Environment Waikato Technical Report 2005/43

Estuarine Vegetation Survey - Aotea Harbour

Prepared by:
Meg Graeme,
Natural Solutions – Marine and Terrestrial Ecologists Ltd

For:
Environment Waikato
PO Box 4010
HAMILTON EAST

ISSN: 1172-4005

Document #: 1010795

Environment Waikato
REGIONAL COUNCIL

Peer reviewed by:
Malene Felsing Initials  Date July 2005

Approved for release by:
Peter Singleton Initials  Date July 2005

Table of Contents

List of Figures

List of Tables

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 Kawhia 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 the 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 Aotea Harbour. Comments are included on the threats to estuarine vegetation, and other field notes of interest. This study also produced a separate electronic vegetation map of Aotea Harbour.

Methodology

The survey was undertaken from the 24th – 27th 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 harbours (see Graeme, 1997, 1998a, 1998b, 1999).

A 1:5,000 scaled aerial map of the harbour was laminated and overlayed 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 vulnerability to threats. An estimation was made of historical estuarine vegetation extent where there had been infilling or drainage.

Wetland Vegetation Classification

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

    a) **Saltmarsh -** a broad-species community in which three sub-communities are distinguishable. They are:

    b) **'Rush community'** – this is generally sea rush (*Juncus maritimus* var *australiensis*), oioi *(Apodasmia similis),* and on the West Coast three-square rush *(Schoenoplectus pungens)*.

    c) **'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.

    d) **'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*), lepinella (*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.

Field Notes

Summary

The following observations give a general overview of estuarine vegetation in Aotea Harbour (see Figure 1 for a map of the harbour).

- The main seagrass beds cover a wide circle over the middle harbour flats. These seagrass beds vary greatly in their patchiness and plant density within patches (Figure 2).

- In the rush community, sea rush patches predominated over oioi, and three-square was often present in arcs on the seaward side of sea rush. Three-square patches do not usually show up clearly on aerial maps.

- The only 'large' area of sea meadow was found at the mouth of the Omaia Stream. Scattered thin bands of sea meadow were common, and included sea primrose, remuremu, segmented herb *Lilaeopsis ruthiana,* 'clover leafed' *Ranunculus acaulis*, slender clubrush, and arrow grass.

- Approximately 7 mangrove trees were found in the survey. Figure 11 shows a large mangrove near the mouth of Papatapu Stream that has seedling mangroves around it (in a spartina sward).

- A distinguishing feature of the Aotea Harbour estuarine vegetation is the frequent occurrence of coastal shrub daisy (*Olearia solandri*) edging the inland side of the rush zone (Figure 7). While some extensive bands of saltmarsh ribbonwood are also found in the harbour, the olearia seems to often replace saltmarsh ribbonwood in this back-swamp niche. Where significant areas of olearia are found they are noted, but not mapped as 'saltmarsh ribbonwood' community.

- The western side of the harbour (south-west of Pakoka Landing) has intact estuarine-freshwater wetland sequences (i.e. sea rush/oioi rushland – marsh clubrush/raupo/flax) with varying sized areas of freshwater swamp forest (cabbage tree/manuka), and extensive coastal forest (Figures 3-7). Goat browsing is seriously damaging the understorey regeneration of the coastal forest.

- There is a greater predominance of farming in the catchments of the eastern side of the harbour (see Figure 2). Estuarine-freshwater wetland systems are usually

modified by the effects of stock access, and freshwater swamp forest is rare The only notable site is the kahikatea/cabbage tree forest backing the wetland in Te Maari Bay.

- Spartina has colonised large areas on the northeast side of the harbour. Much of the spartina in Aotea Harbour is very short with scattered tall flowering plants along the edges of some patches.

- Saltwater paspalum was found scattered around most of the harbour edge, although usually only in small patches and generally concentrated along the eastern and southern side of the harbour.

Table 1 lists common estuarine and freshwater vegetation species found during the survey of Aotea 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 Aotea Harbour.

