

Estuarine Vegetation Survey Whitianga Harbour

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CONTENTS

1. Introduction	1
2. Methodology.....	1
2.1 Wetland vegetation classification	2
3. Field Notes	1
3.1 Summary.....	1
3.2 Site descriptions.....	5
3.3 Threats.....	74
3.4 Birds	76
4. Discussion and Recommendations	77
5. Bibliography	79
Appendix 1: GPS locations of figures.....	81

1. Introduction

A 1997 pilot study of Whangamata, Wharekawa, and Otahu estuaries determined that it is feasible to map vascular estuarine vegetation from aerial photography together with field surveys. The success of this work encouraged Environment Waikato to continue with this method. The estuarine vegetation of Tairua, Coromandel, Te Kouma, Manaia, Whitianga Port Waikato, Raglan, Aotea, Kawhia harbours and the inner Firth of Thames have since been surveyed and mapped. Of these surveyed harbours, Whangamata, Otahu, Wharekawa, Tairua and Manaia have been re-surveyed to determine changes in vegetation communities over time.

The mapped vegetation is within the Coastal Marine Area (CMA) and includes the spatial cover of mangrove, seagrass, sea meadow and saltmarsh communities. The results of the estuarine 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.

The estuarine vegetation of Whitianga Harbour was first mapped in 1999. This report details the results from a re-survey of estuarine vegetation in the Whitianga Harbour. Comments are included on the threats to estuarine vegetation, and other field notes of interest. This report is accompanied by digitised aerial maps of the survey site with vegetation community overlays.

2. Methodology

The field survey was undertaken over 14 days between the 24th September 2008 and the 23rd March 2009. The survey was undertaken using a combination of boating and walking. The same methodology for mapping saltmarsh, mangrove, seagrass and weed communities was followed as that previously used to map Coromandel Peninsula estuaries (e.g. see Graeme, 1999), except that a personal digital assistant (PDA) loaded with 2006 aerial photographs of the survey site was used as the primary mapping device. The PDA replaced the use of colour pen notations on hard copy aerial photographs, although hard copy aerials were used as a backup for when the PDA battery ran out, or sun lighting made it too difficult to see the PDA screen clearly in the field. Coded polygons were drawn directly onto the PDA aerial photographs to define the spatial extent of wetland vegetation types as they were ground-truthed in the field.

The upper saltwater influence is usually indicated by the upstream limit of oioi, saltwater paspalum or saltmarsh ribbonwood.

Field notes were made of estuarine wetland characteristics and their vulnerability to particular threats.

2.1 Wetland vegetation classification

Estuarine wetland vegetation of the Waikato Region is split into four groups:

1. **Saltmarsh** – a multi-species community in which three sub-communities are distinguishable in the Waikato Region. They are:
 - a) 'Rush/sedge community' – This is generally sea rush (*Juncus kraussii* var. *australiensis*), oioi (*Apodasmia similis*), and on the West Coast, three-square sedge (*Schoenoplectus pungens*). Marsh clubrush (*Bolboschoenus fluviatilis*) is commonly found up streams and rivers at the upper estuarine limit in some harbours, although it is not mapped within this survey as it is a species of brackish freshwater.
 - b) 'Saltmarsh ribbonwood community' – Saltmarsh ribbonwood (*Plagianthus divaricatus*) dominates this zone, although rushes are also common giving a patchy appearance compared with the uniformity of the 'rush/sedge community'. Small areas of sea primrose (*Samolus repens*), remuremu (*Selliera radicans*), the coast spear 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 coast spear grass. The sea meadow community can include sea primrose, remuremu, glasswort, , slender clubrush (*Isolepis cernua*), and arrow grass (*Triglochin striata*), and in more brackish areas bachelor's button (*Cotula coronopifolia*), leptinella (*Leptinella doica*) and sharp spike-sedge (*Eleocharis acuta*)
2. **Mangrove** (*Avicennia marina* subsp. *australasica*) – This is usually a monospecific community although seagrass, sea meadow, spartina (*Spartina* spp). and saltwater paspalum (*Paspalum vaginatum*) beds can sometimes be found underneath mature mangrove stands.
3. **Seagrass** (*Zostera capricorni*) – This is usually a monospecific community, and is the vegetation which occurs at the lowest level in the tide.
4. **'Weed community'** – In the Waikato Region the most significant estuarine weeds are saltwater paspalum and spartina. Both of these grasses generally grow in the open estuary and trap sediment, greatly increasing the harbour's infilling rate. These weeds also compete with the native wetland communities.

There are other weed species (such as tall fescue (*Schedonorus phoenix*)) which can tolerate a degree of salt influence but for clarity of

mapping they have not been included in the surveys due to their presence above the spring high tide mark.

For the purpose of mapping, additional vegetation categories have also been added to more accurately portray the increasing prevalence of 'mixed' short-stature communities. Saltwater paspalum in particular is spreading and mixing with rush/sedge, sea meadow and saltmarsh ribbonwood communities. Where two differently layers co-exist (e.g. seagrass or saltwater paspalum under mangroves) these are mapped as individual layers.

3. Field Notes

3.1 Summary

The following observations provide a general overview of estuarine vegetation in the Whitianga Harbour following the field visit.

