

Estuarine Vegetation Survey - Kawhia Harbour

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1 Introduction

A 1997 pilot study of Whangamata, Wharekawa, and Otahu harbours determined that it is feasible to map vascular estuarine vegetation using aerial photography. The success of this work encouraged Environment Waikato to continue with this method. The estuarine vegetation of Tairua, Coromandel, Te Kouma, Manaia and Whitianga harbours were mapped in 1998 and 1999. Port Waikato, Raglan and Aotea harbours have recently been mapped in 2004 and 2005.

The vegetation mapped is in the Coastal Marine Area (CMA) and includes the spatial cover of mangrove, seagrass, sea meadow, and saltmarsh communities. The results of harbour surveys are included in Environment Waikato's Global Information System (GIS) database and are used for State of the Environment investigations and assessing consent applications that may affect estuarine vegetation.

This report details results from the estuarine vegetation survey of Kawhia Harbour. Comments are included on the threats to estuarine vegetation, and other field notes of interest.

2 Methodology

The survey was undertaken from the 25th – 31st January and the 23rd February 2005 using a combination of boat at high tide and boat and walking at low tide. The same methodology for mapping saltmarsh, mangrove, seagrass and weed communities was followed as that previously used to map East Coast estuaries (see Graeme, 1997, 1998a, 1998b, 1999).

A 1:10,000 scaled aerial map of the harbour was laminated and overlaid with another clear acetate sheet. Colour-coded lines were drawn on the overlay to define the spatial extent of wetland vegetation types and to allow transferral to GIS. These boundary lines were ground-truthed to establish their accuracy. The upper limit of the saltmarsh was determined by the upstream limit of oioi. Field notes were made of estuarine wetland characteristics and their vulnerability to threats. An estimation was made of historical estuarine vegetation extent where there had been infilling or drainage.

2.1.1 Wetland Vegetation Classification

For the purpose of this investigation, wetland vegetation species influenced by the tidal cycles were split into four groups: saltmarsh, mangrove, seagrass and weed communities.

1. **Saltmarsh** - a broad-species community in which three sub-communities are distinguishable. They are:
 - a) **'Rush community'** – this is generally sea rush (*Juncus maritimus* var. *australiensis*), oioi (*Apodasmia similis*), and on the West Coast three-square rush (*Schoenoplectus pungens*);
 - b) **'Saltmarsh ribbonwood community'** - this includes areas where rushes are interspersed with saltmarsh ribbonwood (*Plagianthus divaricatus*), giving a patchy appearance compared with the uniformity of the 'rush community'. Small areas of sea primrose (*Samolus repens*), remuremu (*Selliera radicans*), the silver tussock grass (*Austrostipa stipoides*), and glasswort (*Sarcocornia quinqueflora*) can also be present.
 - c) **'Sea meadow community'**, - this is devoid of tall plants such as rushes and saltmarsh ribbonwood, with the exception of silver tussock grass. The salt

meadow community includes sea primrose, remuremu, glasswort, and in more brackish areas bachelor's button (*Cotula coronopifolia*), leptinella (*Leptinella doica*), sharp spike-sedge (*Eleocharis acuta*), slender clubrush (*Isolepis cernua*), and arrow grass (*Triglochin striata*).

2. **Mangrove** (*Avicennia marina* var. *resinifera*) – this is usually a monospecific community although seagrass beds can sometimes be found below trees.
3. **Seagrass** (*Zostera* sp.) – this is usually a monospecific community.
4. **'Weed community'** - in the Waikato Region the most significant estuarine weeds are saltwater paspalum (*Paspalum vaginatum*) and cord grass (*Spartina* spp.). Both of these weeds grow in the open estuary, and trap sediment greatly increasing the harbour's infilling rate. These weeds also compete with the native wetland communities. Tall fescue (*Schedonorus phoenix*) is another grass that is common along the margins of estuaries although it is found above the spring high tide mark. Tall fescue was not mapped within this study as it is predominately a brackish-freshwater species.

3 Field Notes

3.1.1 Summary

The following observations give a general overview of estuarine vegetation in Kawhia Harbour (see Figures 1 and 2 for maps of the harbour).

- The main seagrass beds cover the wide open mid-tide harbour flats. These seagrass beds vary greatly in patchiness and plant density.
- Sea meadow communities were common as thin fringes along the upper arms of the harbour. Occasional larger patches of sea primrose are found amongst rush (e.g. the head of the Mangaora Inlet and the Oteke Stream mouth).
- Sea rush and oioi were present throughout the harbour with thin bands along open coastline and wide bands at the head of tidal arms. Three-square has a more scattered distribution and is concentrated around the town edge.
- Approximately 17 individual mangrove plants were found in the survey. These are scattered around the upper arms of the harbour.
- A significant estuarine and freshwater wetland complex includes the Tiritirimatangi Peninsula wetland, and the wetlands in the upper reaches of the peninsula's eastern arm and the Awaroa arm. Together these wetlands and associated coastal and swamp forest have high wildlife and vegetation value. Swamp forest is uncommon around the harbour.
- There is a wide diversity of estuarine vegetation and remnant freshwater wetland habitats up the Owhiro Stream arm including sea rush, oioi, seagrass, a mangrove, marsh clubrush, saltmarsh ribbonwood, sea primrose, remuremu Bachelors button, slender clubrush, sharp spike-sedge (*Eleocharis acuta*), raupo, and remnant manuka, kahikatea and mingimingi swamp forest. Apart from goats in the forest edges, this arm does not have a stock problem like other arms in the harbour.
- The outstanding limestone outcrops and the fenced banks with large patches of mature native forest (including some swamp forest) around the Rakaunui Inlet are very attractive. This area has potential as a community project to continue the riparian fencing and planting already started. Riparian retirement of wetlands and forest remnants will enhance wildlife habitat (a bittern was seen in the Inlet). Populations of spartina and saltwater paspalum are however a concern in this Inlet.

