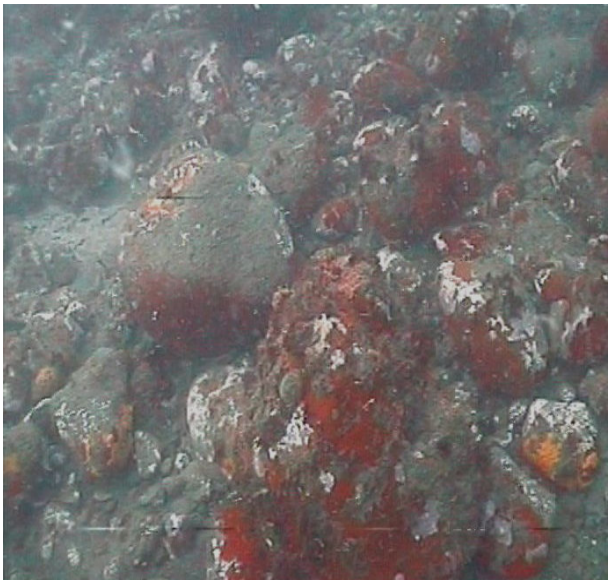
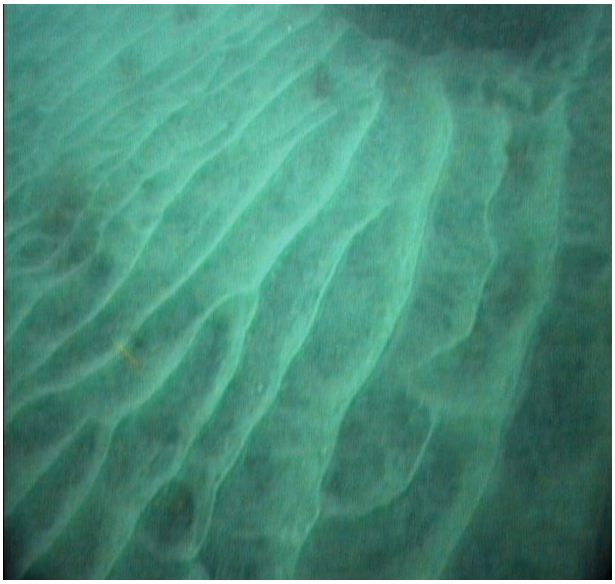
Classification of the Bay of Plenty coastal environment into MPA habitat classes





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Classification of the Bay of Plenty Marine Environment into MPA Habitat Classes

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1.0 Introduction

The Bay of Plenty Conservancy of the Department of Conservation (DoC) is currently identifying a suite of sites within the Bay of Plenty marine environs as candidates for a representative Marine Protected Areas (MPA) network. The suite of sites will provide a principle layer of information for public forums to differentiate among similar habitats of differing contributions to a Marine Protected Areas network in the Bay of Plenty.

As part of the project, classification of the Bay of Plenty (BoP) coastal environment into discreet habitat classes, covering both marine and estuarine environments, is required.

The habitats classification project has two main objectives:

1) Classify habitats in estuarine and marine environments in accordance with the MPA classification protection standard and implementation guidelines (Ministry of Fisheries and Department of Conservation 2008), within the Bay of Plenty region (Table 1.1); and,

2) Provide a measure of certainty/confidence relating to the habitat classification.

The MPA classification, protection standard and implementation guidelines developed by the Ministry of Fisheries and the Department of Conservation identifies a total of 43 habitat types, in accordance with environment, depth, and exposure classes (Table 1.1).

Table 1.1 Coastal classification and mapping scheme (Mean High Water Spring – 200 metre depth (Source: Ministry of Fisheries and Department of Conservation. 2008. Marine Protected Areas: Classification, Protection Standard and Implementation Guidelines).

