Cawthron Report No. 782

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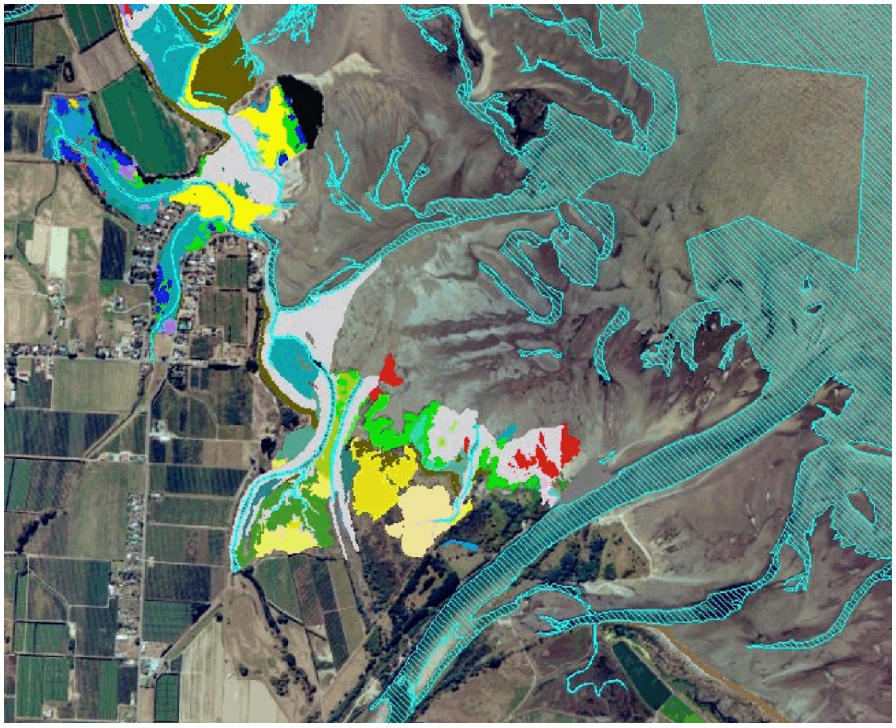
Broad Scale Mapping of Motueka River Intertidal Delta Habitats



Prepared for

Stakeholders of the
Motueka Integrated Catchment Management
(Motueka ICM) Programme

June 2003

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by

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Cover Photograph: An example of broad-scale habitat mapping using GIS, showing an aerial photograph of Motueka Estuary with some of the dominant substrates/habitats overlaid by ground-truthing

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This document is an accompanying report with the CD-ROM, Broad Scale Map of Motueka River Intertidal Delta Habitat

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1. INTRODUCTION

Estuarine intertidal and delta systems of large rivers are known to play an important role with regard to nourishment of coastal sea ecosystems. They can also encompass high-value ecological habitat and resources of cultural, recreational and/or commercial importance.

A detailed point-in-time, spatial description of major habitats of the Motueka River intertidal delta region was undertaken using a methodology known as broad-scale mapping. The results of this investigation are reported here as an output of the coastal component of the Motueka Integrated Catchment Management (Motueka ICM) Programme (FRST 2000-2002 Contract No. C09X0014). The report includes the following components:

- A CD Rom (called "Broad Scale Map of Motueka River Intertidal Delta Habitat" containing the completed habitat map (with enclosed Read Me File and copy of this Word document).
- A summary report (this document) which includes;
    - a methodology outline,
    - a map describing the general structural class distribution of habitats (e.g. rushland),
    - a map representing the pattern of dominant cover (e.g. *Leptocarpus similis*),
    - a summary table comparing the areas of major habitats,
    - a table providing the area and relative proportions of the habitat groupings and
    - a brief summary of results.

2. AIM

The aim of the broad-scale habitat mapping was to describe the intertidal environment according to different dominant habitat types based on surface features of substrate characteristics (mud, sand, cobble, *etc*) and vegetation type (mangrove, eelgrass, salt marsh species, *etc*), in order to develop a baseline map. Once a baseline map has been constructed, changes in the position and/or size of habitats (MfE Confirmed Indicators for the Marine Environment, ME6 2001) can be assessed by repeating the mapping exercise. This information can then be used to evaluate the implications of flood events (and ultimately land use characteristics and related river water quantity and quality) on the structure and function of the intertidal ecosystem. This procedure involves the use of aerial photography together with detailed ground-truthing and digital mapping using Geographical Information System (GIS) technology. An outline of the approach is provided in detail in Robertson *et. al*. (2002) and in summary below.