- There is a lack of large seagrass beds in the harbour.
- Extensive mangals (mangrove forests) dominate the central islands and along the middle and upper harbour edges.
- Mangroves range in height from 6-8m, with the occasional tree estimated at 9m or more in height.
- Wide beds of sea rush and oioi dominate behind the mangroves in the sheltered upper embayments and river arms.
- Relatively large areas of saltmarsh ribbonwood occur along the landward edge of estuarine wetland communities, particularly up the Whenuakite River.
- In a few areas unaffected by farming, the saltmarsh ribbonwood zone grades into freshwater swamp communities characterised by swamp coprosma (*Coprosma propinqua*), manuka (*Leptospermum scoparium*), pohuehue (*Muehlenbeckia complexa*), coastal shrub daisy (*Olearia solandri*), blue-green sedge (*Baumea juncea*), tall fescue and pampas (*Cortaderia selloana*).
- Sea meadow communities of notable size are found along river outwash edges; in patches amongst rush/sedgeland or between mangals and rush/sedgeland; and on shell banks. Sea meadow species present include glasswort, sea primrose, remuremu, coast spear grass.
- Only one patch of spartina was found, at the mouth of Owhero Creek.
- Saltwater paspalum is common around the harbour, particularly along river margins and between the mangrove and rush/sedge communities such as on the true left bank of the Waipakupaku Creek.
- Saltwater paspalum occurs either as dense monospecific mats or mixed with sea meadow, rush/sedge, mangrove or saltmarsh ribbonwood communities. Saltwater paspalum was also noted mixed with the landward edge of seagrass beds.
- The steeper margins of the harbour are predominantly covered in regenerating native bush. In contrast, the flatter areas (e.g. around Whitianga township) are highly developed either as urban development or for agriculture.

- Stock access into the CMA is an issue along the true right banks of the Whenuakite River, the true right bank of the Ounuora River (Mill Creek) downstream of the state highway bridge and the true left bank of the Whangamaroro River.
- Many of the stream banks above the CMA are not adequately fenced to restrict farm pollution entering the waterways and harbour.

Table 1 lists common estuarine plant species found during the surveys. The 'estuarine vegetation community' category for the estuarine species corresponds to the vegetation boundaries digitised on the aerial maps.

See Figure 1 for a map showing the site names and figure numbers mentioned below. A table of GPS points of the figure locations is in Appendix 1.

Table 1: Check list of common estuarine plant species found in Whitianga Harbour.

Common/Maori name	Scientific name	Estuarine Vegetation Community
arrow grass	<i>Triglochin striata</i>	sea meadow
coast spear grass	<i>Austrostipa stipoides</i>	sea meadow
glasswort	<i>Sarcocornia quinqueflora</i>	sea meadow
mangrove	<i>Avicennia marina</i> subsp. <i>australasica</i>	mangrove
oioi	<i>Apodasmia 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 capricorni</i>	seagrass

slender clubrush	<i>Isolepis cernua</i>	sea meadow
spartina/cord grass *	<i>Spartina spp.</i>	weed