Estuarine Species:

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

Freshwater Species:

blue-green rush	*Baumea juncea*
cabbage tree	*Cordyline australis*
coastal shrub daisy	*Olearia solandri*
flax	*Phormium tenax*
kahikatea	*Dacrycarpus dacrydioides*
manuka	*Leptospermum scoparium*
marsh clubrush	*Bolboschoenus fluviatilis*
mingimingi	*Coprosma propinqua*
pampas	*Cortaderia selloana and C. jubata*
raupo	*Typha orientalis*

Site Descriptions/Notes

The harbour is described clockwise from the true-right bank (TRB) of the harbour mouth. See Figure 1 for a map showing site localities mentioned in this report. Figure 2 shows an overview of some of the seagrass beds that dominate the central open flats.

The first estuarine vegetation around the coastline is found in the lagoon at **Koroa Bay** below the sand dunes. Sea rush and sea primrose, as well as marsh clubrush and

raupo line the lagoon. This native vegetation in the lagoon is being taken over by spartina and saltwater paspalum.

The main seagrass beds start around **Rauiri Head**. There is also an extensive estuarine wetland at Rauiri Head which extends up between thin ridges of manuka, blue-green rush, knobby rush (*Ficinia nodosa*), and pampas. The upper estuarine wetland has sea rush edged by oioi and blue-green rush (Figure 3), and this grades into the lower wetland which is dominated by sea rush fringed with saltmarsh ribbonwood. Fernbirds were heard here, and mustelid footprints seen.

Around into **Motutere Island Bay** there is a cabbage tree swamp fringing the southern shore (Figure 4). Pasture interrupts the forest sequence further into the bay before the sea rush edged by saltmarsh ribbonwood extends inland into raupo and manuka/cabbage tree/flax swamp. A fernbird was heard in this swamp. There is a similar swamp in the northern indent of the bay. Cattle prints were seen in the peaty mud. They may have come from the northern farmland where only a single wire fence borders the harbour margin in varying states of repair.

Moving north out of Motutere Island bay, harbour edge weeds (eleagnus, privet, and wattle) were found near derelict buildings. Back in the forest edge goats were seen. Further north-east towards **Piritoka Point**, relatively wide (for West Coast harbours) bands of rush edge large and small gullies of raupo/flax/cabbage tree/manuka swamp (Figures 5 & 6). Just before Piritoka Point bay, stock have had access to the harbour and have damaged the rush edge. At this site there are also patches of saltwater paspalum, which beg the questions: Are stock bringing the saltwater paspalum in? Is saltwater paspalum preferentially colonising ground disturbed and opened up by stock? Coastal shrub daisy and flax back a small bay between Piritoka and **Te Pahi Point**. Coastal shrub daisy also edges the rush at a small lagoon behind a sand spit at **Te Puhi Point** (Figure 7).

Moving around **Te Heru Point** and up towards **Pakoka Landing**, a forest of akeake, kanuka and kowhai lines the estuary arm. Spartina is present on the TRB upstream of **Ohiawhakainga Creek**. Patches of sea meadow are found at the mouth of the **Motakotako Creek** in front of the rushes. The saline influence on the vegetation finishes just upstream of the road bridge at Pakoka Landing. Moving downstream on the true-left bank (TLB) are bands of saltmarsh ribbonwood with marsh clubrush and raupo wetland behind. Small patches of seagrass are found on the mud flats around the corner where the river widens out. The farmland is not fenced along the TLB and stock access is potentially a problem. A mature (~10 years?) flowering mangrove is upstream of **Karetoto Island** (Figure 8). A small patch of saltwater paspalum is found immediately opposite the island.

A patch of seagrass lies behind the oyster bank at **Mowhiti Point**. The harbour edge is lined by a thin band of rush. Figure 9 shows a small area of sea meadow on an eroding bank within this thin rush zone.