- Te Motu has a relatively intact silver tussock/rush wetland with large patches of sea primrose around the island's inlet edge. Other vegetation around the wetland edge includes manuka, mingimingi and flax as well as pines and lots of pampas. The restoration of this island's natural vegetatino would make a good community project.
- The south-western catchments of the harbour (west of Nathan Point) are covered in regenerating coastal and lowland forest. The bays generally have a narrow band of rush and/or sea meadow with small freshwater swamps (saltmarsh ribbonwood, manuka and flax) at the bays head.
- Stock access to the Coastal Marine Area (CMA) is a wide-spread problem and is degrading water quality and estuarine vegetation values.
- Goat browsing is a common problem in the coastal forest around the harbour.
- Spartina is scattered all around Kawhia Harbour. Large populations are found upstream of the Waiharake causeway and around the coastline to Pakingahau Point, and in the bay beside Lemon Point. Much of the spartina has been sprayed however many patches are showing signs of regrowth and many small patches had not been sprayed.
- Only 5 saltwater paspalum sites were found. The infestation beside the Tuapu Island causeway (Rakaunui Inlet) is spreading vigorously and has established thick mats which are competing with the rush.

Table 1 lists common estuarine and freshwater vegetation species found during the survey of Kawhia Harbour. The 'vegetation community' for the estuarine species corresponds to the colour codes on the corresponding acetate maps.

Table 1: Common estuarine and freshwater species of Kawhia Harbour.

Estuarine Species:

Common/Maori name	Scientific name	Mapped Vegetation Community
arrow grass	<i>Triglochin striata</i>	sea meadow
bachelor's button	<i>Cotula coronopifolia</i>	sea meadow
glasswort	<i>Sarcocornia quinqueflora</i>	sea meadow
leptinella	<i>Leptinella dioica</i>	sea meadow
mangrove	<i>Avicennia marina</i> subsp. <i>australasica</i>	mangrove
oioi	<i>Apodasmia similis</i> (= <i>Leptocarpus similis</i>)	rush/sedge
remuremu	<i>Selliera radicans</i>	sea meadow
saltmarsh ribbonwood	<i>Plagianthus divaricatus</i>	saltmarsh ribbonwood
saltwater paspalum	<i>Paspalum vaginatum</i>	weed
sea primrose	<i>Samolus repens</i>	sea meadow
sea rush	<i>Juncus krausii</i> var. <i>australiensis</i>	rush/sedge
seagrass	<i>Zostera novazelandica</i>	seagrass
silver tussock	<i>Austrostipa stipoides</i>	sea meadow
slender clubrush	<i>Isolepis cernua</i>	sea meadow
spartina	<i>Spartina</i> sp.	weed
three-square	<i>Schoenoplectus pungens</i>	rush/sedge

Freshwater Species:

crack willow	<i>Salix fragilis</i>
giant umbrella sedge	<i>Cyperus ustulatus</i>
manuka	<i>Leptospermum scoparium</i>
marsh clubrush	<i>Bolboschoenus fluviatililis</i>
mingimingi	<i>Coprosma propinqua</i>
pampas	<i>Cortaderia selloana</i> and <i>C. jubata</i>
raupo	<i>Typha orientalis</i>

3.1.2 Site Descriptions/Notes

The harbour is described clockwise from the True Right Bank (TRB) of the harbour mouth. See Figures 1 and 2 for maps showing site localities mentioned in this report.

Just inside the harbour entrance is **Te Ariaotewiwini Inlet** with some small patches of seagrass in the lower inlet channel. A patch of sea rush and oioi covers the NE corner of the inlet. There is also some three-square rush, sea primrose and arrow grass. The rush grades inland into marsh clubrush, and to the seaward side of the inlet into knobby clubrush (*Ficinia nodosa*), marram (*Ammophila arenaria*) and pampas.

The next estuarine vegetation encountered is the seagrass beds in an interrupted band along the beach toward the **marae and township**. Much of the town harbour frontage is armoured with hard structures. A three-square rush band begins at Tainui Street and runs north along the coastline. The seagrass patches that line the foreshore disappear around **Te Puru Point** just north of Tainui Street.

Sea rush and oioi replace three-square further out of town at the mouth of **Te Wharu Bay**. A patch of spartina was found by the creek on the southern boundary of the boat

storage site. A wilding phoenix palm was also noted north of the boat storage site. The rush is backed by freshwater swamp land that is dominated by willow and other weeds, as well as patches of raupo. A fernbird was heard in the saltmarsh ribbonwood at the back of this rush zone. Fernbirds were also heard in the saltmarsh ribbonwood lining old drainage channels in the rushland and in the nearby willow and raupo wetland of the upper western arm of the bay. A patch of mercer grass (*Paspalum distichum*) lines a drain and is creeping out over arrow grass and rushes. The back of the swamp is grazed and poorly fenced. Stock prints were found on the mudflats from **Orongahura Stream** to the head of the bay opposite **Kaiwhai Island**. An artificial broken concrete edge has been put in along the side of the Bed & Breakfast property. Wild grape was found on the island and the point opposite. The rush edge around the head of the bay is often backed by saltmarsh ribbonwood and then raupo, manuka, punga and willow. The road cuts the head of the **Manuwatuhatuha Stream** off from the rest of the bay; however the culvert seems sufficient to allow natural water circulation. A fernbird was also heard in the rushes in this embayment. The upper eastern arm of the bay has two spartina patches. One patch is very short and is growing up into the pasture (Figure 3). The farmed harbour edge has been fenced off except for shortcuts taken over the tips of the arm. This allows cattle to pug and graze the harbour edge. Scattered patches of rush line the eastern side of the bay with the creeping herb *Lilaeopsis ruthiana* and sand buttercup (*Ranunculus acaulis*) found along eroding edges. The western headland of the side bay and **Motutarakatau Pt** (Figure 4) have Mexican daisy along their cliffs. Rushes line this bay with scatterings of sea meadow and two raupo swamps at the head of the bay. Seagrass beds line either side of the stream at the mouth of Te Wharu Bay.

There is very little estuarine vegetation along the coastline from Motutarakatau Pt to the **Mangaora Inlet** causeway. The TRB headland upstream of the causeway has wattle and ginger amongst the regenerating scrub. Titiko and oysters cover the flats. Half way up the arm a fence in the estuary allows stock access to the foreshore (Figure 5). Eleagnus is found on the upstream edge of a regenerating kanuka block. The next bush fragment has honeysuckle and privet invading. The following farmland edge is not fenced along the harbour. Two patches of healthy spartina are found at the top of the arm – one either side of the stream (Figure 6). Large patches of sea primrose form a mosaic with the rush at the stream mouth and saltmarsh ribbonwood backs much of the rush at the head of the arm (Figure 7). Honeysuckle is found up here on the TLB. A fernbird was heard not far downstream. The farmland is fenced for the entire TLB with the exception of the flats in the homestead bay which has a fence out in the estuary. More eleagnus smothers the harbour edge downstream of the homestead bay. A small patch of spartina was found at the very tip of the side arm beside the causeway road.