* denotes an exotic species

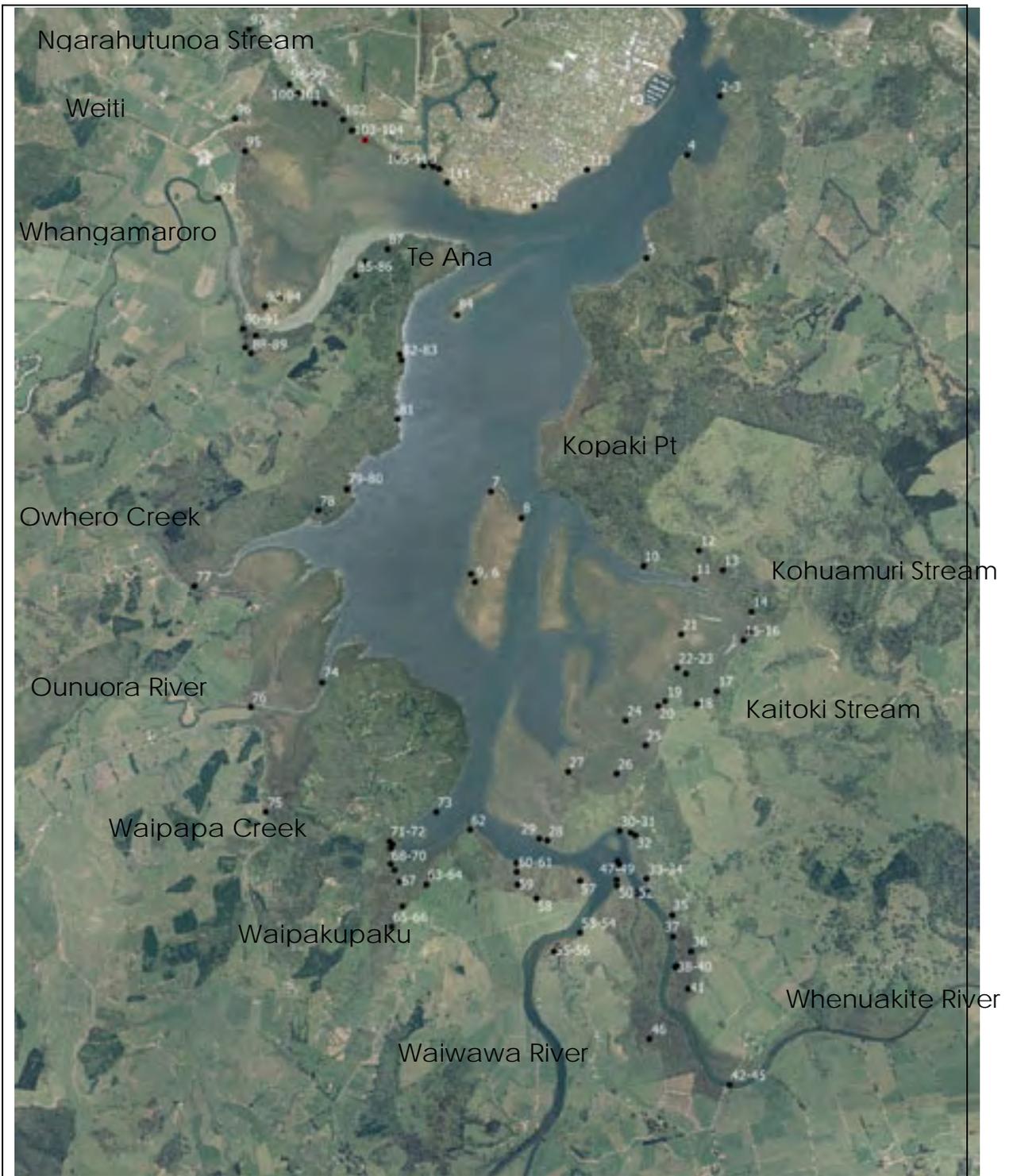


Figure 1: Whitianga Harbour site localities mentioned in this report. The numbers refer to the location of the following figures.

Site descriptions

Whitianga Harbour is described clockwise from the harbour mouth. See Figure 1 for a map showing the site names and figure numbers mentioned below. True left bank (TLB) and true right bank (TRB) refer to the side of a river when facing downstream.

Isolated mangroves and the odd scattered rush patch occur in the outer embayments near the **harbour mouth** (Figure 2). The brown seaweed Neptune's necklace (*Hormosira banksi*) is common on rocky platforms along the intertidal coastal edge. The first significant mangrove fringe does not occur until the bay north of Red Hill (Figure 3). Behind the mangroves and narrow rush/sedge band is a freshwater wetland with manuka, flax, *Coprosma propinqua x robusta*, coastal shrub daisy and willow (*Salix* sp.). Regenerating coastal forest (including pohutukawa, coastal five finger, kanuka, pines, *Pittosporum umbellatum* and ngaio, red matipo, wattle species covers most of the landward edge along this side of the harbour up to the first ridgeline (Figure 4).

The rush/sedge fringe which lines the freshwater wetlands along this north-eastern harbour edge is undermined by wave action in many places where there isn't a seaward protective zone of mangroves (Figure 5).

A dense and wide mangal has formed between the saltmarsh and oyster farm structures in the embayment between Red Hill and Kopaki Point. Some seagrass is found beneath taller mangroves along the northern edge here. Mangroves become stunted along the landward edge where they blend with the wide saltmarsh zone. A large raupo/*Baumea juncea*/manuka swamp is found in behind the saltmarsh. Banded rail were heard and seen in this area.

Sand/shell ridges (chenier ridges) along the front edge of the mangal have saltwater paspalum, glasswort, sea primrose, saltmarsh ribbonwood, sea rush and coastal spear grass growing on them.

The **large islands within the mid-harbour** are covered with mangroves that have established in the lee of the chenier ridges. These chenier ridges support rush/sedgeland, sea meadow species, saltwater paspalum, saltmarsh ribbonwood, shore bind weed, knobby clubrush (*Ficinia nodosa*) (see Figures 6-8) and some coastal forest species such as ngaio, pohutukawa, flax and manuka. Red matipo, akeake, *Coprosma propinqua*, *C. propinqua x robusta*, flax, bracken, pampas, phoenix palm, coastal five finger, wattle species, coastal shrub daisy, and five-finger (*Pseudopanax lessonii*). A population of Tamarisk salt cedar (*Tamarix* sp.) has established on the larger mangrove island (Figure 9).

Banded rail and pig footprints were seen out on the larger of the harbour islands. Little black shags were observed around **Kopaki Point**.

Some of the large mangroves immediately east of Kopaki Point have fallen over and there is a notable lack of replacement juveniles. The intertidal flats along the Kohuamuri Stream channel are thigh-deep mud seaward of the mangrove fringe. The substrate beneath the mangroves is more firm and there are a lot of pneumatophores, crab holes and scattered titiko. The mangrove canopy here is 7-8m tall along the cliff side of the channel (Figure 10). There are also young mangrove seedlings along the landward edge and in light wells where old trees have fallen over. Flying insects were common under the mangrove canopy.

Figure 11 shows a mangrove-lined side creek that enters the Kohuamuri Stream channel. Sheep were seen at the head of this bay (Figure 12) as well as banded rail footprints. Here, *Baumea juncea* was mixed with oioi, sea rush, as well as amongst mangroves.

Moving past this small side arm, the rush/sedge community behind the mangroves it is relatively narrow. Saltmarsh ribbonwood is uncommon and the rush/sedgeland generally grades into manuka and regenerating coastal forest (Figure 13). A pig wallow and tracks were found in the rush/sedgeland. Patches of seagrass often occur under tall mangrove canopy, and usually towards the landward side of the mangal. While possum control has been undertaken around Kopaki Point, further up towards **Kohuamuri Stream** possum browse was notable on the pohutukawa and also mangroves where there is dry access to trees from the land (Figure 14). At the mouth of the Kohuamuri Stream is a whitebait stand and large maimai hut. Banded rail were heard here.