Level 1	Biogeographic region (14)									
Level 2	Environment type	Estuarine		Marine						
Level 3	Depth	Intertidal	Subtidal	Intertidal (MHWS – MLWS)			Shallow Subtidal (MLWS – 30m)			Deep Subtidal (30m – 200m)
Level 4	Exposure	low	low	low	med	high	low	med	high	low
Level 5	Habitat type	Mud flat	Mud flat	Mud flat	Sandy beach	Sandy beach	Shallow mud	Shallow sand	Shallow sand	Deep mud
		Sand beach	Sand flat		Gravel beach	Gravel beach		Shallow gravel field	Shallow gravel field	Deep sand
		Gravel beach	Gravel field		Cobble beach	Cobble beach		Shallow cobble field	Shallow cobble field	Deep gravel field
		Cobble beach	Cobble field		Boulder beach	Boulder beach		Shallow boulder reef	Shallow boulder reef	Deep cobble field
		Boulder beach	Boulder reef		Rocky platform	Rocky platform		Shallow Rocky reef	Shallow Rocky reef	Deep boulder field
		Rocky platform	Rocky reef					Shallow Biogenic reef	Shallow Biogenic reef	Deep rocky reef
			Biogenic reef							Deep Biogenic reef

Notes:

- Terms above are defined in the Glossary
- Biogenic reefs include habitats such as bryozoan beds, rodolith beds, tube worm mounds and sponge gardens
- Artificial substrate such as marine farms and marinas has not been included in the classification as it is not considered important for representation in the network of protected areas, however, it should be considered for the purposes of mapping all features present in a biogeographic region
- This list presents the proxies for habitat types. Each listed category may not occur in every bioregion. Marine habitats do not typically function independently and these habitat types frequently occur in combination
- A proportion of all habitats identified in Table 2 that occur in a given Biogeographic Region are required to be protected in at least one marine reserve and at least one other form of marine protection

2.0 Methodology

The following is an outline of the methodology used to undertake and meet the objectives of the project.

2.1 Compilation of Datasets

To assess and classify the dominant habitat types across the Bay of Plenty, a range of datasets were compiled - these ranged from existing spatial datasets held by DoC such as shapefiles of seagrass and rocky reef habitat, existing spatial maps of soft sediment habitat types, and additional datasets held by ASR Ltd. All available datasets that were not in digital format were digitised during the project using Arc GIS (9.1). Main datasets used for the classification of MPA habitats are presented in Table 2.1.

Table 2.1 Main data sources used to define MPA habitat classes.

Data type	Description	Source
Bathymetry file	Bathymetry of the entire BoP region	ASR Ltd
Shape file	Shape file demarcating land and water for the area under analysis	Area_BOP_Coast.shp (DoC)
Spatial map	Subtidal habitat information for the area around Cape Runaway	Mead. S., Scarfe. B., Blenkinsopp. C. and Frazerhurst. J. (2003) Cape Runaway Marine Survey (ASR Ltd)
Spatial map (digitised)	Digitised polygon shape files based on information from the Bay of Plenty Sediments map by Doyle *et al.* (1979)	Doyle. A. C., Carther. L., Glasby. G. P., Lewis. K. B. (1979). Bay of Plenty Sediments. N. Z. Oceanographic Institute Chart. Department of Scientific and Industrial Research
Shape file	Shape file of the distribution of sand around Bay of Plenty	sand_nzmg.shp (Doc)
Shape file	Shape file of the distribution of Tauranga seagrass within Tauranga Harbour	Tauranga_seagrass1996.polygon.shp (EBoP)
Shape file	Shape file of the distribution of within Ohiwa Harbour	Ohiwa_seagrass1996.polygon.shp (EBoP)
Shape file	Shape file of the distribution of rocky reef within the Bay of Plenty	Rocky.polygon.shp (DoC)
Shape file	Shape file of the distribution of mud within the Bay of Plenty	Mud.polygon.shp (DoC)
Shape file	Shape file of the distribution of gravel within the Bay of Plenty	Gravel.polygon.shp (DoC)
Spatial map	Contains distribution of intertidal habitats shown in the 'Bathy' field	TUMONZ 3 (2007)

2.2 Grid Development

Following data compilation, a grid shapefile was constructed in GIS and arranged over and in accordance with the Bay of Plenty DoC conservancy boundary GIS shapefile. The grid was, however, extended further east than the existing BoP DoC conservancy boundary, i.e., east of Opotiki and beyond Cape Runaway (Fig. 2.1)[1]. The grid was composed of 10,073 individual cells each with a corresponding grain size of 1 km^2.

