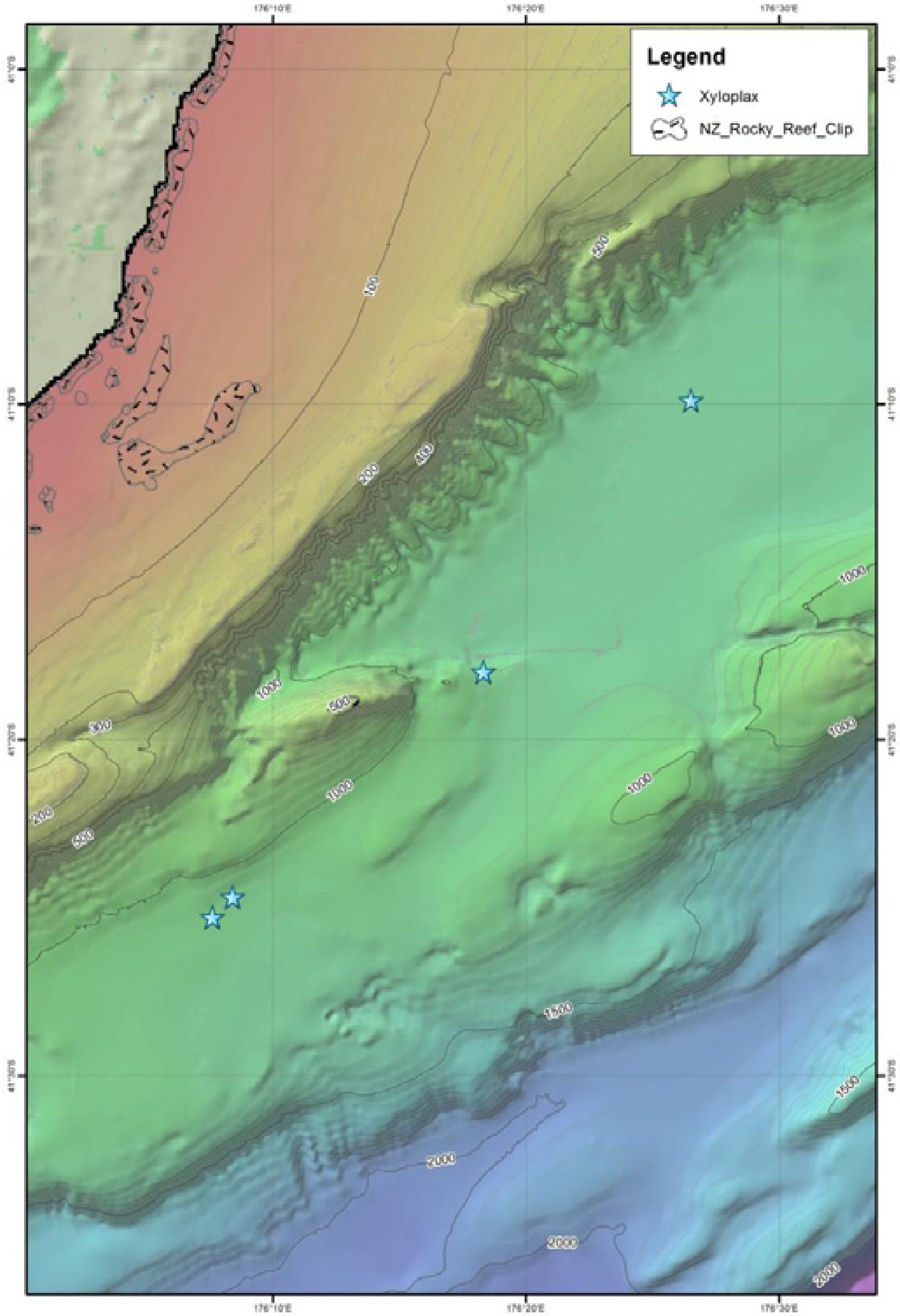

Figure 5-7: *Xyloplax* capture locations in woodfall habitat off the Wairarapa coast.

Figure 5-8: Xyloplax specimens.

5.4.2 Biodiversity values

General values:

Molluscs are the principal group represented (also including chitons and gastropods), followed by crustaceans, polychaetes and echinoderms. The fauna is frequently closely related to the fauna encountered around hydrothermal vents, cold seeps, and whale falls. However, sunken-wood ecosystems remain poorly known compared with these other deep-sea ecosystems and it has only been since the 1970s that intensive studies have been carried out, often opportunistically. Like whale-falls, woodfalls are reducing environments and the organic substrate undergoes a prolonged decay process during which a diverse range of organisms comes to be associated with it (Kiel & Godert 2006; Bernardino et al. 2010; Samadi et al. 2010).