South of Kohuamuri Stream, pig tracks and droppings were common through the rush/sedgeland (Figure 15). Figure 16 shows an extra tall mangrove alongside the **Kaitoki Stream** channel with stunted mangroves on a rocky base in the foreground. The rush/sedgeland band behind the mangal widens south of Kaitoki Stream mouth (Figure 17). Some earthworks in the CMA has occurred near the mouth of the Kaitoki Stream (Figure 18).

Below **Kaitoki Point** the rush/sedgeland zone is very wide and blends with tall mangroves along the landward fringe of the mangal (Figure 19). Large patches of slender clubrush, arrow grass and sea primrose also occur here (Figure 19 and 21), and banded rail and pukeko footprints were common. Figure 20 shows tidal pools alongside the mangrove-rush/sedge boundary which had thousands of juvenile fish in them. Note that the manuka wetland fringe here was incorrectly mapped as 'saltmarsh ribbonwood community in the 1999 survey. Saltmarsh ribbonwood is only present in narrow scattered patches along the edge. A few patchy areas of sea rush were found that contained small clumps and dead bases in between larger clumps (Figure 22). Figure 23 shows rushland with a distinct boundary

between two areas of different height sea rush. Smaller isolated patches of rush/sedgeland are separated by mangroves from the main rush/sedgeland band. Sea rush is generally the only or dominant species here. Oioi is more common in the wide landward rush/sedge band. The two terrestrial islands provide some floral diversity amongst the mangroves (Figure 24). The rush/sedgeland band is still very wide from Kaitoki Point around to the mouth of the Whenuakite and Waiwawa River channels (Figure 25). Fernbird are common in this area. Figure 26 shows a large dense patch of *Baumea juncea* with sea rush and oioi landward.

Towards the mouths of **Whenuakite and Waiwawa Rivers**, there are islands and sand bars with saltmarsh ribbonwood, *Coprosma propinqua*, *C. propinqua x robusta*, coastal shrub daisy, ngaio and manuka (Figure 27). Small pioneer patches of saltwater paspalum occur along the mangrove-rush/sedge boundary, often invading sea meadow patches. Out on the sand bar lining the TRB of the river channel, saltwater paspalum becomes dominant (Figure 28). Back under the pure mangrove canopy there are lots of small titiko. Large logs have washed up on the open intertidal flats of the river channel and these provide popular bird roosts particularly for pied stilt (Figure 29).

Around from Kaitoki Point and upriver past the bluffs is a small mangrove island at the mouth of the **Whenuakite River**. Over on the TRB seagrass is common behind and under the mangroves (Figures 30-32). There was some sign of grazing on mangroves, and animal tracks and camps (goats or sheep) were found on higher ground. The mangrove canopy was about 5m tall here but the tallest mangroves were up to 8m.

Travelling up the TRB of the Whenuakite River - pugged, tracked and grazed vegetation is common where unfenced farmland adjoins the harbour margin (Figure 33-35). Stock grazing is also hindering forest regeneration on the harbour edge. Figure 36 shows a stream where the rush/sedgeland on one side is clearly damaged by stock and the other side isn't. Seaward of the wide rush/sedgeland is a mangrove fringe with an understorey of dense saltwater paspalum (Figure 37). Banded rail were heard here. An area of dead saltwater paspalum was found amongst rush/sedgeland away from the mangrove canopy (Figure 38). The reason why the saltwater paspalum has died is unclear but assumed to be the result of a severe frost coinciding with a low early morning tide. Arrow grass was found alive amongst the dead saltwater paspalum (Figure 39) and saltwater paspalum was healthy under the shelter of mangroves (Figure 40).

Further up the Whenuakite River on the TRB the inland extent of the estuarine to freshwater vegetation sequence is un-naturally truncated over the floodplain due to land drainage for agriculture (Figure 41). Large areas of saltmarsh ribbonwood occur around the **Te Kauanga Rd bridge** (Figures 42 and 43) and fernbird were heard. Pukeko and swallows are also common here. The estuarine influence is reduced to the immediate stream edge

upstream of the bridge, and estuarine vegetation completely disappears about 1.5km upstream of the bridge. Freshwater wetland continues as the predominant streamside vegetation upstream except where land drainage and stop-banking has occurred, as is the case along the upper reaches of the TLB (Figure 44).

Downstream of the Te Kauanga Rd bridge on the TLB the estuarine vegetation zone widens but is still constrained inland by stopbanks (Figure 45). Large areas of saltmarsh ribbonwood occur in behind the rush/sedgeland and lining waterways (Figure 46). The upstream limit of mangroves is about 0.5km downstream of the bridge. Mangroves then dominate along the river banks and side creeks (Figure 47) further downstream. Sea rush and saltwater paspalum are common along the river edge under the mangrove canopy (Figure 48). Scattered small patches of sea meadow (arrow grass and sea primrose) are common too. Saltwater paspalum becomes the dominant mangrove understorey towards the junction of the Whenuakite and Waiwawa Rivers (Figure 49). Fantails were common in the mangal chasing insects.