The MPA habitats classification required categorisation of five levels (Table 1.1), these were: Bioregion (Level 1); Environment Type (Level 2); Depth (Level 3); Exposure (level 4); and, Habitat Type (Level 5). Each of these levels was determined based on available data and assigned for each grid cell.

[1] The Department of Conservation's Bay of Plenty conservancy boundary runs from Waihi Beach in the north-west across to Opotiki in the south-east and offshore to the 200 m depth interval. The area west of Opotiki out to Cape Runaway is administered by the Department of Conservation's East Coast/Hawke's Bay conservancy.

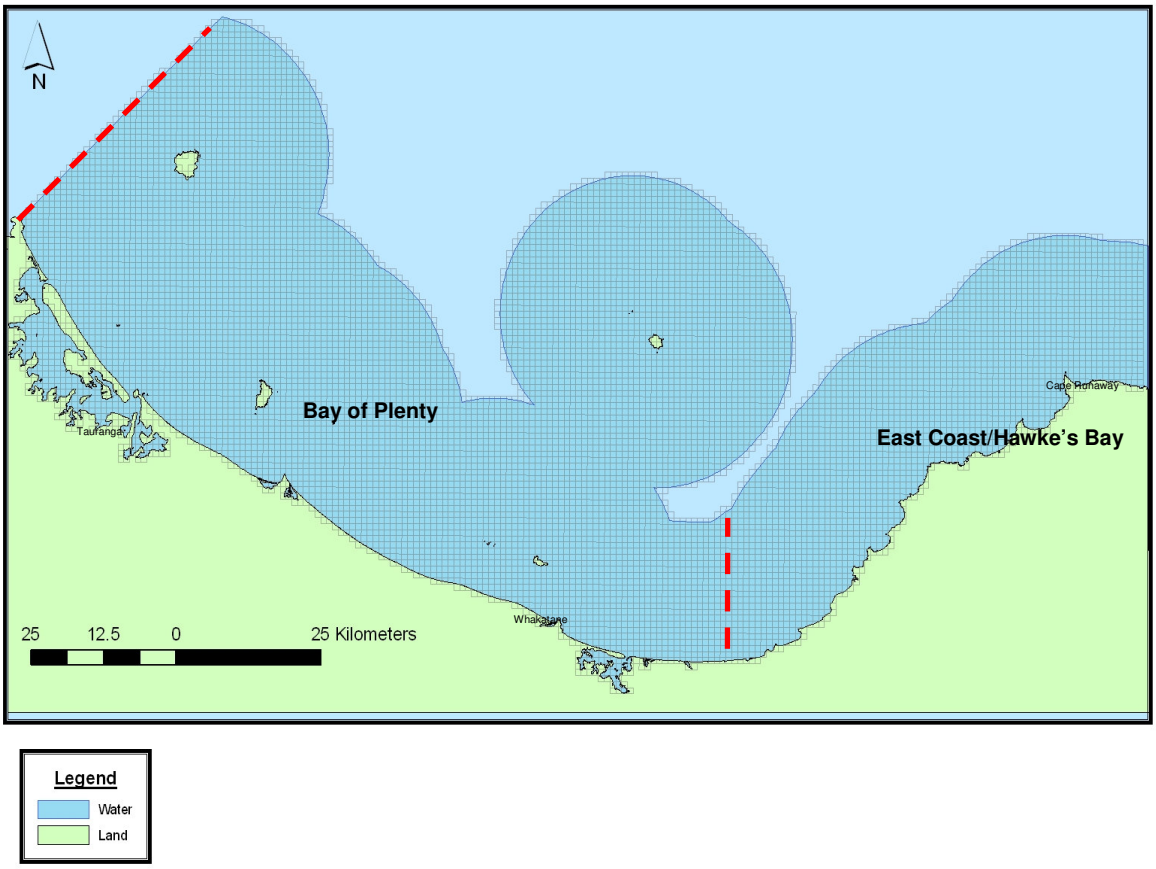

Figure. 2.1 Grid boundary across the Bay of Plenty region surveyed; individual cells have a grain size of 1 km^2. Horizontal dashed red lines denote the Department of Conservation's Bay of Plenty regional boundary. The area west of Opotiki out to Cape Runaway and beyond is administered by the Department of Conservation's East Coast/Hawke's Bay conservancy.