No estuarine vegetation is found around the coast line from **Puhi Point** until nearer the head of **Kawaroa Bay**. Rushes line much of the bay, and around the stream mouth is a thin broken strip of saltmarsh ribbonwood, mingimingi, coastal shrub daisy (*Olearia solandri*) and manuka. A patch of spartina is present in the indent on the TLB of the bay. Some of the spartina is sprayed but there is also a patch of live spartina and pugged rush behind a fence. Around the point you pass **Ngatokakairiri Island** which has a lot of garden weeds. Generally, the land is farmed to the harbour edge so the thin band (due to topography) of saltmarsh ribbonwood/coastal shrub daisy/manuka that would be expected here is usually absent. Sparsely scattered rush is the only feature until the upper **Oparau River** where patches of glasswort were commonly found along steep banks, usually under the shade of trees. Two side arms on the TRB of the Oparau are lined with rush with a few totara on the banks. Entromorpha (green seaweed) beds were found up both arms. Further up the Oparau, just before the road bridge, are patches of seagrass. Above the road bridge small patches of oioi and sea meadow can still be found along the banks but peter out on the third bend upstream of the bridge. Saltmarsh ribbonwood on the bank opposite the two side arms is competing with gorse.

The arm SE of the Oparau is unfenced allowing cattle access to the harbour flats and freshwater wetlands. There are small areas of raupo around the arm as well as one small swampy gully with lake clubrush, manuka and willow. Around the point is a mangrove.

There is a significant wetland at the NE end of the **Tiritirimatangi Peninsula**. Oioi and sea rush is backed by marsh clubrush, saltmarsh ribbonwood, mingimingi, flax, tall fescue, raupo and manuka (Figure 8). This links around the causeway to an even larger wetland complex with an important bird roost. Approximately 60 New Zealand dotterel, 200 South Island Pied Oystercatchers, 150 stilts and 50 godwits were counted here. The rush zone is backed by a substantial saltmarsh ribbonwood and coastal shrub daisy band which grades into a manuka and mingimingi swamp. This wetland system links with a small lake. Unfortunately willow are spreading and dominating in areas. This peninsula would make a great restoration project. Stock have not been fenced from the harbour on the peninsula or causeway.

Te Kauri Stream arm immediately to the south east of the peninsula causeway has three different swamps at the upper end of the arm. Remnant coastal and swamp forest backs the raupo and marsh clubrush swamp along the edge of the main stream mouth (Figure 9). Further upstream at the top of the saltwater influence, the river bend flats on the TLB have scattered remnant kahikatea although these are within a paddock. A fernbird was heard in the lower TLB swamp. Further along on the TLB, old cars and rubbish has been pushed over a steep bank and down through pines to the harbour edge.

The **Awaroa Inlet** (Hauturu) upstream from **Uenukutuhatu Rock** has a small mangrove and some seagrass. As the Inlet narrows at its head, the estuarine rush margin is replaced by freshwater marsh clubrush on both banks. Forested edges, including a patch of cut-over regenerating bush, provide a natural backdrop to much of the arm. However, stock still have access to the harbour edge in places. The large river flats upstream are grazed. The southern headland of the Awaroa Inlet has the invasive *Robinia pseudoacacia* amongst the forest edge trees. There are also goats.

The small bay to the east of the Awaroa entrance has pampas taking over the pasture. The harbour edge is not fenced and there is severe pugging of the rushes and mudflats, and cow dung on the flats (Figure 10 and 11). There is a large mangrove which was in flower but no seedlings were found. Cows are also not fenced from the TRB of the neighbouring **Waikorere Creek** (Figure 12). This bay has two freshwater wetland areas backing the saltmarsh on the eastern side and the head of the arm. A fernbird was heard in each swamp. The wetland at the bay's head is the largest and contains marsh clubrush, raupo and manuka behind oioi and sea rush. The TLB of the bay is fenced hard along the harbour's edge so while there is no room for riparian vegetation to filter land run-off, at least the saltmarsh is undisturbed (Figure 13). **Mahoe Point** at the head of the Waikorere Creek bay has a large saltmarsh fringe backed by a manuka/ coastal shrub daisy /mingimingi freshwater swamp (Figure 14). These swamps provide a significant area of estuarine/freshwater wetland that supports fernbird, and potentially bittern and crake. With the proximity of the Tiritirimatangi Peninsula wetland, and the wetlands in the upper reaches of the peninsula's eastern arm and the Awaroa arm, the area has high wildlife and vegetation value.

Seventeen spoonbill were roosting on **Okehu Rocks**. Agapanthus, eleagnus and a purple flowered garden plant were seen around **Okehu Point**. Sea rush backed by raupo wetlands are found in the bays along the coastline towards Rakauni Inlet. These swamps and the coastline are not fenced from stock.

O Wiwi Ku Island has a scattered fringe of oioi, sea rush, saltmarsh ribbonwood, silver tussock, glasswort, sea primrose, and remuremu. Large fossil clams and brachiopods are found in the limestone rocks.

Large seagrass beds extend up to the islands at the mouth of the Rakaunui Inlet (Figure 15). Silver tussock and the native ice plant (*Disphyma australe*) were found on the island rock stacks. The tops of the ice plant were grazed, presumably by birds.

The TRB at the entrance to the **Rakaunui Inlet** has been fenced and planted with flax and cabbage trees. The outstanding limestone outcrops and the fenced banks with large patches of mature native forest are very attractive (good community project to continue riparian fencing for rest of the inlet). Near the first plantings of flax is some white-flowering agapanthus on a limestone outcrop (Figure 16). These have the potential to become a weed. The only other agapanthus site found was NE at Okehu Point (Tuaerere Bay). Before the **Devils Gap** is an embayment with 5 small mangrove trees and on the opposite side of the river is a much larger tree and a seedling. In total eleven mangroves were found in the Inlet. The oioi, sea rush and marsh clubrush of the upper arm of the **Tawairoa Stream** is backed by kahikatea and coastal forest (Figure 17). There are also mats of entomorpha present. Small patches of seagrass are found in a side arm of the upper **Rakaueke Creek**. A lot of dead kanuka was noted amongst the forest edge of the middle Rakaunui Inlet. Presumably this is caused by disease as they are unlikely to be sprayed as they are scattered through thick regenerating bush and no other vegetation has been killed (Figure 18). Oyster beds are present around the middle of the Inlet. A bittern was seen in a small arm two to the west of **Pukeinoi Arm**. The next arm (separating **Tuapu Island**) has a number of very small live infestations of spartina as well as three sprayed sites. On either side of the island causeway are patches of saltwater paspalum. This is the biggest infestation site in the harbour. Only 3 other sites were found throughout the harbour. Saltwater paspalum can be controlled with Gallant herbicide and so could be included in the spartina spraying programme.