At the mouth of the **Waiwawa River**, on the TRB, patches of dead saltwater paspalum were present (Figures 50-52). Many banded rail footprints were seen and fernbird heard. The natural inland extent of estuarine vegetation is truncated by stopbanks. The remaining estuarine vegetation upstream is limited to the immediate stream side (Figures 53 and 54) and a disturbed wider estuarine flat on the inside of the river bend (Figures 55 and 56). The inside river bend wetland is not fenced from stock access. Tall fescue is present on pugged higher ground. Fernbird, pied stilt and a bittern were present in this area. Oioi marked the upper extent of estuarine vegetation on the TRB of the river.

Moving downstream along the TLB of the Waiwawa River, the bank sides are much eroded, and attempts have been made to protect the banks with concrete debris. Dead saltwater paspalum was found on the TLB of the river mouth (presumably again from frost). Banded rail were present here. Some good pampas and wattle control has been undertaken in the area, however stock access into the CMA is a problem from along the stopbank and a track out to the river mouth (Figures 57 and 58). Around the corner of the river mouth there is a good diversity of native vegetation along the harbour edge and on raised islands within the saltmarsh. Species noted include *Coprosma propinqua*, manuka, fernbird, coastal shrub daisy, *Baumea juncea*, red matipo, flax, *Coprosma tenuicaulis*, kanuka, ngaio, silver fern, totara, tanekaha (Figure 59). This area has been heavily tracked by stock. There were banded rail foot prints present.

Large expanses of rush/sedgeland occur in behind the mangroves that line the Whenuakite/Waiwawa river edge (Figure 60). Fernbird were heard in the rush/sedgeland. The distribution of mangrove and rush/sedgeland

communities is affected by drainage systems that cut through the estuarine vegetation.

Towards the Waipakupaku Creek embayment, the stopbank dramatically narrows the functioning estuarine edge. Sea primrose and saltwater paspalum patches are scattered under a ~3m high canopy of mangroves (with some taller trees) (Figure 61). A dead cow and sheep were found out amongst the mangroves. The river banks are steep and eroded with many crab holes. Earthworks have been recently undertaken out on the point (Figure 62). Banded rail are in the area.

The outer exposed edge of mangroves at the southern mouth of the **Waipakupaku Creek embayment** have 'prop' roots along their lower branches. Seagrass below the mangroves varies from dense beds to scattered patches around Waipakupaku Creek arm. Pampas and wattle are a problem along the land edge. Rubbish and spoil has been dumped along the estuarine edge further into the embayment and stock damage to estuarine soils and vegetation is an issue (Figures 63-65). Signs of machinery operating in the saltmarsh were also apparent.

Floodgates and stopbanks form a boundary between the estuarine vegetation and freshwater vegetation at the head of the Waipakupaku Creek embayment (Figure 66). Along the TLB, between the rush/sedgeland community and the mangal, is a large expanse of saltwater paspalum. Much of this infestation has died off recently (Figures 67-71), again presumably because of a severe frost. A seed head found on dead saltwater paspalum (in early October 2008) indicated it may have died during the 2008 winter, although it is expected that it will grow back from underneath. Fernbird and bittern are present in the area. Sea meadow is common at the rush/sedge and mangrove interface (where it is not smothered by saltwater paspalum) (Figure 72). Patches of sea rush (and saltwater paspalum) extend seaward into the mangal. The thick landward saltmarsh band is characterised by oioi. Freshwater manuka/*Baumea juncea* wetland is common behind the estuarine vegetation before the land rises steeply. Much of this harbour edge is covered in early regenerating coastal forest but with wilding pines and wattle often present (Figures 72 and 73). Housing associated with lifestyle blocks have extended into the area.

A patch of young mangroves is establishing out from the main mangal lining Ounuora River and Waipapa Creek mouths (Figure 74). Banded rail footprints were seen amongst mangroves at the **Waipapa Creek** river mouth. Saltwater paspalum is common along the creek banks. Oioi and sea rush are generally the only community between the mangroves and steep land edge except at the head of the arm where saltmarsh ribbonwood dominates along the stream and causeway edges (Figure 75). The causeway forms a boundary between the saltwater and freshwater wetland communities up the Waipapa Creek.

Stock are not fenced out of the CMA on the lower TRB of **Ounuora River (Mill Creek)** and have been grazing and pugging the narrow band of mangroves, saltmarsh ribbonwood, sea rush and saltwater paspalum (Figure 76). A wide band of rush/sedgeland extends out from the TLB of the Ounuora River mouth to a long narrow coastal scrub island bar. The inland estuarine boundary is defined by a stopbank but this is breached at its northern end. Some of the mangroves between Ounuora River and Owhero Creek are up to 9m high.

Around into the **Owhero Creek** embayment there is a large patch of rush/sedgeland enclosed on the seaward side by mangroves, but then the mangroves extend towards the land edge with a sporadic narrow band of rush/sedge. Areas of flat bedrock are often exposed or very near the surface along the landward edge of the TRB. A number of exposed bedrock areas had seagrass growing in muddy hollows and cracks. A patch of short-statured spartina occurs near where the highway comes close to the estuary arm (Figure 77). The head of the arm grades into freshwater wetland communities and then farmland. Downstream on the TLB is a large rush/sedge band with a manuka/*Gleichenia* wetland behind. Fernbird were heard in this area. A small rocky outcrop is surrounded by rush and mangrove with a few saltmarsh ribbonwood, coast spear grass and glasswort on higher ground.