Large patches of spartina have established around the sandspit west of **Kainamunamu Stream** and along to **Papatapu Stream** (Figure 10). The stream mouths are now full of spartina with rush along the landward edge. It was unclear whether the Kainamunamu Stream banks were fenced, but the Papatapu Stream mouth was not fenced from stock. The island at the mouth of the Papatapu Stream has introduced African iceplant, a scrambling rose and yucca on it. Opposite the island is a mature mangrove with a number of seedlings near it amongst sparina (Figure 11). More spartina is found further around towards **Ruaaweke Point** and around the shoreline of **Te Maari Bay**.

Te Maari Stream mouth has grazed land with remnant kahikatea and kowhai on the TLB, with marsh clubrush, raupo, tall fescue, giant umbrella sedge (*Cyperus ustulatus*), mingimingi, manuka, and reed sweetgrass (*Glyceria maxima*) on the TRB and further

downstream on the TLB. Seagrass is found up the 'un-named stream' arm of the bay (in the **Pourau Stream** side arm). The TRB of the 'un-named stream' mouth has scattered oioi thinly lining the marsh clubrush and raupo wetland, with kahikatea and cabbage tree forest grading into remnant coastal forest along the road edge. The grazed flats just upstream on the TLB would have supported similar kahikatea and cabbage tree swamp forest. On the inside of **Tikitiki Point** is a patch of saltwater paspalum.

Two patches of spartina were found around the coast in the next bay. One of the patches is quite small and up near the mouth of the **Kaingata Stream**. Stock tracks were noted leading from the regenerating forest to the larger spartina patch further out. The farmland in this bay is not fenced from the harbour. The headlands either side of the **Te Kopua Stream** bay is poor grazing land with a patchwork of regenerating forest cover (the undergrowth is grazed). Much of the bay's edge is lined by wide bands of rush. The head of Te Kopua Stream narrows into a thick rushland with saltmarsh ribbonwood lining the stream and forest edge at the head of the estuary.

Six spoonbill herons were seen on the **Motukotuku Rocks**. Silver tussock and the native iceplant (*Disphyma australe*) were roosting on these rocks.

The coastline south of the Motukotuku Rocks and around along the TRB of the **Omaia Arm** is backed by forest (kanuka, broadleaf, mahoe, nikau, karaka, kowhai and akeake). It generally has a thin rush edge with scattered small areas of sea meadow (usually silver tussock) and a patch of saltmarsh ribbonwood. The head of the arm has a large patch of sea primrose and 4 mangroves backed by rushland (Figure 12). The rush grades into a large marsh clubrush and raupo wetland further upstream with saltmarsh ribbonwood edging the stream. The saltmarsh ribbonwood grades into mingimingi past a whitebait stand (Figure 13). Moving out of the bay a thicker band of rush edges the inner true-left side of the bay. The rush band then thins towards the outer bay and a couple of patches of saltwater paspalum were found here.

The harbour edge is not fenced around **Ohau Point**, along the coast to the south and around into the TRB of Matakowhai Bay. Stock damage to the harbour is evident at the heads of the small embayments (Figure 14 & 15) and along the entire true-right side of Matakowhai Bay from Te Ruakotare Point. The thin line of large pohutukawa fringing the edge have little regenerating vegetation underneath and so no replacement trees are establishing (Figure 15). An additional threat here is possums targeting and killing specific trees as evidenced by scattered dead pohutukawa. Saltwater paspalum is common south of Ohau Point to past Matakowhai Point, particularly at the head of **Pukerau Stream** (Figure 14). A small patch of short spartina mixed with saltwater paspalum was found in the embayment immediately south of Ohau Point (Figure 16).

The TRB of **Matakowhai Bay** has extensive rush and saltmarsh ribbonwood communities. Remuremu, glasswort, sea primrose, slender clubrush and buck's horn plantain are found in thin bands along the seaward edge of the rush, while scattered patches of saltwater paspalum are found along the seaward edge and middle of the rush zone. The TRB of the bay is generally unfenced and many cattle footprints (and poo) and cattle bones were found along the harbour edge. In contrast the TLB of the bay (south of the stream) is mostly fenced except where the straight fence lines cut across embayments in the coastline. These unprotected embayments are pugged and grazed. Further south along the open harbour edge the seagrass beds extend closer into the shore. More possum-damaged pohutukawa were noted here.