Kaitawa Inlet is not fenced along the TLB but is along the TRB behind the coastal forest edge (Figure 19). There are three main areas of estuarine/freshwater wetland with the largest being around the mouth of the Kaitawa Stream (Figure 20). This wetland contains oioi, sea rush, marsh clubrush, and a small amount of saltmarsh ribbonwood, backed by flax, cabbage trees, manuka, raupo, pampas and willow.

The native ice plant was seen on the **Opeope Rocks** and eleagnus is present on the harbour edge opposite. The next small bay is not fenced from stock. At the head is a medium sized mangrove. Native ice plant grows on the limestone outcrops further around the point. **Arapatiki Bay** has an estuarine wetland edge backed by flax, manuka, kanuka and small patches of raupo. Towards the northern end of the bay is a patch of spartina which has invaded back into the rush. Nearby was a large areas of 'rooted' up rush which looked like pig damage (Figure 21). The forested headland of **Te Umuroa Point** has some healthy patches of regenerating forest. A small bay between Te Umuroa Point and **Pakingahau Point** has a large patch of saltwater paspalum (Figure 22). Sprayed patches of spartina, some large, are a feature along the indented coastline north of the Waiharakeke causeway. Stock are not fenced from the harbour in the arm enclosed by a pine headland and a small narrow peninsula with native regenerating bush. The bush edge further around has a sparse understorey indicating a goat browsing problem.

Upstream of the **Waiharakeke causeway** there are many large patches of spartina along the TRB of the **Owhiro Stream** arm. A smaller patch of spartina, upstream of the large sprayed patches, has not been sprayed (Figure 23). The farmland neighbouring these spartina patches has been fenced along its harbour edges with the exception that stock have access at the end of the headland where the farmland abuts native bush. A small mangrove is found downstream of this headland. There are another 8 unsprayed patches of spartina of varying sizes extending upstream from the bush patch. Akeake and kowhai are common in forest edge patches. Sea meadow species found along the TRB near the spartina patches include bachelor's button, leptinella, *Lilaeopsis ruthiana*, remuremu, sea primrose and arrow grass. Much of the TLB of the arm is lined by a significant block of regenerating coastal forest with thin

bands of rush. Where the harbour arm narrows, large beds of seagrass are found on either side of the channel (Figure 24). A mangrove is found on the TRB. The arm then winds upstream with scattered oioi lining marsh clubrush beds (Figure 25). A few saltmarsh ribbonwoods are also present. Bachelor's button, slender clubrush, and sharp spike-sedge (*Eleocharis acuta*) replace sea primrose and remuremu as the dominant sea meadow species. The swampy margins turn into marsh clubrush and raupo with remnant manuka, kahikatea and mingimingi swamp forest along the edge. Apart from goats in the forest edges, this arm does not have a stock problem like other arms in the harbour. There is a wide diversity of estuarine vegetation and remnant freshwater wetland habitats up the arm. Fencing of the few areas where stock can still access the harbour and stream edges, as well as goat control, will further enhance the health of the vegetation communities and their wildlife value.

A large patch of spartina has been sprayed in the small embayment cut off by the road near the **Waiharakeke** causeway. A mangrove tree is growing in a corner amongst the spartina. Further west a small patch of live spartina is tucked in the corner at the head of the small bay. There is more sprayed spartina along the side of the bay and out on **Paparoa Point**. A patch of saltwater paspalum was also found towards the point. A tiny patch of live spartina was found along the SW barren road edge south of Paparoa Point.

Rush and sea meadow line the road edge further into **Kinohaku Bay**. Montbrecia, eleagnus and a large sprayed patch of spartina are encountered before the causeway over the **Opounae Stream**. Rush, sea meadow and saltmarsh ribbonwood fill the embayment upstream of the causeway. Honeysuckle is invading the harbour edge and around the **Oteke Stream** mouth. The mouth of the Oteke Stream has relatively large patches of sea primrose amongst the rush beds (Figure 26). A small patch of unsprayed spartina was found just north of the hall. There is remnant harbour vegetation protected along TLB of Kinohaku Bay as a DOC reserve. Puriri, white rata, tawa and rewarewa were noted here. Stock access to the harbour margin is a problem for the rest of **Maire Point** and around to the **Huhutahi Stream** mouth. Sea rush and very small patches of oioi line the head of the Huhutahi Stream bay. There is some forestry in the catchment of these bays. This will be a future sediment source if permanent wide riparian margins have not be left along watercourses.

The harbour edge behind the rush and scattered saltmarsh ribbonwood becomes weedy around the settlement of **Te Waitere**. Weeds noted include ginger, chinese privet, pampas, banana passionfruit, montbrecia, eleagnus and grape.

Lemon Point bay (west of Te Waitere) was becoming dominated by spartina until DOC started an eradication programme. The majority of the large patches have died however there are scattered surviving plants that will need follow-up control (Figure 27). Sea meadow species found include sea primrose, remuremu, isolepis and native celery (*Apium prostratum*). Stock access to the upper arm is a serious concern (some of the worst stock damage to the harbour was noted here). The farming practise of not fencing the harbour margin is allowing cattle to regularly wander along the foreshore and over the flats. This is adding increased sediment and pathogens to the harbour, and pugging rush and seagrass communities (Figures 28, 29 and 30). Also the pugging and grazing of spartina dislodges fragments that can float away in the tide and establish new populations. Appropriate fencing is required to rectify this situation (similarly for other sites around the harbour where stock access is an issue). Heading north towards **Nathan Point (Ohaua)** there is very little estuarine vegetation along the harbour margin, however there are scattered patches of seagrass and a small patch of spartina out from an indented cove. Goats were seen around either side of Nathan Point.

Te Motu has a relatively intact silver tussock/rush wetland with large patches of sea primrose scalloping the island's inlet edge (Figure 31). There are a few small but thick-bladed patches of seagrass in the creek. Other vegetation around the wetland edge

includes manuka, mingimingi and flax as well as pines and lots of pampas. The restoration of this island's natural vegetation would make a good community project. The main objectives would be to remove the pampas (and probably the pines) and poison the rabbits and mustelids. Rabbits have been grazing spinifex on the harbour entrance side of the island and digging up the root bases of silver tussock.