Lush seagrass and sea primrose beds are present in the back of a small mangrove embayment to the **north of Owhero Creek mouth** (Figure 78). The embayment is surrounded by bluffs and advanced regenerating bush.

A thin band of mangrove and saltwater paspalum are found along the next shallow embayment (Figure 79-80). There is no estuarine vegetation until past the next headland where mangroves begin to thicken **towards Te Ana Point** and there are pockets of saltmarsh ribbonwood with freshwater wetland behind (Figure 81). An area of 'yellowing' flax was noted here. There was a small area of cleared mangroves, presumably cleared to provide an open water view from the nearby house. Sparse seagrass beds were present behind the mangroves or under younger mangroves establishing in the back. Saltwater paspalum extends down into the seagrass zone (Figure 82). Generally there is very little saltmarsh present as the mangroves grow right up to the freshwater wetland edge of tangle fern (*Gleichenia* sp.) and *Baumea juncea* (Figure 83). Fernbird were present here.

Low (but old) mangroves occur on the exposed western side of the small **mangrove island near Te Ana Point** (Figure 84). The rest of the island supports much taller well-rooted mangroves.

Around Te Ana Point, the mangroves generally extend up to the land edge with little or no rush/sedgeland in-between (Figure 85). Healthy dense seagrass beds of varying widths extending out from the land edge under

the mangrove canopy (Figure 86). Also of note was the presence of *Machaerina sinclarii* along the harbour edge immediately south-west of Te Ana Pt (Figure 87). Further up the **TRB of the Whangamaroro River**, is an embayment bound by stopbanks. There are more healthy dense seagrass beds here under 0.5-5m tall mangroves. There are quite distinct plant height zones but the canopy height didn't seem to affect whether seagrass was present or not (this may be related to water depth and flow). Scattered patches of sea primrose, saltwater paspalum and sea rush occur below the mangrove. A dredged channel with a ramp allows cattle into the CMA (Figure 88). Further along, farming rubbish has been dumped in the CMA (Figure 89). Saltwater paspalum becomes more prevalent further upstream mixing with sea rush, oioi, saltmarsh ribbonwood and mangrove (Figure 90). Many of the tall mangroves along the rush/saltwater paspalum zone are dying, but the cause is unclear. Fernbird were heard in the saltmarsh ribbonwood here. Figure 91 shows an area where saltwater paspalum is not present (uncommon in this area) amongst the estuarine vegetation communities. The upstream limit of estuarine vegetation is indicated by thin patches of oioi and saltwater paspalum (Figure 92).

Downstream on the **TLB of the Whangamaroro River** is a roost and a possible breeding site for pied stilts (Figure 93). Saltwater paspalum is prevalent here. Some of the old isolated mangroves are up to 9m high along the landward mangal fringe (Figure 94). Small scale infilling of the saltmarsh is still occurring along the farmland edge.

An extensive area of rush/sedgeland occurs towards the TRB of the **Weiti Stream**. This has some open patches, particularly towards the mangrove zone, where unvegetated mud or a combination of saltwater paspalum and arrow grass are common (Figure 95).

At the **Weiti Stream mouth**, the outflow debris has been mechanically spread and pushed into saltmarsh and mangroves. This disturbance is encouraging the spread of weeds. Tall fescue and bachelors button are common on the disturbed sandy silt outwash soils. Wattle is very common along disturbed higher ground such as stopbanks. On the **TLB of the Weiti Stream** there is a saltmarsh ribbonwood band backing the saltmarsh (Figure 96). This grades into a manuka forest which has a thick understorey of the introduced weed montbrettia (*Crocasmia x crocosmifolia*). Stock access is an issue here. Stock tracks are found along the top of the stopbank, with side tracks leading down to the saltmarsh. Carpets of arrow grass are common under the landward patchy mangrove edge. Copper butterflies were seen in saltmarsh ribbonwood and tall fescue. The inland extent of the estuarine vegetation is truncated by stopbanks from the Weiti Stream to **Ngarahutunoa Stream**. Further up the Ngarahutunoa Stream, State Highway 25 crosses the estuary. Pampas is common alongside the drainage channels from the golf course. Recent earthworks along the golf course land has encroached into highly significant freshwater wetland vegetation (Figure 97). This threatened habitat type is characterised by

Baumea juncea, *Coprosma propinqua* and *Coprosma propinqua x robusta*, manuka, flax; and is critical habitat for fernbird.

Industrial land has infilled the harbour edge along **Moewai Park Rd**. Cat prints were found in the mangroves near the Whitianga rubbish dump (Figure 98). The old dump site is poorly contained with rubbish spilling out into the CMA. Glass, plastic, cans, metal etc. were found among the saltwater paspalum, oioi and mangroves making walking in the area quite dangerous (Figure 99). Banded rail footprints were present in an open area of young sea rush and saltwater paspalum (Figure 100). Further downstream past the industrial zone, infilling has not been as extensive and there is a wide rush/sedgeland zone (Figure 101). A thin band of saltmarsh ribbonwood and manuka screen the urban development along Moewai Park Rd and adds to the high natural character of the area. Patches of arrow grass and sea primrose occur under mangrove. Seagrass patches are also found along the landward edge of the mangroves and in open areas within the mangal. In a few places the estuarine and freshwater communities are mixed. Figure 102 shows *Baumea juncea* and raupo amongst short 1-1.5m tall mangroves, with a wide oioi zone landward. Many walkways (raised boardwalk, concrete etc) were found through the mangroves along the eastern end of the wide rush/sedgeland with varying impacts on the native vegetation (Figure 103). Infilling of the esplanade reserve (and mangrove clearance) is of particular concern near the junction with Hei Esplanade (Figure 104). Along the front of Hei Esplanade, there is a thin band of rush/sedgeland and saltmarsh ribbonwood (with saltwater paspalum mixed through) behind the mangroves with a planted coastal forest edge (Figure 105).