Cotoneaster is a problem weed along the TRB cliffs of **Okapu Bay**. A mix of saltmarsh ribbonwood, rushland and sea meadow exists at the eastern head of the estuary however stock access is a problem in this area (Figure 17). Saltwater paspalum was found near the end of the small peninsula sticking out into the southern Okapu embayment. Towards the Aotea Road intersection there has been rubbish dumped off the road into the harbour. Another patch of saltwater paspalum was found near the

intersection. Above the Aotea Road intersection there is a perched embayment. The tidal flux has been modified by the road culvert so that the embayment drains (and presumably fills) much slower than the rest of the harbour (Figure 18). The next embayment crossed by the Aotea Road to the west is predominately filled with rush with some saltmarsh ribbonwood around the edges and along the upper stream channel. There is also spartina either side of the road embankment here. The thick band of rush (Figure 19) grades from the road around into a thinner rush band backed by saltmarsh ribbonwood at the north-east tip of **Kakawa Point**. A small mangrove was found within the rush band. Further around the point towards the road saltwater paspalum occurs frequently amongst the rush. A car and other rubbish have been dumped near the harbour side beside the house.

Upstream of the road, rushland is constricted by drainage of **Te Kowiwi Creek** (and the road culvert). Bachelor's button grows thickly in the main drain and a number of saltwater paspalum patches are present. A fernbird was heard here. The high tide line from the head of the bay to **Tahuri Point** is used by vehicles. The rush zone is thickest towards the head of the bay (and the road) and has scattered bands of saltmarsh ribbonwood behind. Saltwater paspalum becomes common amongst the rush along the edge towards Tahuri Point (Figure 20).

Birds seen utilising Aotea Harbour during the survey

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

Weeds

Spartina locations:

- North side of Motutere Island Bay
- Upstream of Ohaiwhakainga Creek (Pakoka Landing)
- Common between Kainamunamu Stream and Te Maari Bay
- Kaingata Stream
- Small embayment south of Ohau Point
- Western arm Okapu

Saltwater Paspalum locations:

- Korua Bay
- South Piritoka Point Bay
- TLB opposite Karetoto Island (Pakoka Landing)
- Tikitiki Point – Te Maari Bay
- Ohau Point – past Matakowhai Point (particularly Pukerau Stream)
- Southern Okapu Bay
- Aotea road intersection
- Kakawa Point – Tahuri Point

Weed species present on the harbour edge:

- African iceplant
- Cotoneaster
- Eleagnus
- Pampas
- Privet
- Tall fescue
- Wattle
- Yucca

Riparian management and stock access

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

The other main threat to the harbour is from stock directly accessing to the harbour. Stock physically damage the harbour vegetation by pugging sediments, sea meadow turfs and rushes (rush root bases are particularly vulnerable); and by 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 sedimentation in the harbour are a direct result of stock access into the harbour where they defecate and mobilise sediments.

Areas where stock access is noted as a problem in the site descriptions above include:

- The head and northern side of Motutere Island Bay (N2669917 E6356120 – N2669886 E6356671)
- South Piritoka Point Bay (N2670294 E6358893)
- Papatapu Stream (N2674503 E6360043)
- TLB Kaingata Stream (N2675260 E6357880)
- Ohau Point to Matakowhai Bay (N2673786 E6355449 – N2673037 E6352578)
- Okapu Bay (N2672533 E6351850)

Other issues

Other identified issues include a whitebait stand up the Omaia arm with a swing gate for the whitebait net that seems to stretch across the entire waterway, rubbish dumping (N2674433 E6351160, N2670639 E6352356), and vehicle access (Tahuri Point to Te Kowiwi Creek causeway, and Opaku Bay).