The catchments west of Nathan Point are covered in regenerating coastal and lowland forest. Goats are a problem throughout as evidenced by heavy grazing of the coastal understorey. There is *eleagnus* west of Nathan Point and south along the edge towards **Rangitaiki Stream** mouth. There are scattered *spartina* patches towards the small arm west of Rangitaiki Stream, and a sprayed patch at the top of the arm. The middle of the next bay to the west (east of Heteri Point) also has three large *spartina* patches. A manuka and flax swamp extends up from the head of the bay. **Waikutakuta Inlet** also has a patch of *spartina* in the middle. Scattered rush and sea meadow continue along the coastline until a patch of *saltwater paspalum* is encountered at the southern end of **Ohineruru Bay**.

Scattered rush and sea meadow continue around **Totara Point** and into **Waipapa Point** Bay. Sea meadow is composed mainly of remuremu and silver tussock, as well as sea primrose and *isolepis* patches. A ngaio was found along the harbour edge as well as goat prints and dung, 4x4 tracks, cow pats and mustelid tracks on beach. A varied band of saltmarsh is found just north of the house up the eastern side arm which includes coastal shrub daisy, sea rush, saltmarsh ribbonwood, and sea meadow communities. A small patch of *spartina* is found directly in front of the house. At the head of the western side arm there are two small patches of *spartina*, an *eleagnus* patch by a derelict house, and sea meadow amongst rush (Figure 32). Rush lines the bay from **Waipapa Point** to **Onepoto Point** and peters out before **Torea Point**. A patch of *spartina* in front of a band of sea rush has been sprayed at the top of the Onepoto arm (Figure 33). *Eleagnus* was noted just before Torea Point.

The regenerating native bush surrounding these south western bays includes kanuka, kowhai, tree daisy, rewarewa and rimu with remnant mature puriri and rata. A lot of birds and fish were seen feeding in the bays.

Extensive **seagrass** beds cover the open harbour flats over an area from Te Maika across to Matatua Point, the middle of the harbour and around the mouths of the bays up to a line north of Puti Point, below Tiritirimatangi Peninsula and across to O Wivi Ku Island (Figure 34). Large flocks of swans (up to 100) were commonly seen on the seagrass beds.

3.1.3 Birds seen during the survey:

White faced heron, South Island pied oyster catcher, godwit, pied stilt, black backed gull, red billed gull, swan, Canada geese, spur-winged plover, New Zealand dotterel, spoonbill, kingfisher, pied shag, fernbird, paradise duck, Caspian tern, white fronted tern.

3.1.4 Weeds

Estuarine weeds

Spartina:

- The many sites are highlighted throughout the general text above.

Most of the *spartina* sites have been sprayed once, however only in a very few places have all the plants within a patch died. Follow-up spraying is essential. Further scattered patches have been noted that were not controlled during the first spray run.

Saltwater *paspalum*:

- causeway on western side of Tuapu Island (Rakaunui Inlet)
- small bay between Te Umuroa Point and Pakingahau Point (Owhiro Arm)

- SE of Paparoa Point (opposite Te Waitere)
- southern end of Ohineruru Bay

Weed species threatening the native harbour riparian vegetation:

- Agapanthus (only two wilding populations noted - Okehu Point (Tuaerere Bay) & TRB at the entrance of Rakaunui Inlet)
- Eleagnus
- Pampas
- Ginger
- Chinese privet
- Banana passionfruit
- Montbrecia
- Grape
- Willow
- Honeysuckle
- Mexican daisy
- Phoenix palm (only one wilding noted)

3.1.5 Unfenced harbour margins

The other main threat to the harbour is from land run-off and uncontrolled stock access to the harbour.

Unfenced farm margins along waterways do not provide a vegetation buffer that can absorb and filter the run-off from the land. This type of land management increases the level of sediment, nutrients and pathogens in the harbour.

Unfenced harbour margins also mean that stock have access to the harbour. Stock can physically damage the harbour vegetation by pugging sediments, sea meadow turfs and rushes (rush root bases are particularly vulnerable); and grazing mangroves, spartina and saltwater paspalum. The grazing of weed species can facilitate the spread of these weeds through trampling and dislodging fragments that can be washed away in the tide or by physically moving fragments lodged in hooves. Increased pathogens and sediment are a direct result of stock in the CMA due to stock defecation and the mobilisation of sediments.

Areas where stock access was noted as a problem:

- upper Te Waru Bay (western and eastern upper arms)
- middle and upper TRB of Mangaora Inlet
- arm SE of the Oparau River
- Tiritirimatangi Peninsula
- Parts of the Awaroa Inlet
- bay east of the Awaroa Inlet
- TRB of the Waikorere Creek bay
- Okehu Point to Rakauni Inlet
- TLB of the Kaitawa Inlet
- upper arms of the Rakaunui Inlet
- small bay just south of Opeope Rocks
- arm enclosed by a pine headland and a small narrow peninsula with native regenerating bush (north of the Waiharakeke causeway)
- small section along TRB of Owhiro Stream arm
- Maire Point (from DOC reserve) around to the Huhutahi Stream mouth
- Lemon Point bay (south-west of Te Waitere) to Nathan Point.