3. METHODS

3.1 Colour aerial photography

The photograph used for the Motueka estuary study was taken in June 2001 by New Zealand Aerial Mapping Ltd. and provided to us as a rectified tiff file at a scale of 1:10,000.

3.2 Classification of habitat features

The classification of the features follows the proposed national classification system (with adaptations), which was developed under a Ministry of the Environment SMF (Sustainable Management Fund) programme (Monitoring Changes in Wetland Extent: An Environmental Performance Indicator for Wetlands) by Lincoln Environmental, Lincoln. The classification system for wetland types is based on the Atkinson System (Atkinson 1985) and covers four levels, ranging from broad to fine-scale;

- Level I: Hydrosystem (*e.g.* intertidal river delta)
- Level II: Wetland Class (*e.g.* saltmarsh, mud/sand flat, macroalgal bed)
- Level III: Structural Class (*e.g.* marshland, mobile sand, cobble)
- Level IV: Dominant Cover (*e.g. Leptocarpus similis*)

Substrate classification was based on surface layers only and does not consider underlying substrate; e.g. cobble or gravel fields covered by sand would be classed as sand flat. A list of all the classification types used in the study and their codes are given in Table 1, followed by the definitions for classification of the Level III structural class.

Table 1 Adapted Estuarine components of UNEP-GRID classification

Level I Hydrosystem	**Level IA Sub-System**	**Level II Wetland Class**	**Level III Structural Class**	**Level IV Dominant Cover**	**Habitat Code**
River delta (alternating saline and freshwater)	Intertidal/ supratidal	Saltmarsh	Grassland	*Ammophila arenaria*, "Marram grass'	Amar
				Elytrigia pycnanph„ "Sea couch"	Elpy
				Festuca arundinacea, "Tall fescue"	Fear
				Paspalum distichum, "Mercer grass"	Padi
			Herbfield	*Apium prostratum*, "Native celery"	Appr
				Cotula coronopifolia , "Bachelor's button"	Coco
				Leptinella dioica	Ledi
				Plantago coronopus, "Buck's-horn plantain"	Plco
				Samolus repens, "Primrose"	Sare
				Sarcocornia quinqueflora, "Glasswort"	Saqu
				Selliera radicans, "Remuremu"	Sera
				Suaeda novae – zelandiae, "Sea blite"	Suno
				Triglochin striata, "Arrow-grass"	Trst

Level I Hydrosystem	Level IA Sub-System	Level II Wetland Class	Level III Structural Class	Level IV Dominant Cover	Habitat Code
			Reedland	*Glyceria maxima*, "Reed sweetgrass"	Glma
				Spartina anglica, "Cord grass"	Span
				Spartina alterniflora, "Smooth cord grass"	Spal
				Typha orientalis, "Raupo"	Tyor
			Rushland	*Baumea juncea*, " Bare twig rush"	Baju
				Isolepis nodosa, "Knobby clubrush"	Isno
				Juncus artoiculatus, "Jointed rush"	Juar
				Juncus effuses, "Softrush"	Juef
				Juncus kraussii, "Searush"	Jukr
				Juncus pallidus, " Pale rush"	Jupa
				Leptocarpus similis, "Jointed wirerush"	Lesi
				Wilsonia backhousei	Wiba
			Sedgeland	*Cyperus eragrostis*, "Umbrella sedge"	Cyer
				Cyperus ustulatus, "Giant umbrella sedge	Cyus
				Eleocharis sphacelata, "Bamboo spike-sedge"	Elsp
				Isolepis cernua, "Slender clubrush"	Isce
				Schoenoplectus pungens, "Three-square"	Scpu
			Scrub	*Avicennia marina var. resinfera*, "Mangrove"	Avre
				Cordyline australis, "Cabbage tree"	Coau
				Cytisus scoparius, "Broom"	Cysc
				Leptospermum scoparium, "Manuka"	Lesc
				Plagianthus divaricatus, "Saltmarsh ribbonwood"	Pldi
				Ulex europaeus, "Gorse"	Uleu
			Tussockland	*Cortaderia* sp., "Toetoe"	Co sp
				Phormium tenax, "New Zealand flax"	Phte
				Poa, "Silver tussock"	Poa
				Puccinella stricta, "Salt grass"	Pust
				Stipa stipoides, "Needle tussock"	Stst
		Seagrass meadows	Seagrass meadow	*Zostera sp*, "Eelgrass"	Zo sp
		Macroalgal bed	Macroalgal bed	*Enteromorpha* sp.	En sp
				Gracilaria chilensis	Grch
				Ulva sp, "Sea lettuce"	Ulri
		Mud/sandflat	Firm shell/sand (<1cm)		FSS
			Firm sand (<1cm)		FS
			Soft sand		SS
			Mobile sand (<1cm)		MS
			Firm mud/sand (0-2cm)		FMS
			Soft mud/sand (2-5cm)		SM
			Very soft mud/sand (>5cm)		VSM
		Stonefield	Gravel field		GF
			Cobble field		CF
		Boulderfield	Boulder field		BF
		Rockland	Rockland		RF
		Shell bank	Shell bank		Shell
		Shellfish field	Cocklebed		Cockle
			Musselreef		Mussel
			Oysterreef		Oyster
		Worm field	Sabellid field		Sabellid
	Subtidal	Water	Water		Water