Xyloplax species are known from only three regions in the world.

Regional specific values:

Notwithstanding the demotion of *Xyloplax*'s zoological status, they remain exceptional creatures, rare globally, and are associated off the Wairarapa coast with a range of other remarkable organisms in the same habitat. Whereas sea daisies inhabit the borings made by shipworm, other wood-associated animals live on the surface or in furrows, feeding on bacterial- and fungal-mediated decaying cellulose and other wood products and the biofilms associated with them (Palacios et al. 2006). These include limpets of the families

Cocculinidae (*Coccopigya hispida*) and Pseudococculinidae (*Tentaoculus haptricola*, *Colatrachelus hestica*) (Marshall 1985) and tiny snails of the family Skeneidae (*Bathyxylophila excelsa*, *Dillwynella lignicola*, *D. haptricola*, *Hyalogyrina glabra*, *Leptogyra patula*, *Leptogyropsis kalinovoae* and *Xyloskenea costulifera* (Marshall 1988). *Coccopigya hispida* is itself host to an endemic monotypic genus and species of parasitic copepod, *Cocculinika myzorama*. The type (and only known) locality is off Castlepoint at 1198–1211 m (Jones & Marshall 1986).

The wood-fall sites off the Wairarapa coast are among the closest to the New Zealand mainland and have a high diversity of associated species. The depth range for all three Wairarapa collection sites of *Xyloplax* is within 1110–1208 m, suggesting the possibility of one or more sinks within GWRC's jurisdiction in which transported wood may be trapped. Videography of the underwater sites where sunken logs have been found would help to clarify the situation.

5.4.3 Habitat features relevant to criteria

Representativeness – Wood-fall habitats are not presently represented in existing protected areas.

Rarity – Deep-sea wood fall habitats are known in New Zealand only from the Kermadec Trench, in the Bay of Plenty, and off the coast of Wairarapa, Kaikoura, Timaru and Hokitika, nd on Mernoo Bank. Within the region they have only been described at a few localities off the Wairarapa coast but may exist elsewhere at depths between 1110–1208 m. The Cook Strait canyons are obvious places to search.

Diversity – The family Xyloplacidae is very rare nationally and internationally and in New Zealand known otherwise only from the Hokitika Canyon. Species are habitat-dependent. The parasitic copepod *Cocculinika myzorama* is so far known only from its type locality off Castlepoint on sunken wood.

5.4.4 Threats – Present and future

The main threat is probably trawling which removes or disturbs the sunken wood habitat. Anything that prevents a continuous supply of wood material from adjacent coasts may impact on these populations.

5.4.5 Existing status and levels of protection

None.

5.4.6 Habitat relevant references

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5.5 Wellington habitat corridors

5.5.1 Description

By virtue of its position at the southern end of the North Island and the location of Cook Strait, the Wellington region is a natural corridor for the egress of fish, invertebrates, marine mammals and seabirds between the North and South Islands and from east to west coasts. Coastal waters are also a passage for different life stages of diadromous fish to enter or leave freshwater streams and rivers. In addition the territorial seas are a corridor between coastal roosting/haul-out sites or nesting/pupping sites, and offshore feeding sites for seabirds and New Zealand fur seals.

5.5.2 Biodiversity values

Habitat specific values: The DoC Marine Mammal Incidental Sightings database lists 12 species of whales and dolphins as occurring in the Wellington region. These include blue whales, minke whales, sei whales (*Balaenoptera borealis*), humpback whales, southern right whales, sperm whales, pilot whales, killer whales, bottlenose dolphins, dusky dolphins, Hector's dolphin (*Cephalorhynchus hectori*) and common dolphins. Some of these species, especially the larger baleen whales, may be in transit between northern calving and breeding grounds and Southern Ocean feeding grounds while the toothed whales and dolphins forage widely in regional waters. Historically southern right whale cows utilised sheltered waters inshore of Kapiti and Mana Islands to calve and suckle during autumn and winter and may do again as the New Zealand population slowly rebuilds after coming close to extinction in the early part of the 20th century (Carol et al. in press, Jackson et al. in press).