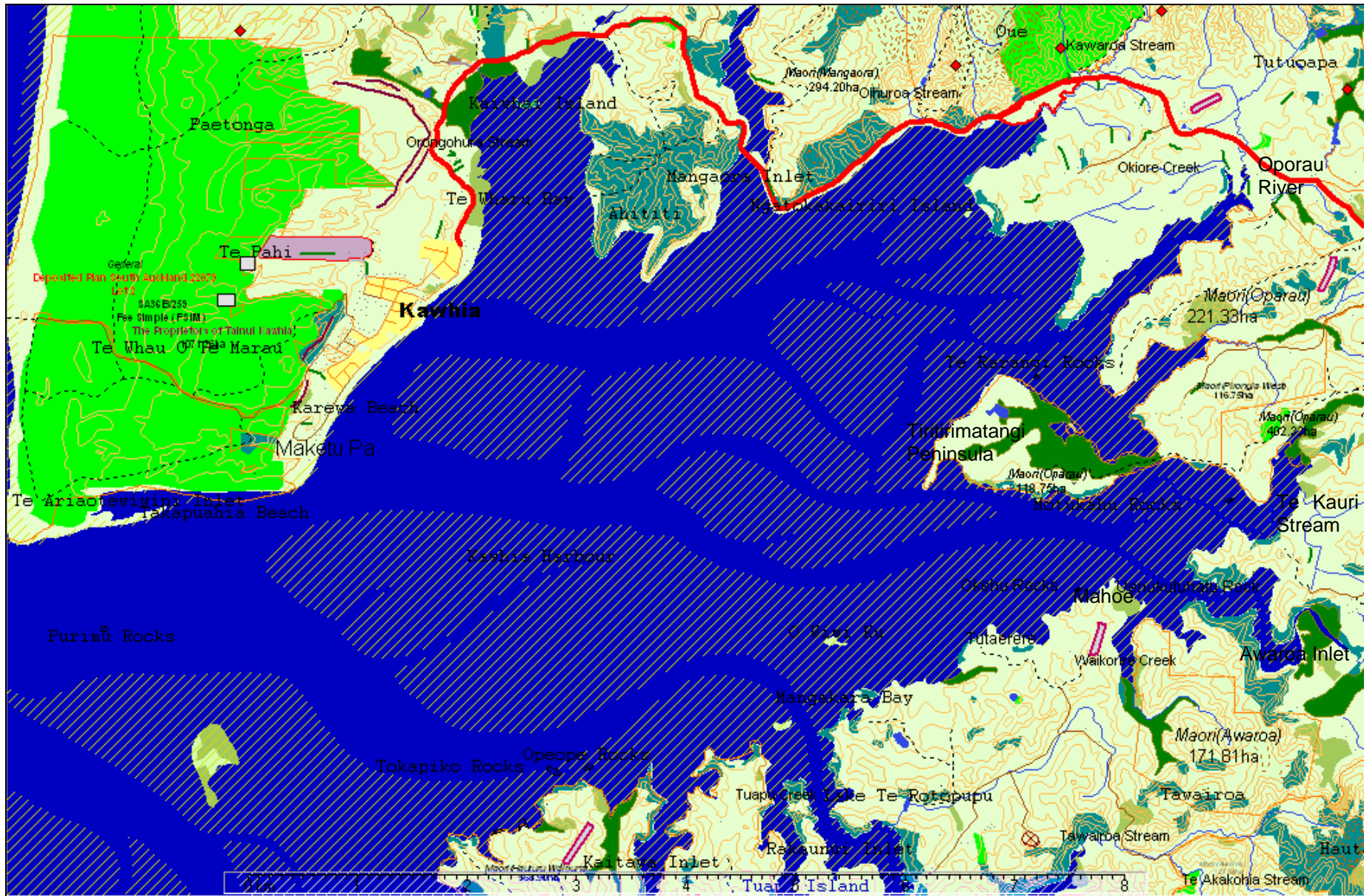


Figure 1: Site localities mentioned in this report

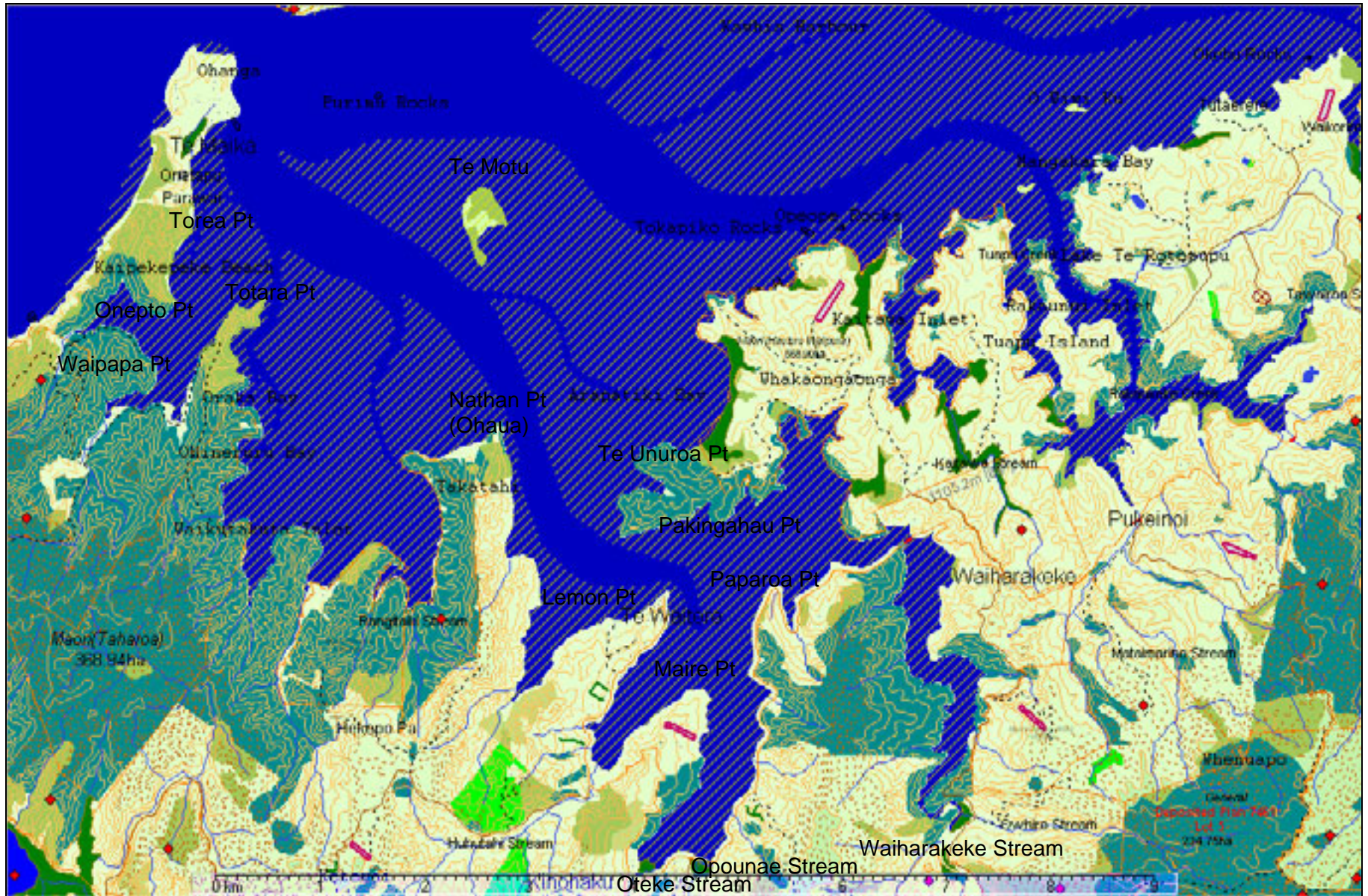


Figure 2: Site localities mentioned in this report.