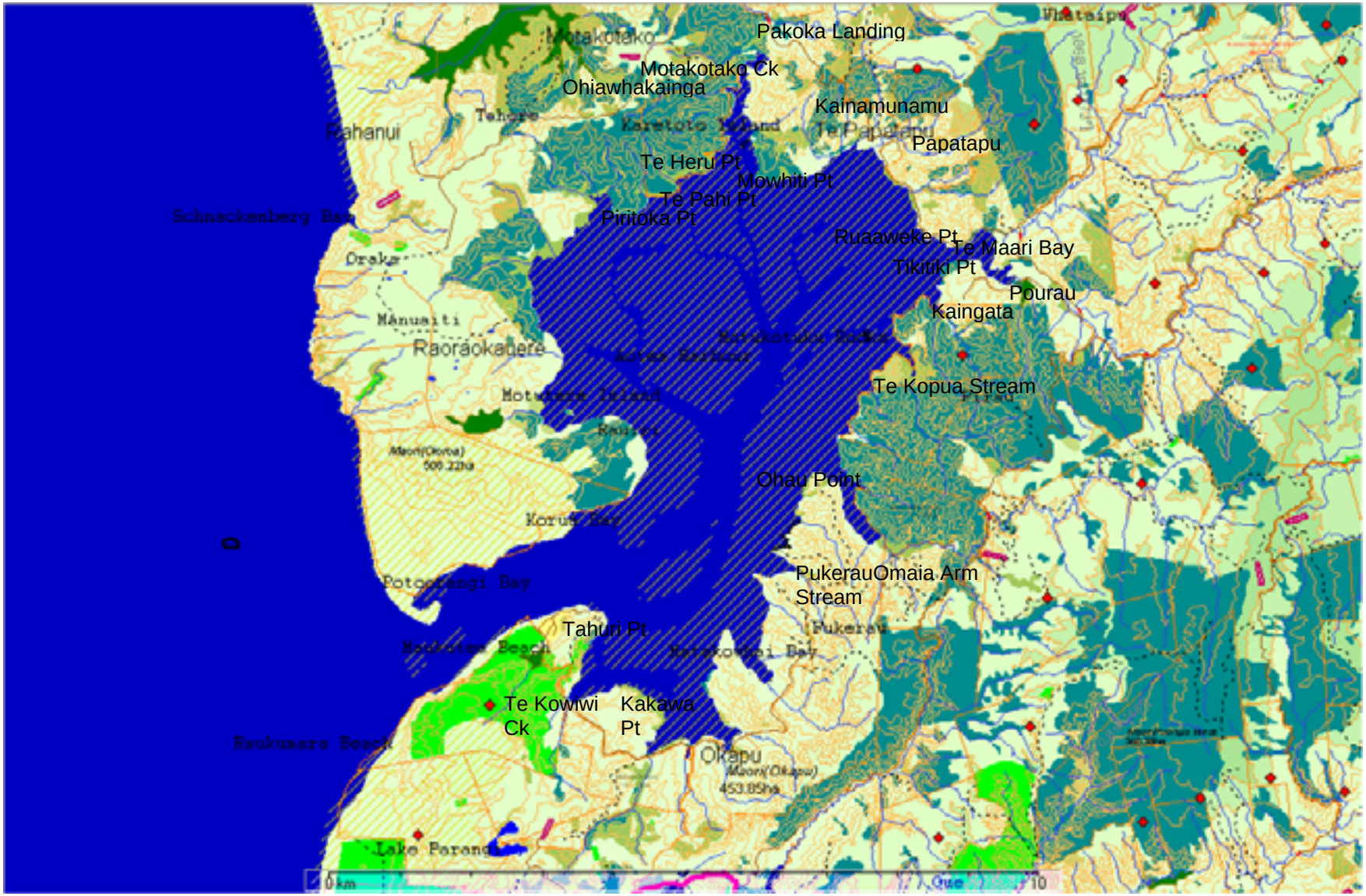

Figure 1: Aotea Harbour.