2.3 Bioregion

The Bay of Plenty region under consideration for this study sits within the north-eastern bioregion (Level 1), which extends from Ahipara on the west coast of the North Island to East Cape on the east coast of the North Island (Fig. 2.2). Consequently, no over-lapping biographic regions occurred across the BoP area.

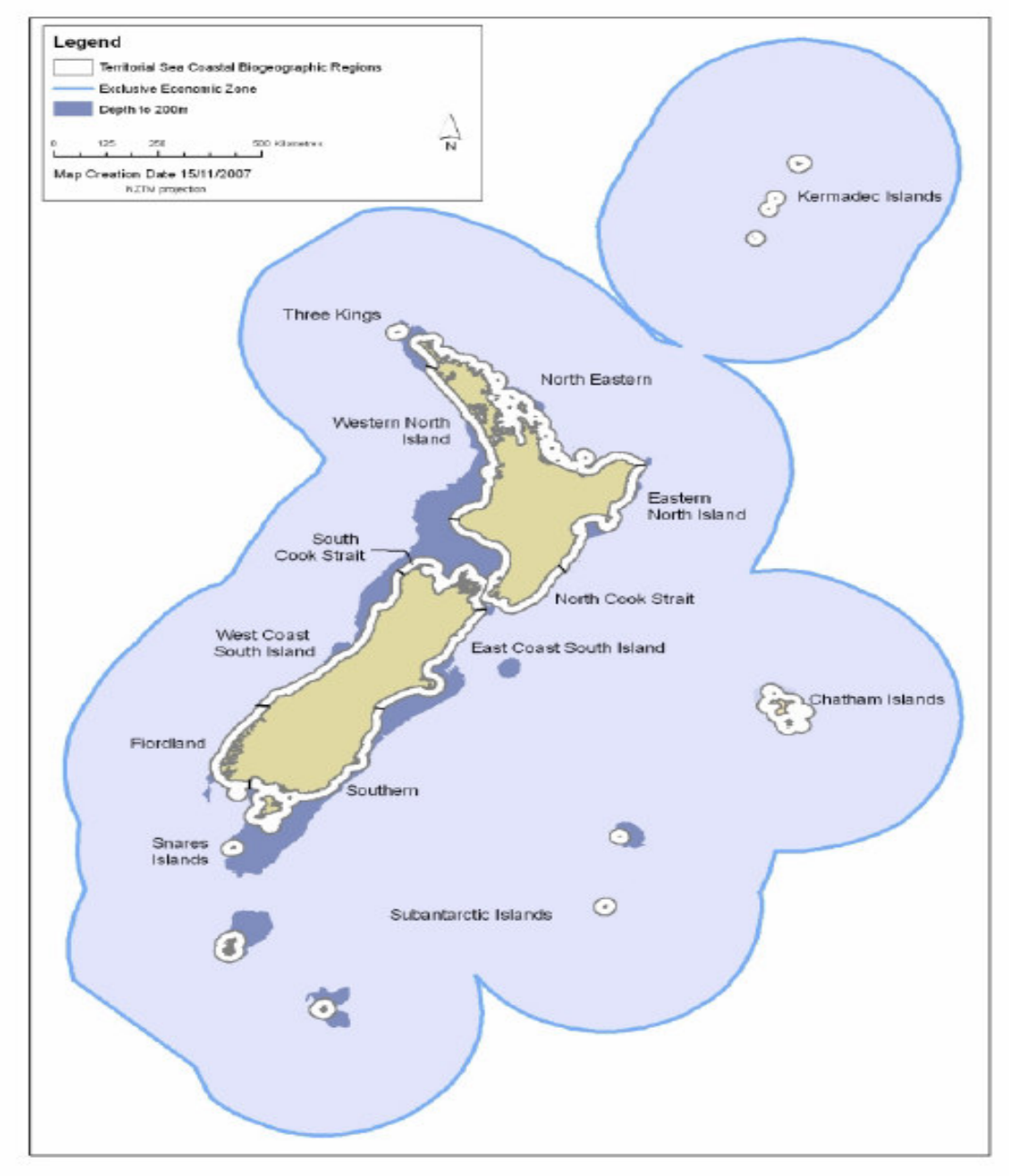

Figure 2.2 Coastal biographic regions across New Zealand.