3.3 Ground-truthing of habitat features

Field surveys were undertaken to verify photography, and identify dominant habitat and map boundaries. The approach involved an experienced estuarine scientist plus a technician walking over the whole estuary at low-mid tide during the period April-May 2002, identifying the dominant habitats and their boundaries and recording these as codes on aerial images at a scale of approximately 1:5,000 or 1:10,000. For the purposes of this intertidal survey, the upper boundary was set at MHWS (Mean High Water Spring), however in some areas supra-littoral habitat was included where it was considered integral with the upper intertidal. The lower boundary was set at MLWS (Mean Low Water Spring). The substrate types and their spatial extents were confirmed by field verification of the textural and tonal patterns identified on the aerial photographs. The codes and list of dominant habitat types, including various categories of bare and vegetated substrate, are shown in Table 1.

3.4 Digitisation of habitat boundaries

Vegetation and substrate features were then digitally mapped on-screen from the rectified photograph using the Arcview 'image analysis' extension. This procedure required using the mouse to draw habitat boundaries on the computer screen, as precisely as possible, around the features identified from the field surveys. Each drawing was then saved to a shape file or GIS layer associated with each specific feature. To calculate the area cover for a chosen habit type, the Arcview 'X-tools' extension was used. This provides the area of any selected features in hectares.

4. CLASSIFICATION AND DEFINITIONS OF HABITAT TYPES

4.1 Habitat codes and terminology

The identified vegetation patches were classified using an interpretation of the Atkinson system (Table 1), described below:

- The individual plant species have been coded by using the two first letters of their Latin species and genus names *e.g.* Pldi = ribbonwood, *Plagianthus divaricatus*.
- / separates canopy vegetation *e.g.* Pldi/Lesi (ribbonwood is taller than jointed wire rush).
- - separates vegetation with approximately the same height *e.g.* Lesi-Jukr (jointed wire rush is the same height as searush).

- ( ) are used for subdominant species *e.g.* (Pldi)/Lesi = dominant cover is jointed wire rush and subdominant cover is ribbonwood. The use of ( ) is not based on percentage cover but the subjective observation of which vegetation is the dominant or subdominant species within the patch.
- The classification always starts with the tallest vegetation type and works down *e.g.* (Pldi/Baju)/Lesi-Jukr = a patch with a dominant cover of jointed wire rush and searush (which are of the same height) with a subdominant cover of ribbonwood and *Baumea juncea* (which are taller than the dominant cover).

4.2 Definitions of classification Level III Structural Class

Cushionfield: Vegetation in which the cover of cushion plants in the canopy is 20-100% and in which the cushion-plant cover exceeds that of any other growth form or bare ground. Cushion plants include herbaceous, semi-woody and woody plants with short densely packed branches and closely spaced leaves that together form dense hemispherical cushions.

Herbfield: Vegetation in which the cover of herbs in the canopy is 20-100% and in which the herb cover exceeds that of any other growth form or bare ground. Herbs include all herbaceous and low-growing semi-woody plants that are not separated as ferns, tussocks, grasses, sedges, rushes, reeds, cushion plants, mosses or lichens.

Lichenfield: Vegetation in which the cover of lichens in the canopy is 20-100% and in which the lichen cover exceeds that of any other growth form or bare ground.