Figure 3: Stock are not fenced from many parts of the harbour. This example is the upper east arm of Te Wharu Bay. The green circular patch of grass growing out into the estuary on the left of the picture is spartina. It is a vivid green where it extends out up into the pasture. 31/1/05



Figure 4: Motutarakatua Point looking back towards Te Wharu Bay. Mexican daisy has established on the cliff faces. 31/1/05



Figure 5: A fence line that allows stock into the harbour, Mangaora Inlet. Note the lack of rush and sea primrose inside the fence, and the riparian vegetation dominated by privet and barberry along this shoreline. 23/2/05



Figure 6: The vivid green patch is one of the two spartina populations at the head of the Mangaora Stream. Between the spartina and sea rush are beds of sea primrose. 23/2/05



Figure 7: An overview of the head of Mangaora Estuary showing sea rush grading into marsh clubrush upstream (to the left of the photo). There is scattered saltmarsh ribbonwood along the harbour edge behind the rush. 23/2/05



Figure 8: Looking from the significant Tiritirimatangi Peninsula wetland around to the wetland at the base of the causeway. This wetland complex is composed of oioi and sea rush backed by saltmarsh ribbonwood, coastal shrub daisy, marsh clubrush, mingimingi, flax, tall fescue, raupo and manuka. 29/1/05



Figure 9: Saltmarsh along the edge of the Te Kauri Stream inlet south-east of Tiritirimatangi Peninsula includes sea rush, oioi and three-square. Remnant coastal forest provides a natural backdrop to the harbour and buffers landuse effects on the harbour. 29/1/05



Figure 10: In the small bay between the Awaroa Inlet and the Waikorire Creek, a flowering mangrove in amongst a band of oioi has escaped grazing. The swamp clubrush in the middle-ground however is grazed and pugged and the harbour flats pugged. Cow pats were also found on the flats. Note the pampas taking over the pasture and the sprayed kanuka in the background. 31/1/05



Figure 11 Stock tracks through an oioi fringe along the side of the small bay between the Awaroa Inlet and the Waikorire Creek. 31/1/05



Figure 12: This is a example of poor land management. The True Right Bank (TRB) of the Waikorire Creek arm is not fenced and cattle wander through the saltmarsh and over the flats. Note the important riparian vegetation (kanuka and punga) has been sprayed but the invasive pampas (which is taking over the pasture) has been left unsprayed. 31/1/05



Figure 13 The TLB of the Waikorire Creek arm is fenced hard along the harbour edge. This means that the cattle do not have access to the saltmarsh and harbour flats but there is no room for riparian vegetation to filter land run-off including sediment, nutrients and pathogens. 31/1/05



Figure 14: Mahoe Point at the head of the Waikorere Creek bay has a large saltmarsh fringe backed by a manuka/ coastal shrub daisy /mingimingi freshwater swamp. 31/1/05



Figure 15: Seagrass beds extend up the harbour to the mouth of the Rakaunui Inlet. Silver tussock and the native ice plant are found on the limestone islands. 30/1/05



Figure 16: White agapanthus on the limestone cliffs at the mouth of the Rakaunui Inlet. 30/1/05



Figure 17: Scattered plants of oioi amongst the extensive marsh clubrush beds indicate the last of the saltwater influence up the Tawairoa Stream, Rakaunui Inlet. Remnant coastal forest provides a natural riparian edge around some of the Inlet. 30/1/05



Figure 18: An example of a good riparian strip up the Rakaunui Inlet. Note the dead kanuka amongst the kowhai, akeake and rewarewa. Silver tussock lines the intertidal edge. 30/1/05



Figure 19: Kaitawa Inlet is not fenced along the TLB but is along the TRB behind the coastal forest edge (shown here). 31/1/05



Figure 20: The upper eastern arm of the Kaitawa Stream. This wetland contains oioi, sea rush, marsh clubrush, and a small amount of saltmarsh ribbonwood, backed by flax, cabbage trees, manuka, raupo, pampas and willow. 31/1/05



Figure 21: Pig rooting at Arapatiki Bay. 23/2/05



Figure 22: Saltwater paspalum backed by silver tussock and sea rush in a small bay between Te Umuroa Point and Pakingahau Point. 23/2/05

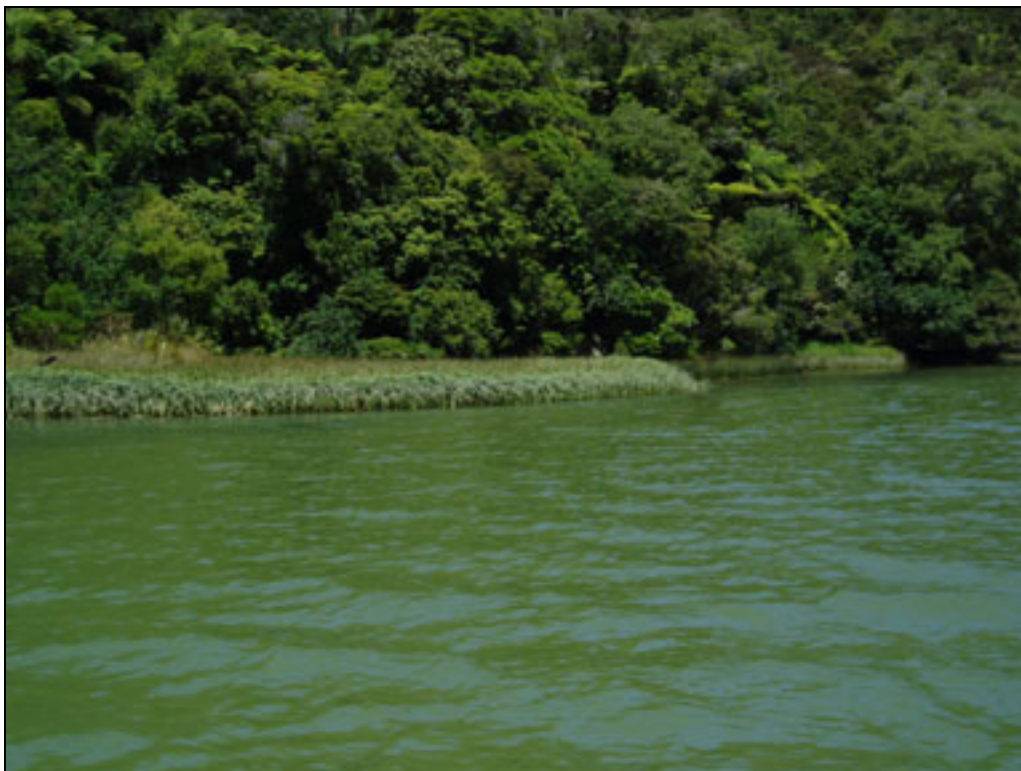


Figure 23: A small healthy patch of spartina upstream of the Waiharakeke causeway along the TRB of the Owhiro Stream arm. 27/1/05