2.4 Environment Type and Depth Classification

Following grid construction, bathymetry data for the entire region (held by ASR Ltd) was used to facilitate accurate environment description (estuarine or marine – Level 2) and classification of depths (e.g., estuarine, intertidal, shallow subtidal and deep subtidal areas – Level 3).

2.5 Exposure Classification

No formal analysis (e.g., fetch analysis) was undertaken for the BoP region to assess exposure levels (Level 4). However, consideration of the available (but limited) literature for the Bay of Plenty region (see Pickrill & Mitchell, 1979) suggests that the BoP northeastern coast wave climate is smaller than the rest of coastal New Zealand. Swell waves originate from subtropical cyclones and shorter period seas are generated by local weather patterns. Deep water waves are predominantly from the northerly through to the easterly direction, ranging from 0.5-1.5m in height and 5-7s in period. Similarly, Macky *et al*. (1995) described the offshore wave climate in the western Bay of Plenty as ~ 1 m for 70% of the time (0.8 m mean), with a peak in spectral density at 0.09-0.10 Hz (10-11 sec period) and with most of wave energy arriving from the north-east to east sector.

The MPA classification (Table 1.1) presents one exposure option for estuarine environments and deep subtidal areas which is *low exposure*. Based on the findings of Pickrill and Mitchell (1979), Macky *et al*. 1995 and ASR Ltd's unpublished data for parts of the BoP, all other marine environments in the BoP region were assigned as *medium exposure*.

2.6 Habitat Classification

Using available data, each individual grid cell was assessed for major (primary) habitats according to the MPA classification protection standard and implementation guidelines (Table 1.1). In instances where more than one habitat occurred within a given cell, the habitat with the highest percent cover was assigned to that cell. If the secondary habitat had a reasonably high percent cover within the grid cell it was classified as a secondary habitat.

If habitat data was unavailable for a particular cell (unknown data cell), but was known for a cell (known data cell) located immediately adjacent to the unknown data cell, the unknown data cell was assigned the habitat type of the known data cell and given a low confidence score (see Section 2.7 below). In instances where an unknown data cell was assigned a habitat type this information could not be then used to estimate habitat types in other adjacent cells where the data was unknown (see Fig. 2.3).

The bulk of the classification was done directly in Arc GIS using digitised datasets. These are provided as additional shapefiles included in a GIS module that accompanies this report.

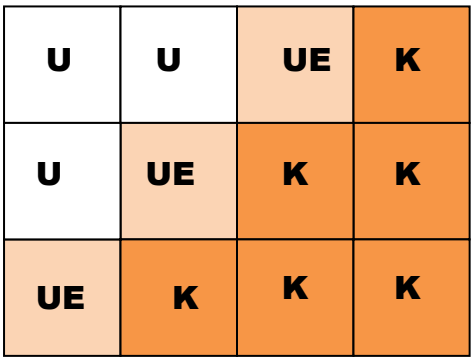

Figure 2.3 Example of habitat estimation used in the study. Dark orange cells indicate known habitat types (K). Light orange cells (UE) indicate unknown habitat types that have been estimated from adjacent known (K) data cells. Un-shaded cells indicate unknown habitat types (U). Habitat types cannot be assigned to these U cells, as cells immediately adjacent have been estimated (UE) or are unknown (U).

2.7 Certainty/Confidence in Data

A confidence in data rank was assigned to each 1km^2 cell based on the source, detail, and currency of the data used for the habitat classification. The ranking system ranged from 1 (high confidence) to 5 (low confidence); see Table 2.1 (below). The purpose of the confidence layer was to identify knowledge gaps and provide a measure of confidence when assessing and viewing the data. The confidence data for the grid is incorporated into the GIS module as an additional layer.

Example metadata for classification levels (Sections 2.3-2.7) is presented in Fig. 2.4.

Table 2.1 Certainty and confidence in data ranking scale.