Figure 2: **A view from Tahuri Point over the seagrass beds towards the farmed catchment between Ruakotare Point and Okapu. Note the spatial patchiness of the seagrass beds. 26/2/05**

Figure 3: **A view through a narrow ridge of manuka/knobby clubrush to the upper reaches of one of the sea rush/oioi/Baumea arms at Rauiri Head. 24/2/05**

Figure 4: **On the southern side of Motutere Island bay the saltmarsh edge grades into cabbage tree swamp and then into kanuka forest . 24/2/05**

Figure 5: **Saltmarsh backed by freshwater wetland (marsh clubrush/raupo/flax/cabbage tree) and coastal dune forest south-west of Piritoka Point. 24/2/05**

Figure 6: Saltmarsh backed by freshwater wetland (marsh clubrush/raupo/flax/cabbage tree) and coastal dune forest South-west of Piritoka Point. 24/2/05

Figure 7: Te Puhi Point lagoon with a band of coastal shrub daisy between the sea rush and coastal forest. 24/2/05

Figure 8: **A mangrove upstream of Karetoto Island. Note the dead kanuka in the background, presumably from aerial herbicide spraying. 24/2/05**

S

Figure 9: **Sea meadow turf along the eroding rush edge East of Mowhiti Point. Species present in this zone include *Lilaeopsis ruthiana, Ranunculus acaulis*, slender clubrush, *Lobelia anceps?* (fleshy pink form) and tall fescue. 25/2/05**

Figure 10: There are a variety of estuarine/freshwater communities around the sandspit west of Kainamunamu Stream. The catamaran is sitting on a patch of short spartina that extends out of the picture to the right. 25/2/05

Figure 11: An adult mangrove and seedlings surrounded by spartina at Papatapu Stream. 25/2/05

Figure 12: The largest area of sea meadow (entirely sea primrose) was found at the mouth of the Omaia Stream. It is underwater in the foreground adjoining the rush and mangroves. Note the saltmarsh ribbonwood (left), and marsh clubrush (right) inland of the sea rush. 26/2/05

Figure 13: Saltmarsh ribbonwood, mingimingi, flax and blue-green rush line the lower Omaia Stream. Behind this edge is an extensive marsh clubrush /raupo wetland and coastal forest. 26/2/05

Figure 14: Stock access to the harbour edge is a problem around Pukerau Stream. The upper end of this bay is also heavily infested with saltwater paspalum. 26/2/05

Figure 15: Stock access to the harbour edge is a problem around Ohau Point. The grazing of the understorey means there are no young pohutukawa surviving to replace the present old trees. Some of these existing trees are dying due to possum browsing. 26/2/05

Figure 16: Saltwater paspalum is mixed with short spartina in a small embayment south of Ohau Point. 26/2/05

Figure 17: Stock and vehicle tracks on the mudflats of Opaku Bay.

Figure 18: The perched inlet at the Aotea Road – Okapu intersection which drains (and fills) slower than the main harbour to the right. 27/2/05

Figure 19: The thick rush band in the western arm of Okapu Bay with the Aotea road climbing the hill in left background. 27/2/05

Figure 20: Saltwater paspalum dominates patches of oioi, sea rush and three-square on the southern side of Tahuri Point. 27/2/05

Discussion

1:5,000 scaled aerial photo-maps were used for the survey of Aotea Harbour. It is recommended that this scale is used in the future, particularly for West Coast harbours. This requires an increased handling of maps in the field but the ability to more clearly identify seagrass beds and thin rush bands on the map.

The same problems were encountered with the identification of seagrass beds in Aotea Harbour as were found when surveying seagrass in Raglan and Kawhia Harbours. Coarse and dark-coloured sediments made distinguishing seagrass beds on the map difficult, as did the sometimes 'patchy' nature of the seagrass beds. 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 cast a shadow over the estuarine vegetation on the map. 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 need to be mapped from the ground onto aerials, as opposed to the East Coast harbours where seagrass, mangrove and rush boundaries are often easily identified and mapped from the aerial photo-map, with some specific points requiring ground-truthing.