New Zealand fur seals (*Arctocephalus forsteri*), Antarctic fur seals (*Arctocephalus gazella*), leopard seals (*Hydrurga leptonyx*), and southern elephant seals (*Mirounga leonina*), have all been recorded from Wellington regional waters, though all but the New Zealand fur seals are only occasional visitors. According to DoC[2], New Zealand fur seals breed at Honeycomb Rock, Cape Palliser, and possibly Kapiti Island. During winter, fur seals regularly haul out at Kapiti Island, Mana Island, Pipinui Point, from Ohau Point to Cape Terawhiti, Tongue Point, Sinclair Head, Turakirae Head, Cape Palliser (three sites), Te Kaukau Point, Manurewa Point, Kairingaringa Reef, Honeycomb Rock, and occasionally at Castlepoint. The locations on Wellington's south coast as well Palliser Bay and the Wairarpa coast provide ready access to slope depths where fur seals predominately forage nocturnally for squid and lantern fishes (Myctophids).

According to Parkinson (2000) about 22 species of shore and seabirds commonly occur in the Wellington region. Bartle (1974) described an inshore belt extending from the coast to eight kilometres offshore, that is characterised by the presence of fluttering shearwaters and diving petrels with little blue penguins, gulls, terns and gannets are almost entirely confined to this region. Bartle (1974) also described an offshore belt, which extends further than eight kilometres offshore, that is characterised by fairy prions and sooty shearwaters. The large albatrosses, mollymawks and petrels are largely confined to this region. Buller's shearwaters occur throughout both zones.

Strickland and Quarterman (2001) reviewed the freshwater fish fauna of the Wellington region. They concluded that of the 23 native fish species only four were non-migratory between freshwater and coastal marine habitats for part of their life cycle. In some cases the territorial seas are used just to transit to breeding areas (e.g. short and longfined eels – *Anguilla australis schmidtii* and *A. dieffenbachia* respectively) but in other cases substantial parts of the early life history are spent feeding and growing in coastal waters (e.g. galaxids).

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[2] http://www.doc.govt.nz/upload/documents/conservation/native-animals/marine-mammals/seals-fact-sheet.pdf

Table 5-1: Diadromous fish species in the Wellington Region. Adapted from Table 1 in Strickland and Quarterman (2001).

Scientific Name	Common Name
Anguilla dieffenbachii	Longfin eel
Anguilla australis	Shortfin eel
Gobiomorphus huttoni	Redfin bully
Gobiomorphus cotidianus	Common bully
Gobiomorphus hubbsi	Bluegill bully
Gobiomorphus gobioides	Giant bully
Galaxias brevipinnis	Koaro
Galaxias maculatus	Inanga
Galaxias fasciatus	Banded kokopu
Galaxias argenteus	Giant kokopu
Galaxias postvectis	Shortjaw kokopu
Cheimarrichthys fosteri	Torrentfish
Geotria australis	Lamprey
Retropinna retropinna	Common smelt
Rhombosolea retiaria	Black flounder
Aldrichetta forsteri	Yelloweye mullet
Mugil cephalus	Grey mullet

5.5.3 Habitat features relevant to criteria

Representativeness – The transitional habitats are presently not well represented in existing protected areas.

Rarity – Not applicable

Diversity – Not applicable

Ecological Context – Habitat transition zones or migratory corridors in the Wellington region provide connectivity between habitats onshore or in deeper water critical for breeding, feeding, growth or reproduction and/or may provide seasonal or core habitat for protected or threatened indigenous species such as many of the freshwater fishes, marine mammals and seabirds occurring in the Wellington region.

5.5.4 Threats – Present and future

Present threats include a range of activities that affect the estuary and nearby coastal areas utilised by diadromous fish species. These include altered river flows, altered estuarine vegetation, sedimentation, pollution, dredging, reclamation, sediment dumping and various forms of fishing activity.

Foreshore nest, roosting, foraging, haulout or pupping sites are easily disturbed by the activities by humans and their livestock.

At sea threats include ingestion of plastic waste and various fishing activities.

Emerging threats include sea level rise, increases in sea temperature and other consequences of increasing levels of greenhouse gases in the atmosphere.

5.5.5 Existing status and levels of protection

The narrow exclusion zone around the Cook Strait DC power cable does protect a small proportion of the habitat corridor between the east and west coasts.

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Table 5-2: Habitats of significant marine biodiversity in the Wellington region. Location, biodiversity values, features relevant to selection criteria, threats, and existing status and level of protection.