Confidence description	Rank
Our confidence in the data used for habitat classification within the given cell is "High" being based on up-to-date published literature and/or habitat maps (< 15 yrs) that have a high spatial resolution e.g., habitat maps created from multiple sampling points across the area and/or quantitative surveys that cover the area sufficiently.	1
Our confidence in the data used for habitat classification within the given cell is "High to moderate" and is based on up-to-date published literature and/or habitat maps (< 15 yrs), however data may be limited by spatial resolution.	2
Our confidence in the data used for habitat classification within the given cell is "Moderate" and is based on published literature and/or habitat maps within the reporting area, but data may be limited by currency (habitat maps > 15 yrs) and/or spatial resolution.	3
Our confidence in the data used for habitat classification within the given cell is "Moderate to Low" and is based primarily on anecdotal information.	4
Our confidence in the data used for habitat classification within the given cell is "Low" i.e., there are no published and/or anecdotal information from which a habitat class can be assigned. In some instances the habitat classification will be an estimation derived from adjacent cells with known habitat information.	5

A

ENV_TYPE	DEPTH	EXPOS	HABITATS	HA	SECONDAY_H	SE	REFERENCE	CONFIDENCE	COMMENTS
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	1	Land present
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	1	
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	2	5% data unknown: based on nearby cells
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	2	Land present some data unknown
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	1	
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	2	10% data unknown: based on nearby cells
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	2	10% data unknown: based on nearby cell infor
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	2	5% data unknown: based on nearby cell
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	1	
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	1	
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	2	10% data unknown:data derived from nearby
Estuarine	Intertidal	Low	Mud flat	0		0	mud.polygon.shp	1	

B

ENV_TYPE	DEPTH	EXPOS	HABITATS	HA	SECONDAY_H	SE	REFERENCE	CONFIDENCE	COMMENTS
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	
Marine	Deep Subtidal	Low	Deep Sand	0		0	Doyle. A. C et al. (1979)	2	

Figure 2.4 Metadata examples (accessible in the GIS module) of MPA classifications for A) an estuarine intertidal area, and B) a marine deep subtidal area within the Bay of Plenty, north-eastern Bioregion. Key components evaluated were 1) Environment Type (ENV_TYPE); 2) Depth (DEPTH); 3) Exposure (EXPOS); 4) Habitat (HABITAT); 5) Secondary Habitat (SECONDARY_H); 6) Data Source (REFERENCE); 7) Confidence in data (CONFIDENCE); and, 8) Additional comments (COMMENTS).

3.0 Results and Discussion

3.1 Habitat Classification

The Bay of Plenty region is characterised by both estuarine and marine environments and the study identified a total of 15 MPA habitat classes; these varied considerably in spatial extent (percent cover) across the region (Fig. 3.1, Table 3.1).