A reef heron was observed with pied shags and mallard ducks at the entrance of the **Waterways canal development** (Figure 106). On the TLB of the canal entrance is the last of the tall mangal along this edge (Figure 107). Trees within the south-eastern portion of the mangal have been poisoned (Figures 108-111). Saltwater paspalum is present along the canal edge with sea primrose and a small amount of glasswort. Sea rush, oioi and saltmarsh ribbonwood are present in behind the mangroves. Builders' rubbish (plastic and polystyrene) has washed into the mangroves.

East of the Waterways canal entrance, a small natural creek runs inland to the old South Highway 25 road. Mangroves dominate the lower half of this creek and patches of sea rush, oioi and three square occur along the upper reaches before the road culverts. A few old pohutukawa and macrocarpa provide some canopy shade along the creek edge.

Small patches of sparse seagrass occur along the intertidal flats towards the **Robinson Road boat ramp**. There are small groups of tall mangroves but a lack of mangrove seedlings. A couple of large mangroves have been cut down near the boat ramp.

The land edge between the canal entrance and the boat ramp is very weedy with lots of garden escapees dominating (including agapanthus, nasturtium, honeysuckle and wandering willy).

Garden waste is also dumped along the harbour edge towards Whitianga township (Figure 112). The coastal edge becomes more armoured towards the township and harbour mouth (Figure 113). Saltwater paspalum and the occasional patch of sea meadow are found where sand has built up beside the seawall coast line. Saltwater paspalum and the occasional mangrove have also established up the watercourse running alongside the reserve land of Taylors Mistake. Saltwater paspalum blends with open coast plants such as knobby clubrush and spinifex out at the harbour entrance.



Figure 2: A few isolated mangroves are the only vascular estuarine vegetation in the bay south of Back Bay.



Figure 3: The second bay south of Back Bay (and opposite the marina) has the first major band of mangroves. Neptunes necklace (*Hormosira banksii*) seaweed is common on the hard intertidal flats. Silty sand dominates further into the bay.



Figure 4: The view looking NE into the bay shown in Figure 3. Manuka, flax, *Coprosma propinqua* x *robusta*, coastal shrub daisy and willow occur in the freshwater wetland behind the mangroves at the right hand end of bay.



Figure 5: The third bay south of Back Bay has a perched freshwater swamp with tangle fern (*Gleichenia dicarpa*), *Baumea juncea*, manuka and raupo in behind the eroded thin sea rush edge. Behind the wattle and buffalo grass edge to the north (left) is an oioi sedgeland with a patch of saltmarsh ribbonwood.



Figure 6: Mangroves on an island in the middle of the harbour surround a sand bar carpeted with sea primrose and saltmarsh ribbonwood.



Figure 7: The eroded edge of the central harbour island. Akeake, oioi, glasswort, saltmarsh ribbonwood and mangroves occur here. Old mangrove stumps are in the foreground.



Figure 8: A distinct boundary between the glasswort (darker green) and saltwater paspalum (light green) communities on this island sand bar.



Figure 9: Pink flowered *Tamarix* sp. bush growing on a chenier ridge of the large mangrove island.



Figure 10: A view through an open tall mangal on the TRB of the Kaitoki channel. The mangrove canopy is around 8m tall here.



Figure 11: A mangrove-lined creek that enters the Kohuamuri Stream channel with *Entromorpha* (a brown filamentous algae) on the mud flats in places.



Figure 12: The head of this embayment (on the TRB of the Kohuamuri Stream arm) contains oioi, live and dead mangroves, sea rush, arrow grass and slender clubrush, *Isolepis prolifera*, a *Carex* sp. and manuka. Stock pugging was throughout and sheep were seen grazing on grass behind these mangroves.



Figure 13: Here along the TRB of the Kohuamuri Stream arm there is very little saltmarsh ribbonwood and mangrove, and the oioi and sea rush change abruptly into a manuka edge.



Figure 14: Possum browse on a large mangrove abutting a pohutukawa forest.



Figure 15: Pig tracks criss-cross through the saltmarsh south-west of the Kohuamuri Stream.



Figure 16: A tall (> 9m) mangrove in the distance stands out above the main mangal canopy along the edge of the Kaitoki Stream (visible in the middle background). An old farm fence is found out near the mangroves.



Figure 17: Large mangroves are surrounded by oioi sedgeland. Wattle is a weed along the coastal forest edge. Fernbird were present here.



Figure 18: This photo shows an excavated channel (for duckshooting?) diverging from the Kaitoki stream mouth. The natural channel continues upstream to right beside the mangroves.



Figure 19: A view over saltmarsh showing sea rush landward with patches of oioi seaward and intermixed with the mangrove fringe. Arrow grass (light green) is common within open mud patches. Banded rail and pukeko were noted here.