Reedland: Vegetation in which the cover of reeds in the canopy is 20-100% and in which the reed cover exceeds that of any other growth form or open water. If the reed is broken the stem is both round and hollow – somewhat like a soda straw. The flowers will each bear six tiny petal-like structures – neither grasses nor sedges will bear flowers, which look like that. Reeds are herbaceous plants growing in standing or slowly-running water that have tall, slender, erect, unbranched leaves or culms that are either hollow or have a very spongy pith. Example include *Typha, Bolboschoenus, Scirpus lacutris, Eleocharis sphacelata,* and *Baumea articulata.*

Rushland: Vegetation in which the cover of rushes in the canopy is 20-100% and in which the rush cover exceeds that of any other growth form or bare ground. A tall grasslike, often hollow-stemmed plant, included in the rush growth form are some species of *Juncus* and all species of*, Leptocarpus.* Tussock-rushes are excluded.

Sedgeland: Vegetation in which the cover of sedges in the canopy is 20-100% and in which the sedge cover exceeds that of any other growth form or bare ground. "Sedges have edges." Sedges vary from grass by feeling the stem. If the stem is flat or rounded, it's probably a grass or a reed, if the stem is clearly triangular, it's a sedge. Included in the sedge growth form are many species of *Carex, Uncinia,* and *Scirpus.* Tussock-sedges and reed-forming sedges (c.f. REEDLAND) are excluded.

Scrub: Woody vegetation in which the cover of shrubs and trees in the canopy is > 80% and in which shrub cover exceeds that of trees (c.f. FOREST). Shrubs are woody plants < 10 cm diameter at breast height (dbh).

Tussockland: Vegetation in which the cover of tussock in the canopy is 20-100% and in which the tussock cover exceeds that of any other growth form or bare ground. Tussock includes all grasses, sedges, rushes, and other herbaceous plants with linear leaves (or linear non-woody stems) that are densely clumped and > 10 cm height.

Examples of the growth form occur in all species of *Cortaderia, Gahnia,* and *Phormium,* and in some species of *Chionochloa, Poa, Festuca, Rytidosperma, Cyperus, Carex, Uncinia, Juncus, Astelia, Aciphylla,* and *Celmisia*.

Forest: Woody vegetation in which the cover of trees and shrubs in the canopy is > 80% and in which tree cover exceeds that of shrubs. Trees are woody plants ≥ 10 cm dbh. Tree ferns ≥ 10cm dbh are treated as trees.

Seagrass meadows: Seagrasses are the sole marine representatives of the Angiospermae. They all belong to the order Helobiae, in two families: Potamogetonaceae and Hydrocharitaceae. Although they may occassionally be exposed to the air, they are predominantly submerged, and their flowers are usually pollinated underwater. A notable feature of all seagrass plants is the extensive underground root/rhizome system which anchors them to their substrate. Seagrasses are commonly found in shallow coastal marine locations, salt-marshes and estuaries.

Macroalgal bed: Algae are relatively simple plants that live in freshwater or saltwater environments. In the marine environment, they are often called seaweeds. Although they contain cholorophyll, they differ from many other plants by their lack of vascular tissues (roots, stems, and leaves). Many familiar algae fall into three major divisions: Chlorophyta (green algae), Rhodophyta (red algae), and Phaeophyta (brown algae). Macroalgae are algae that can be seen without the use of a microscope.

Firm mud/sand: A mixture of mud and sand, the surface appears brown, and many have a black anaerobic layer below. When walking on the substrate you'll sink 0-2 cm.

Soft mud/sand: A mixture of mud and sand, the surface appears brown, and many have a black anaerobic layer below. When walking on the substrate you'll sink 2-5 cm.

Very soft mud/sand: A mixture of mud and sand, the surface appears brown, and many have a black anaerobic layer below. When walking on the substrate you'll sink greater than 5 cm.

Mobile sand: The substrate is clearly recognised by the granular beach sand appearance and the often rippled surface layer. Mobile sand is continually being moved by strong tidal or wind-generated currents and often forms bars and beaches. When walking on the substrate you'll sink less than 1 cm.

Firm sand: Firm sand flats may be mud-like in appearance but are granular when rubbed between the fingers, and solid enough to support an adult's weight without sinking more than 1-2 cm. Firm sand may have a thin layer of silt on the surface making identification from a distance impossible.

Soft sand: Substrate containing greater than 99% sand. When walking on the substrate you'll sink greater than 2 cm.