Aotea Harbour seems relatively sandy which may partly be a result of having the majority of the freshwater wetlands intact. These marsh clubrush and raupo wetlands provide an important filter between the land and harbour. Throughout the region freshwater wetlands have been drained to a much higher degree than estuarine wetlands, as estuarine wetlands did not generally result in highly productive land due to the salt influence. These estuarine-freshwater wetland systems provide significant habitat for wetland birds such as fernbird. It should therefore be a priority to ensure the remaining freshwater-estuarine wetlands around Aotea Harbour are protected from future draining or stock damage. Retirement of riparian margins around swampy gullies and along the harbour edge also needs to become a priority for the farmed land to negate the adverse effects of farming activities on the harbour and its vegetation.

The extensive seagrass beds are a significant vegetation community in the harbour. Seagrass is at the base of the food chain providing food for herbivores. Seagrass beds also have a diverse in-faunal community; and provide shelter and settlement habitat for benthic and planktonic fauna, which is in turn rich feeding grounds for carnivorous harbour birds and fish. The seagrass is also sustaining a large population of swans. 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 health of the seagrass.

A number of the scattered mangroves in the harbour have probably been present for at least 10 years. Some of the trees were noted to be flowering and at least one tree has seedlings close by. Mangrove seed arrival into the harbour from northern populations has probably always occurred, but their establishment is limited by the climate and specifically the severity of frosts that kill seedlings. It may be that because of the relatively warm winters of the last decade that more mangrove seedlings have been able to escape the frosts in particular microclimates around the harbour. With these trees now flowering and producing fruits, mangroves may now be able to spread naturally from an established 'within-harbour' population.

Weeds are a significant threat to the integrity of the harbour's estuarine vegetation communities. The Department of Conservation is currently planning to aerial spray the spartina in Aotea Harbour with Gallant herbicide. 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 the Department (politically and/or financially) in obtaining the necessary long-term funding.

The other significant estuarine weed is saltwater paspalum. Unlike Kawhia Harbour, saltwater paspalum has spread all around the margins of Aotea Harbour, although it is still generally present only in small patches. This grass has shown itself to be an aggressive competitor throughout the mid and upper tide zones (Graeme & Kendal, 2001). In particular it threatens low-stature sea meadow communities. If an attempt to eradicate this grass from the harbour is to be made it would be best to happen soon while the extent of the problem is limited. This work could follow neatly in the footsteps of the initial spartina control that is about to be undertaken.

The spread of Pacific oyster beds over the harbour flats has the potential to alter sediment and water flow characteristics.

Access by stock to the harbour is generally a problem around the eastern side of the harbour as this is where the majority of the farms are. However, there are isolated problems with stock access on the north and western sides of the harbour as well. All farmers around the harbour need to be made aware of the detrimental effects their farming practises are having on the harbour and be encouraged to fence their harbour margins as a priority. Fencing of the eastern side of the harbour will also allow the thin pohutukawa fringe that is such a feature of that side, to have the next generation regenerating underneath. Some form of encouragement should also be given to farmers to control possums along this edge.

References

Graeme, M. 1997: *Estuary Vegetation Survey Pilot Study: Whangamata, Otahu*, *Wharekawa*. Report prepared for Environment Waikato.

Graeme, M. 1998a: *Estuary Vegetation Survey: Coromandel & Tairua Harbours*. Report prepared for Environment Waikato.

Graeme, M. 1998b: *Estuary Vegetation Survey: Te Kouma & Manaia Harbours*. Report prepared for Environment Waikato.

Graeme, M. 1999: *Estuary Vegetation Survey: Whitianga Harbour*. Report prepared for Environment Waikato.

Graeme, M. 2004: *Estuarine Vegetation Survey: Port Waikato.* Report prepared for Environment Waikato.

Graeme, M. 2004: *Estuarine Vegetation Survey: Raglan.* Report prepared for Environment Waikato.

Graeme, M. 2004: *Estuarine Vegetation Survey: Kawhia.* Report prepared for Environment Waikato.

Graeme, M. & Kendal, H. 2001: *Saltwater Paspalum (Paspalum vaginatum) – a weed review.* Report for Environment Waikato.