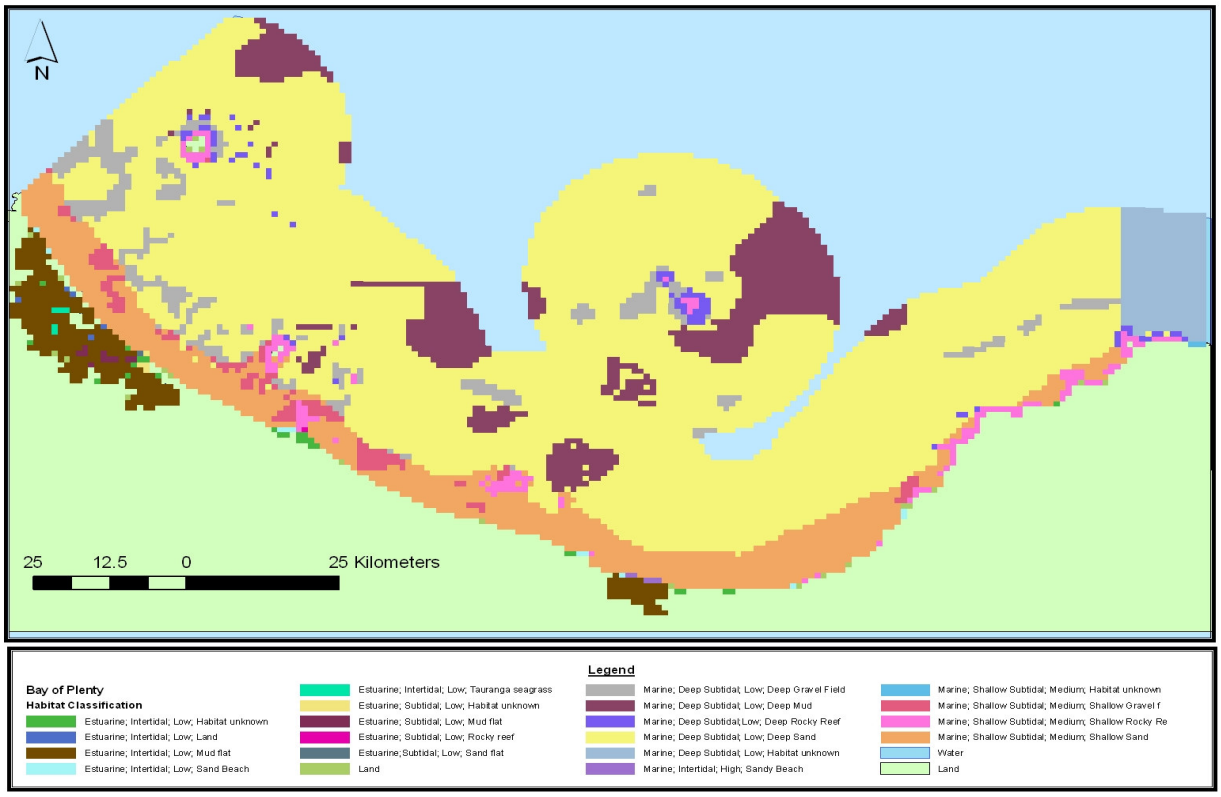

Figure 3.1. Classification of habitat classes for the Bay of Plenty region, as per the MPA classification protection standard and implementation guidelines.

Intertidal and subtidal estuarine areas such as Tauranga Harbour and Ohiwa Harbour, were dominated by mudflats, followed by sandy beach habitat (intertidal) and seagrass (Table 3.1). Minor habitats were subtidal sand flats and subtidal rocky reef.

Shallow subtidal regions (< 30 m depth – Medium Exposure) were characterised by extensive sand habitat (~ 80 % of the shallow subtidal area), interspersed with gravel and shallow rocky reef habitat (both ~ 10 % of the shallow subtidal area). Gravel fields were spatially dominant in the western Bay of Plenty shallow subtidal, with shallow rocky reef

forming a relatively continuous band along the coastline east of Opotiki out to Cape Runaway, as well as occurring in isolated patches in central and more-eastern areas of the BoP region (Fig. 3.1)

Common habitats in deeper subtidal regions (> 30 m depth – Low exposure) were sand, gravel patches, rocky reef and mud. Of these, sand was ubiquitous (~ 80 % of the deep subtidal), whereas mud habitat (~10 % of the deep subtidal) was spatially variable being abundant east of White Island, in the central BoP region and in the north-west tip of the survey boundary. Gravel patches occurred across the entire region accounting for around 5 % of the deep subtidal area, with deep rocky reef considerably lower in spatial extent (< 1 %).

Intertidal marine environments were dominated by sandy beach habitat (Table 3.1). This is unlikely to be an accurate representation of intertidal habitats across the BoP region, as due to the grain size used for analysis (i.e., 1 km^2), gravel beach habitat and rocky platform habitat could not be adequately represented. Additional information on the occurrence of intertidal habitats can be accessed in the attributes data in the GIS module.

Table 3.1 Percent cover and corresponding number of grid cells for estuarine (intertidal and subtidal) and marine (intertidal, shallow subtidal, and deep subtidal) environments across the Bay of Plenty.

Estuarine Habitat	**Percent Cover (total cells)**	
	Intertidal	Subtidal
Mud flat	87.6 (n=333)	62.5 (n=10)
Unknown	6.8 (n=26)	25 (n=4)
Sand beach	2.9 (n=11)	- -
Tauranga seagrass	1.3 (n=5)	- -
Land	1.3 (n=5)	- -
Rocky reef	- -	6.25 (n=1)
Sand flat	- -	6.25 (n=1)

Marine Habitat	**Percent Cover (total cells)**		
	Intertidal	Shallow Subtidal	Deep Subtidal
Sandy beach	100 (n=5)		
Shallow sand		78.9 (n=1164)	
Shallow rocky reef		10.9 (n=161)	
Shallow gravel field		10.0 (n=148)	
Unknown		0.3 (n=3)	4.0 (n=322)
Deep sand			79.4 (n=6491)
Deep mud			10.5 (n=862)
Deep gravel field			5.2 (n=424)
Deep rocky reef			0.9 (n=75)

3.2 Certainty/Confidence in Data

Confidence in data for the Bay of Plenty region was uniformly high (Fig. 3.2). Of the 10,073 cells assessed, 355 (or 3.5 %) were assigned as Low Confidence due to an absence of habitat-related information.