Stonefield/gravelfield: Land in which the area of unconsolidated gravel (2-20 mm diameter) and/or bare stones (20-200 mm diam.) exceeds the area covered by any one class of plant growth-form. The appropriate name is given depending on whether stones or gravel form the greater area of ground surface. Stonefields and gravelfields are named from the leading plant species when plant cover of ≥ 1%.

Boulderfield: Land in which the area of unconsolidated bare boulders (> 200mm diam.) exceeds the area covered by any one class of plant growth-form. Boulderfields are named from the leading plant species when plant cover is ≥ 1%.

Rockland: Land in which the area of residual bare rock exceeds the area covered by any one class of plant growth-form. Cliff vegetation often includes rocklands. They are named from the leading plant species when plant cover is ≥1%

Cocklebed: Area that is dominated by primarily dead cockle shells.

Musselreef: Area that is dominated by one or more mussel species.

Oysterreef: Area that is dominated by one or more oysters species.

Sabellid field: Area that is dominated by raised beds of sabellid polychaete tubes.

5. RESULTS

The broad-scale survey of intertidal habitats in the Motueka delta (see accompanying CD Rom for details) produced a total mapped area of 756 ha and indicated that this area is dominated by unvegetated habitat (70% of the total estuary area, covering 529 ha). Approximately one-third of the unvegetated habitat is classified as mobile sand (34.5% of the total area). The remaining unvegetated areas consist of a variety of habitats, the predominant of which is cobble field, firm mud/sand and soft mud/sand (14%, 9.5% and 8% of the total cover respectively) The vegetated habitats cover only 8.5% of the total estuary. Herbfield is the most abundant covering 26.5 ha (3.5% of the total area), of which *Sarcocornia quinqueflora* (glasswort) is the most dominant. Approximately 22 ha (3% of the total area) was classified as rushland. The majority of this was *Leptocarpus similis* (jointed wirerush) but there are also significant patches of *Juncus krausii* (searush). There is 10 ha of scrubland (1.5% of the total area) consisting entirely of *Plagianthus divaricatus* (saltmarsh ribbonwood). Oyster fields cover approximately 1% of the total area and sabellid fields cover approximately 0.5% of the total area. There are also minor areas containing macroalgal species, reeds and grasses. The broad scale map from which Figures 1, 2 and 3 are derived is included on the CD-ROM, Broad Scale Map of Motueka River Intertidal Delta Habitat.