Figure 24: Where the harbour narrows up the Owhiro Stream arm, large beds of seagrass are found on either side of the channel (dark patches in the water). 27/1/05



Figure 25: The upstream influence of saltwater is indicated by scattered oioi and saltmarsh ribbonwood edging the dominant marsh clubrush beds along the Owhiro Stream banks. 27/1/05



Figure 26: Relatively large patches of sea primrose are found amongst the sea rush at the Oteke Stream mouth (below the red roofed hall in the picture). 27/1/05



Figure 27: Sprayed spartina beds between Te Waitere and Lemon Point. A few scattered spartina plants are still alive and will require follow-up spraying. 27/1/05



Figure 28: Pugged sea meadow west of Te Waitere, TRB Lemon Point Bay. 27/1/05



Figure 29: Pugged harbour sediments and cattle dung, west of Te Waitere, TRB Lemon Point Bay. 27/1/05



Figure 30: Looking across the pugged TLB foreshore of Lemon Point bay to the forested Pukinghau Point (opposite Te Waitere). Note cattle dung in foreground of photo. 27/1/05



Figure 31: A small side arm of the wetland on Te Motu, dominated by silver tussock, sea rush and sea primrose. Pampas and pine are competing with manuka around the wetland edge. 29/1/05



Figure 32: Sea rush, sea meadow and saltmarsh ribbonwood at the head of the arm south of Waipapa Point. Species in the sea meadow are remuremu, sea primrose, arrow grass and leptinella. 26/1/05



Figure 33: Rush and sprayed spartina (in front of rush) up the top of the Oneopoto Arm. 26/1/05



Figure 34: Thick and sparse seagrass beds on the Kaipekepeke Beach flats. 26/1/05

Discussion

The same problems were encountered with the identification of seagrass beds in Kawhia Harbour as found in Aotea. Coarse and dark-coloured sediments made distinguishing seagrass beds difficult, as did the sometimes 'patchy' nature of the seagrass beds. The large spatial distances, undulating surface (shell banks, channel banks etc), coarse dark sediment, and varying patch densities makes determining the boundaries of seagrass beds extremely difficult. Small sparse patches of seagrass do not show on the aerial. Similarly, thin estuarine vegetation bands along the coastline were difficult to identify on the aerial maps and required physical mapping on the ground. This was confounded by the often steep harbour edge topography which could 'overshadow' the estuarine vegetation. The bed sediment characteristics, harbour edge topography, and often thin edge of estuarine vegetation together make the West Coast harbours less appropriate to map directly from aerial imagery. Rather, these West Coast harbours are mapped from the ground onto aerials, compared with the East Coast harbours where seagrass, mangrove and often rush boundaries can be mapped from the aerial with specific points checked on the ground.

It is recommended that 1:5,000 scaled aerial maps (as used for the Aotea Harbour survey) be routinely used in the future, particularly for West Coast harbours. This results in increased handling of maps in the field but easier identification of seagrass beds and thin rush bands.

The seagrass *Zostera* covers a large area of the harbour flats and provides a significant habitat for invertebrates and fish within the harbour. There is also a population of swans that feed on the seagrass. It is recommended that a watching brief be kept on swan numbers to ensure they do not escalate to densities that may be detrimental to the overall seagrass habitat.

All saltmarsh is significant in Kawhia Harbour due to its limited extent – primarily dictated by the harbour geology. Similarly all remaining freshwater wetlands/swamp forest that adjoin estuarine wetland are significant for their scarcity and habitat value and should be actively preserved and enhanced.

Generally, the bands of saltmarsh and sea meadow are usually only 0.5-1m wide along the coastal edge (which often rises steeply up into a band of coastal forest, gorse/pampas, or pasture). Therefore the thickness of the pen width means that this thin saltmarsh or sea meadow band is likely to be over-estimated.

Weeds are a significant threat to the health and integrity of the harbour's vegetation. The Department of Conservation is currently undertaking an aerial spraying programme in an attempt to eradicate spartina from Kawhia Harbour. On-going funding will be vital to this operation's success as 3-4 repeat sprays are likely to be needed to eradicate this competitive grass from the harbour. It is therefore recommended that Environment Waikato assist (politically and/or financially) the Department in obtaining the necessary long-term funding.

The other significant estuarine weed is saltwater paspalum. This invasive grass is only just starting to establish in Kawhia Harbour. The survey found only four patches of saltwater paspalum. Three patches are small and one patch is composed of a number of vigorous thick sub-patches. This grass has shown itself to be an aggressive spreader throughout the mid and upper tide zones (Graeme & Kendal, 2001). It particularly threatens low-stature sea meadow communities. These few pioneer populations of saltwater paspalum should be eradicated as soon as possible. This can be undertaken using gallant and so it would be a wise use of resources to co-ordinate the spraying of saltwater paspalum with the spartina control programme.

Access by stock to the harbour is a widespread and serious problem around the harbour. All farmers around the harbour need to be made aware of the detrimental effects their farming practises are having on the harbour and encouraged to fence their harbour margins as a priority. Another priority should be to help local community groups with a focus on the health of the harbour become active. There is potential for a similar project involving plant propagation, fencing and planting as that successfully used by the Whaingaroa HarbourCare Group. Figure 12 illustrates some of the unsustainable farming practises that are still used. These need to be addressed through education. In Figure 12 the highly valuable riparian vegetation has not been fenced and has instead been sprayed, but the invasive pampas (that is actively taking over the pasture and is a weed problem for riparian strips) has been left unsprayed.

The protective benefits of the regenerating coastal forest around the harbour edges is degraded by the grazing of the undergrowth by goats. Therefore encouragement should also be given to farmers to control goats on their property.

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