For the most part marine areas ranged from High Confidence (Rank of 1) to Moderate to High Confidence (Rank of 2). The same was true for estuarine regions, although subtidal estuarine habitats were ranked as Moderate Confidence (Rank of 3), due to limited information for some cells in this depth-class.

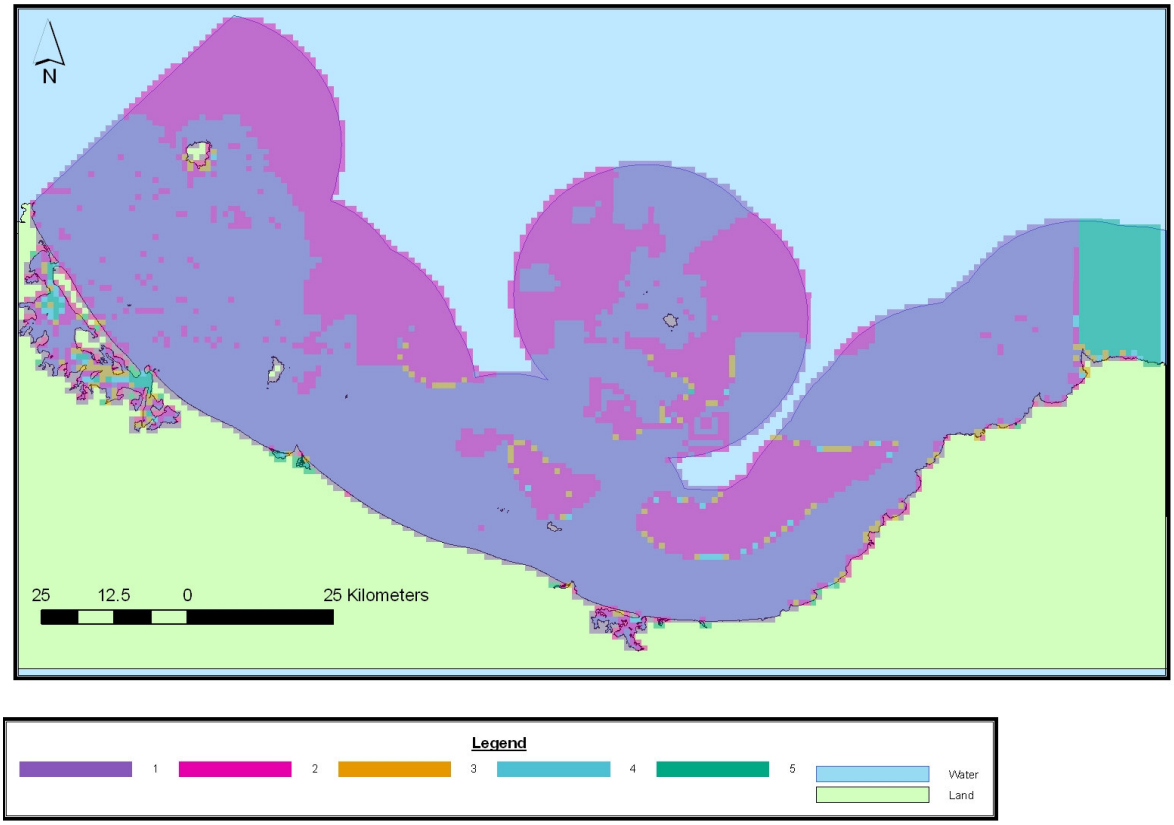

Figure. 3.2. Confidence levels for the Bay of Plenty region. Ranks of 1 (purple) equates to a high level of confidence, whereas ranks of 5 (green) equates to a low level of confidence. Refer to Table 2.1 for additional information.

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