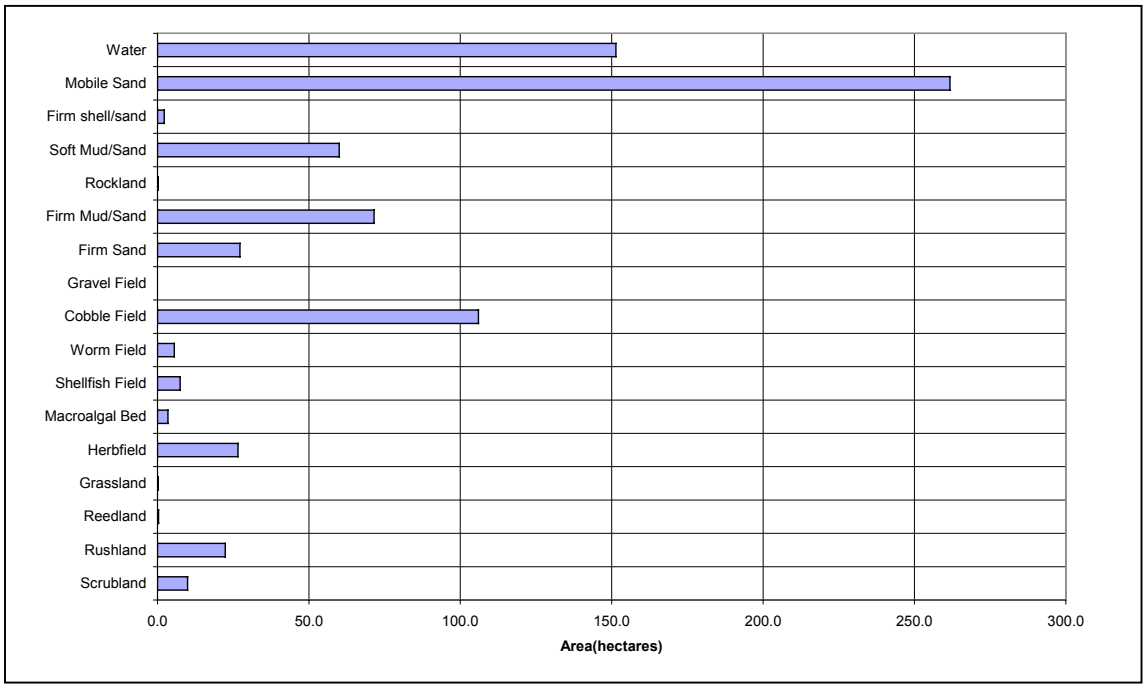

Figure 1 The areas of selected structural class habitats of the Motueka Estuary

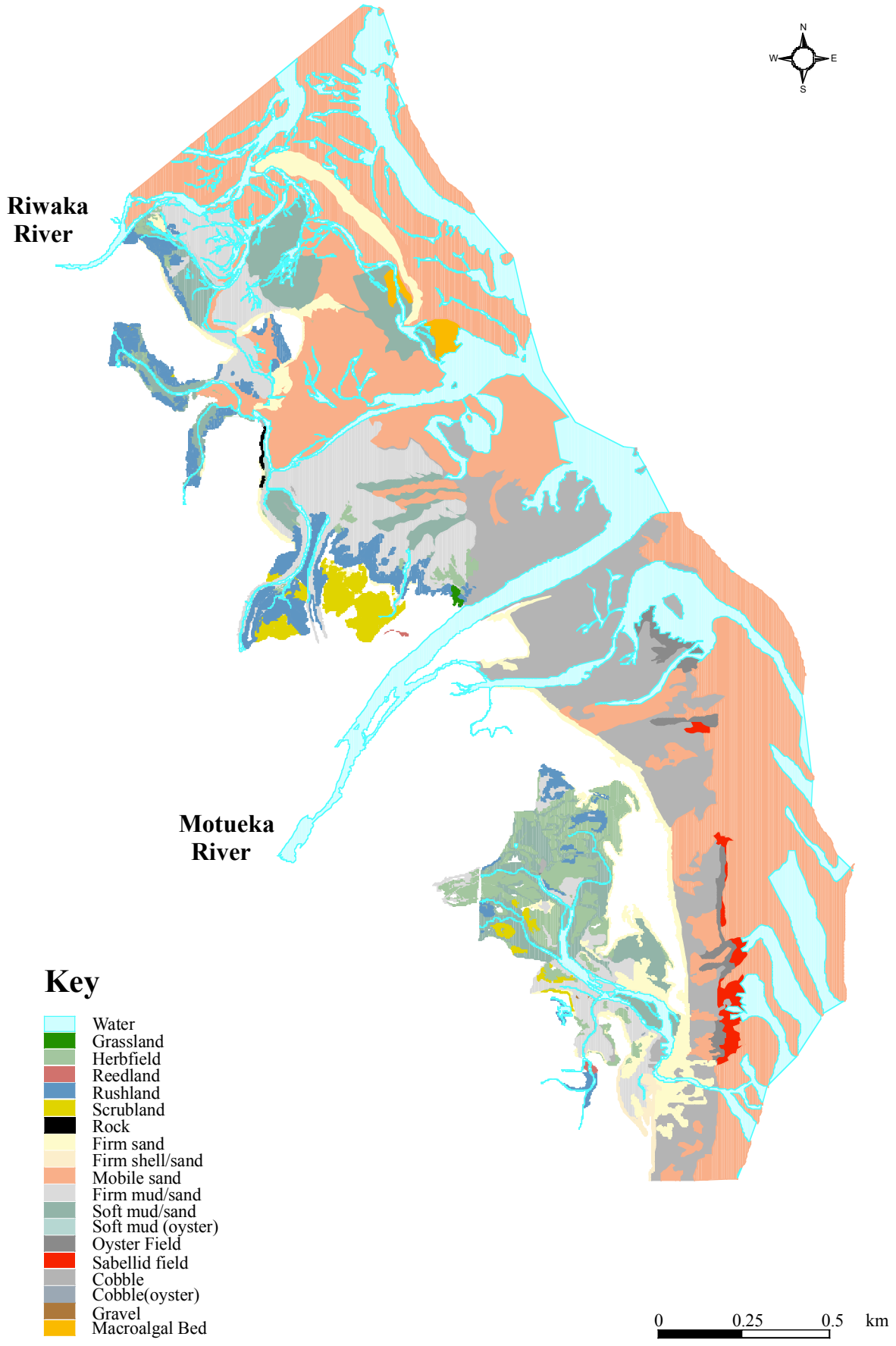

Figure 2 Structural habitat of the Motueka intertidal delta

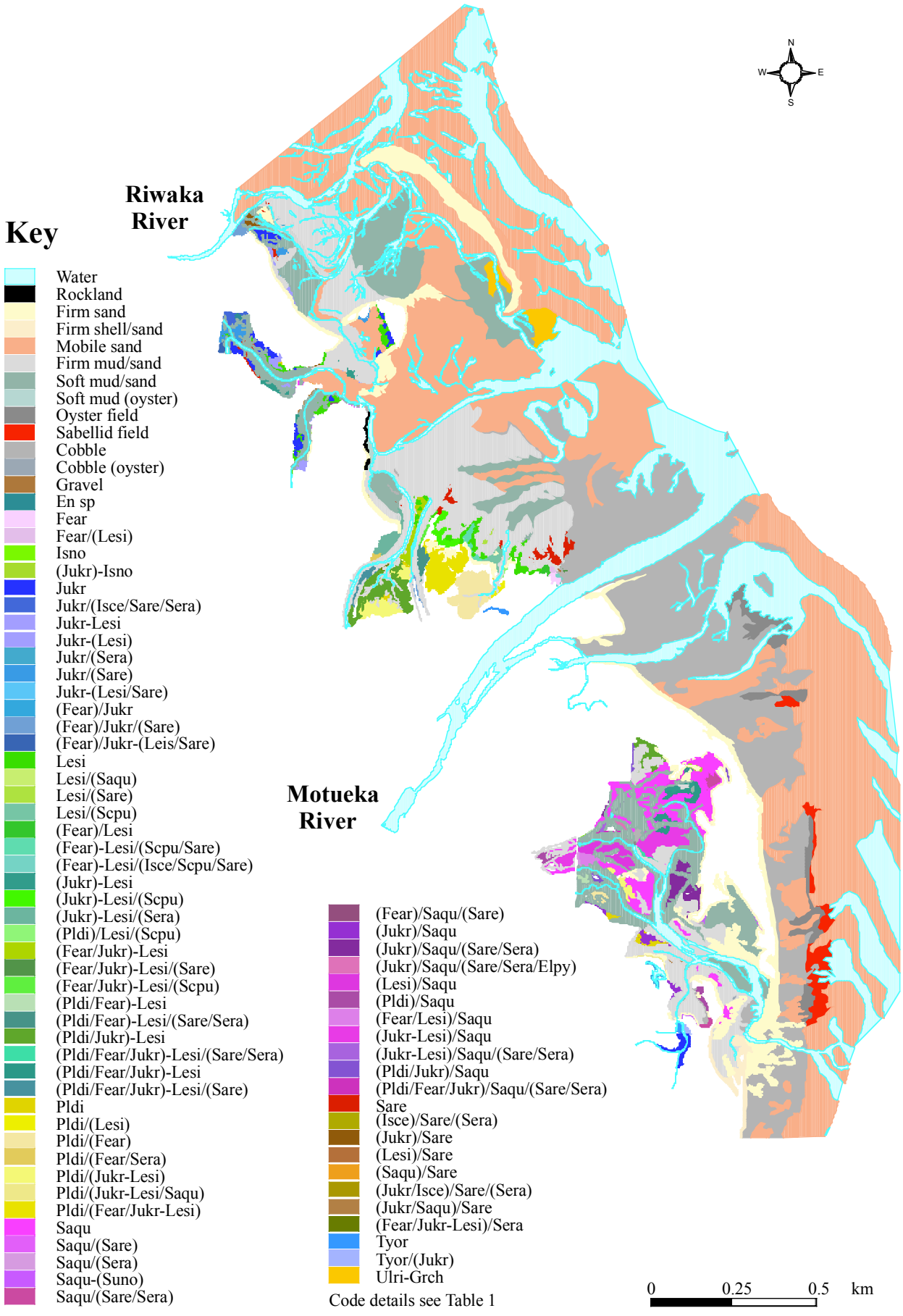

Figure 3 Dominant cover habitat of the Motueka intertidal delta

6. ACKNOWLEDGEMENTS

Thanks to Rod Asher for his help with the ground-truthing of the habitat features.

7. REFERENCES

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