Habitat name	Location	Biodiversity values	Features relevant to criteria[3]	Threats - Present and future	Existing status and levels of protection
Giant kelp, *Macrocystis,* beds	Point Howard to Hinds Point, and Worser Bay to Kau Bay, Wellington Harbour	General: Kelp beds provide three dimensional habitat space and structuring to the environment in rocky reef habitats. Kelp beds are known to harbour high biodiversity and to be critical to food chains. Region Specific: *Macrocystis* beds are considered to sustain "one of the most diverse, productive and dynamic ecosystems of the planet". The beds in the Wellington region are patchily distributed and known to vary in size and position over time.	Representativeness – *Macrocystis* beds are poorly represented in existing protected areas. Rarity –This region is the northern distribution limit for *Macrocystis*. Diversity – Within giant kelp beds a variety of microhabitats occur from holdfast to algal canopy, each with an associated community of epiphytes, fish and invertebrates. This diversity is high in *Macrocystis* beds because they occur over a great vertical extent from sea floor to sea surface in depths of 10 m or more.	Present – MacDiarmid et al. (2012) concluded that major threats to kelp forests on sheltered coasts included sedimentation, increased turbidity, ocean acidification, set netting, and increased storminess. Two of the top 10 threats derived from the global threat of climate change, another (sedimentation) was associated with human activities in catchments, six were derived from activities in the marine environment itself (set netting, invasive space occupiers/competitors, trapping/potting, line fishing, micro-algal blooms, anchoring), and one threat (turbidity) derived from a mixture of	*Macrocystis* beds are poorly represented in existing protected areas. A few beds do occur in Taputeranga Marine Reserve on Wellington's south coast and may sometimes occur in the eastern part of the Kapiti Marine Reserve but both places are marginal habitat for this species.

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[3] Criteria

(a) Representativeness: high representativeness values are given to particular ecosystems and habitats that were once typical and commonplace in a district or in the region, and:

- (i) are no longer commonplace (less than about 30% remaining); or
- (ii) are poorly represented in existing protected areas (less than about 20% legally protected).

(b) Rarity: the ecosystem or habitat has biological and/or physical features that are scarce or threatened in a local, regional or national context. This can include individual species, rare and distinctive biological communities and physical features that are unusual or rare.

(c) Diversity: the ecosystem or habitat has a natural diversity of ecological units, ecosystems, species and physical features within an area.

(d) Ecological context of an area: the ecosystem or habitat:

- (i) enhances connectivity or otherwise buffers representative, rare or diverse indigenous ecosystems and habitats; or
- (ii) provides seasonal or core habitat for protected or threatened indigenous species.

			Ecological context – Kelp beds provide a key habitat for a variety of fish and invertebrates, including commercially, recreationally and culturally important species such as paua, kina, and rock lobsters. As major primary producers kelps also fuel the local reef ecosystem, while drift algae helps to sustain adjacent beach and deeper habitats.	catchment and marine based activities. Future - Threats associated with global climate change are expected to increase over the next 100 years. A potential future threat relates to the development of hydrocarbon resources in the region. The principal major threat from these activities is accidental oil spills.	
Exposed subtidal rocky reefs	Occurs along the majority of coast in the Wellington region with the sandy beaches north of Paekakariki and in Palliser Bay the notable exceptions.	General: Generally high levels of species richness because of the large number of microhabitats, frequently augmented by biogenic 3-dimensional habitats created by reef species as well as high levels of biotic interaction. Region specific: Using the proxy of reef fish species richness, a divide at about Cape Terawhiti coincides with the bioregions identified by Shears et al. (2008). To the NW, in the Abel Bioregion, species richness is predicted to be generally high especially around more exposed headlands between Cape Terawhiti to Pipinui Point, the north-western and south-western headlands of Mana Island, and the south-western tip of Kapiti Island. To the east of Cape Terawhiti, in the Cook Bioregion, species richness is generally lower,	Representativeness – Subtidal rocky reef habitats are poorly protected with less than 20% legally protected within existing marine reserves in both the Able and Cook Bioregions. The subtidal rocky reefs along the Wairarapa coastline are particularly poorly protected with no marine reserves along this coast Rarity – Not applicable Diversity – Rocky reef ecosystems typically have high levels of biodiversity within a small spatial scale. In the Abel Bioregion, species richness is predicted to be generally high especially around more exposed headlands between Cape Terawhiti to Pipinui Point, the north-western and south-western headlands of Mana Island, and the south-western tip of Kapiti Island. In the Cook Bioregion, the	Present – MacDiarmid et al. (2012) concluded that subtidal reef ecosystems on exposed coasts were affected by 46 threats. The major threats (in descending order) were ocean acidification, fishing, increased storminess, increasing sedimentation, and increased turbidity. Two of the top 10 threats to this habitat derived from the global threat of climate change, another (sedimentation) was associated with human activities in catchments, six were derived from activities in the marine environment itself and one threat (turbidity) was derived from a mixture of catchment and marine based activities. Future - Threats associated with global climate change are expected to increase over the next 100 years. A potential future threat relates to the development of	Extensive areas of rocky reef habitat occur within both of the existing marine reserves in the Wellington region.

		especially in Palliser Bay. The highest predicted species richness in this bioregion occurs to the west from Sinclair Head, at Baring Head, at Cape Palliser and around the major headlands northwards up the Wairarapa coast.	highest species richness is predicted to occur to the west from Sinclair Head, at Baring Head, at Cape Palliser and around the major headlands northwards up the Wairarapa coast. Ecological context – Rocky reefs provide important shelter and feeding habitat to a wide range of fish and invertebrates, many of which are highly valued as food species by humans.	hydrocarbon resources in the region. The principal major threat from these activities is accidental oil spills.	
Kelp beds	On exposed rocky reefs region wide	General: Kelp beds provide three dimensional habitat space and structuring to the environment in rocky reef habitats. Kelp beds are known to harbour high biodiversity and to be critical to food chains. Region Specific: *Macrocystis* beds are considered to sustain “one of the most diverse, productive and dynamic ecosystems of the planet”. The beds in the Wellington region are patchily distributed and known to vary in size and position over time.	Representativeness – Beds of *Lessonia, Ecklonia* and *Durvillaea* occur within one or both of the existing marine reserves in the Wellington region. Rarity –This region is the northern distribution limit for *Durvillaea willana*. Diversity – Each of the kelps occupies a distinct and different habitat/niche and is associated with different flora and fauna. Within each kelp bed a variety of microhabitats occur from holdfast to algal canopy, each with an associated community of epiphytes, fish and invertebrates. Ecological context – Kelp beds provide a key habitat for a variety of fish and invertebrates, including commercially, recreationally and culturally important species such as paua, kina, and rock lobsters. As major primary producers kelps	Present threats include sedimentation, indirect effects of fishing, and invasive species. Potential threats include impacts of climate change. Ocean acidification may impact associated species. A potential future threat relates to the development of hydrocarbon resources in the region. The principal major threat from these activities is accidental oil spills.	Beds of *Lessonia, Ecklonia* and *Durvillaea* occur within one or both of the existing marine reserves in the Wellington region.

			also fuel the local reef ecosystem, while drift algae helps to sustain adjacent beach and deeper habitats.		
Deep-sea woodfall habitat	1,100 m off Wairarapa coast	General: Woodfalls are reducing environments undergoing a prolonged decay process during which a diverse range of organisms comes to be associated with it. Molluscs are the principal group represented (also including chitons and gastropods), followed by crustaceans, polychaetes and echinoderms. The fauna is frequently closely related to the fauna around hydrothermal vents, cold seeps, and whale falls. Region specific: In the 1980s, off the Wairarapa coast at depths of 1100–1200 metres, a new kind of organism – sea daisies, named *Xyloplax medusiformis* were first discovered with a range of other remarkable organisms in the same woodfall habitat. Whereas sea daisies inhabit the borings made by shipworm, other wood-associated animals live on the surface or in furrows, feeding on bacterial- and fungal-mediated decaying cellulose and other wood products and the biofilms associated with them. These include limpets of the families Cocculinidae and Pseudococculinidae and tiny snails of the family Skeneidae One snail is itself host to an	Representativeness – These habitats are not presently represented in existing protected areas. Rarity – Deep-sea wood fall habitats are known in New Zealand only from the Kermadec Trench, in the Bay of Plenty, and off the coast of Wairarapa, Kaikoura, Timaru and Hokitika, and on Mernoo Bank. Within the region they have only been described at a few localities off the Wairarapa coast but may exist elsewhere. Diversity – The family Xyloplacidae is very rare nationally and internationally. The parasitic copepod *Cocculinika myzorama* is so far known only from its type locality off Castlepoint on sunken wood.	The main threat is probably trawling which removes or disturbs the sunken wood habitat. Anything that prevents a continuous supply of wood material from adjacent coasts may impact on these populations.	None

		endemic monotypic genus and species of parasitic copepod. The type (and only known) locality is off Castlepoint at 1198–1211 m.			
Wellington habitat corridors	Throughout region	Habitat specific values: 12 species of whales and dolphins occur in the Wellington region. Some of these species transit the region while travelling between northern calving and breeding grounds and Southern Ocean feeding grounds while the toothed whales and dolphins forage widely in regional waters. Historically southern right whale cows utilised sheltered waters inshore of Kapiti and Mana Islands to calve and suckle during autumn and winter. Four seal species occur in the Wellington region but only the NZ fur seal is a long term resident. About 22 species of shore and seabirds commonly occur in the Wellington region. Nineteen species of diadromous fish occur in the Wellington region.	Representativeness – The transitional habitats are presently poorly represented in existing protected areas Ecological Context – Habitat transition zones or migratory corridors in the Wellington region provide connectivity between habitats onshore or in deeper water critical for breeding, feeding, growth or reproduction and/or may provide seasonal or core habitat for protected or threatened indigenous species such as many of the freshwater fishes, marine mammals and seabirds occurring in the Wellington region.	Present threats include a range of activities that affect the estuary and nearby coastal areas utilised by diadromous fish species. These include altered river flows, altered estuarine vegetation, sedimentation, pollution, dredging, reclamation, sediment dumping and various forms of fishing activity. Foreshore nest, roosting, foraging, haulout or pupping sites are easily disturbed by the activities by humans and their livestock. At sea threats include ingestion of plastic waste and various fishing activities. Emerging threats include sea level rise, increases in sea temperature and other consequences of increasing levels of greenhouse gases in the atmosphere.	Practically none. The narrow cable protection zone around the Cook Strait DC power cable does protect a small proportion of the habitat corridor between the east and west coasts.

6 Summary and conclusions

The total area included in Wellington's marine region is about 742,484 ha. Of this about 1.5% occurs in harbours and estuaries, 58% occurs on the continental shelf, 40% is found on the continental slope, and 0.5% occurs at depths below 2000 m. The Wellington region is particularly rich in shelf edge and slope habitats such as canyons, methane seeps and woodfalls that are uncommon in most other regions.

Seven sites of significant marine biodiversity and five habitats of significant marine biodiversity have been identified in the territorial seas within the Wellington Region. The sites range from the shallow Porirua Harbour to methane seeps lying in 1100 m of water at the south-east extremity of the region.

The Wellington Region has been divided into two distinct bioregions, at least for the shallow coastal fauna and flora; the warmer Abel Biogegion north of Cape Terawhiti and the cooler Cook Bioregion east of Cape Terawhiti (Shears et al. 2008). Two of the sites and three of the habitats occur in the Abel Bioregion, while five of the sites and all the habitats occur in the Cook Bioregion.

Just one of the sites (Kapiti Island rhodolith beds) lies at least partly inside an existing protected area. All other sites are currently unprotected.

Exposed rocky reef habitat and kelp beds are partly protected within the existing marine reserves around Kapiti Island and along Wellington's south coast but the other three habitats are currently unprotected except the narrow exclusion zone around the Cook Strait DC power cable does protect a small proportion of the habitat corridor between the east and west coasts.

The identified sites and habitats are threatened by a range of human activities. Those nearest land are typically threatened by a greater number of activities and many of these stem from activities within catchments or from activities such as dredging or spoil dumping that are under the direct jurisdiction of the GWRC. However, some of the more pressing threats to deepwater habitats such as the methane seeps on Opouawe Bank are from the effects of bottom trawling. In these instances the GWRC will need to work with the Ministry for Primary Industries to effect protection.

The sites and habitats identified as containing significant marine biodiversity in the Wellington region are located in either shallow coastal areas (Porirua Harbour, Wellington Harbour freshwater springs and *Adamsiella* beds, Kapiti Island rhodolith beds, Mataikona reefs, giant kelp beds, subtidal reefs, exposed reef kelp beds) or deep water areas (Cook Strait Canyons, methane seeps, sunken wood habitat). Only one habitat (Wellington habitat corridors) occurs in part on the shelf. This reflects our poor knowledge of shelf ecosystems in the Wellington region rather than indicating that shelf habitats are any less important.

The sites and habitats identified as containing significant marine biodiversity in the Wellington region vary widely in the amount of information available to define their habitat features relevant to the biodiversity evaluation criteria. While Porirua Harbour and the Opouawe Bank methane seeps are well studied (see sections 4.1 and 4.7), many of the other sites and habitats are very poorly known. Focused research efforts at these locations or habitats are likely to reveal much relevant information.

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