Figure 20: Many juvenile fish were seen in standing tidal pools between rushes and mangroves such as this.



Figure 21: Sea primrose dominates open mudflats together with scattered mangroves and clumps of searush (light brown in background).



Figure 22: A patchy sea rush community with small clumps and dead bases in between larger clumps.



Figure 23: A distinct boundary between a patch of much taller sea rush and shorter plants in the foreground.



Figure 24: Vegetation noted on this small island within a mangal includes flax, manuka, coastal shrub daisy and mingimingi. Banded rail were present here.



Figure 25: A wide sea rush and oioi band landward of the mangrove fringe. Note the line of old fence posts in the sea rush near the manuka scrub edge abuts kanuka and pine. Fernbird are present here.



Figure 26: Patchy sea rush in the foreground with a large dense patch of *Baumea juncea* in the mid-ground and sea rush and oioi landward. An old fence line cuts across the mangrove/rush interface. Kaitoki Point is in the background.



Figure 27: Raised sand islands support saltmarsh ribbonwood, *Coprosma propinqua*, *Coprosma propinqua x robusta*, coastal shrub daisy, ngaio and manuka.



Figure 28: Saltwater paspalum mixed with sea primrose and sea rush under an open mangrove canopy.



Figure 29: About 50 pied stilts were seen roosting on large logs along the river flats at high tide.



Figure 30: Mangroves abut steep land edges which often have a band of deep mud at their base. Sea primrose is shown here (beside rock). Patches of sea rush, oioi and some saltwater paspalum also occur here.



Figure 31: This photo shows dense seagrass under a mangrove canopy. A lot of epiphytes grow on the mangrove trunks including various encrusting and hanging lichens and moss.



Figure 32: A back-swamp zone with limited sea rush and oioi. Sea primrose, arrow grass and seagrass form dense mats over very deep mud in between land edge and mangroves.



Figure 33: This estuarine edge of slender clubrush, remuremu, sea rush and oioi and *Isolepis prolifera* is pugged due to a lack of farm fencing. The saltmarsh abuts a manuka edge.



Figure 34: Lack of fencing here has resulted in browsing of the estuarine vegetation and a loss lack of regeneration of the native coastal forest edge.



Figure 35: This saltmarsh zone is dominated by oioi, with *Baumea juncea* along the inland manuka edge. Stock tracking, grazing and cow pats occur through the saltmarsh. Scattered small patches of *Isolepis prolifera*, remuremu and slender clubrush were found.



Figure 36: Stock have access to the sea rush and oioi in the foreground. In comparison, the oioi is tall and dense on the opposite stream bank where stock are excluded. Fernbird were present in the ribbonwood to the RHS.



Figure 37: Mangroves with an understorey of saltwater paspalum, oioi and sea rush along the TRB of the lower Whenuakite River.



Figure 38: Dead saltwater paspalum occurs in sheltered open areas amongst sea rush and oioi. Healthy arrow grass is common amongst the saltwater paspalum.



Figure 39: A close up view showing live arrow grass (thin green leaves) amongst dead saltwater paspalum.



Figure 40: Healthy saltwater paspalum under a mangrove canopy and amongst sea rush and oioi.



Figure 41: In this photo the saltmarsh extends inland to a thin band of manuka, coastal shrub daisy and flax bordering a straight farmland boundary.



Figure 42: View downstream from Te Kauanga Rd bridge over rush/sedgeland along the TRB of the river edge and saltmarsh ribbonwood communities further inland.



Figure 43: View upstream from Te Kauanga Rd bridge over rush/sedgeland along the TRB of the river edge and saltmarsh ribbonwood communities further inland.



Figure 44: View upstream from Te Kauanga Rd bridge over the narrow estuarine fringe along the TLB with a pampas dominated stopbank and farmland behind.



Figure 45: The view downstream from the Te Kauanga Rd bridge looking over saltmarsh beside the boat ramp on the TLB.



Figure 46: Saltmarsh ribbonwood with oioi and jointed twig rush along a back-swamp waterway along the TLB of the Whenuakite River.



Figure 47: View of mangroves lining a side arm of the Whenuakite River.



Figure 48: A rush and saltwater paspalum mosaic under a mangrove canopy. Scattered small sea meadow colonies are common too.



Figure 49: Knee-deep saltwater paspalum under a mangrove canopy.



Figure 50: Dead and live patches of saltwater paspalum under an open mangrove canopy.



Figure 51: Live arrow grass shows as thin green tufts within the shorter dead saltwater paspalum.



Figure 52: Mangrove seedlings and dead saltwater paspalum which appear frosted under an open mangrove canopy.



Figure 53: Looking east from a built up ramp adjacent to a floodgate (behind flax). Saltwater paspalum with an outer fringe of arrow grass is present with sea rush and saltmarsh ribbonwood flanking the river bank.



Figure 54: The view west from the ramp above looks over saltwater paspalum and arrow grass to oioi with seagrass on the seaward side and saltmarsh ribbonwood landward.



Figure 55: A view east over saltwater paspalum, arrow grass, sea primrose and seagrass (covered by tide), with oioi and saltmarsh ribbonwood inland. Fernbird are present.



Figure 56: Dead saltwater paspalum, scattered sea primrose, slender club rush, tall fescue, sea rush, oioi and saltmarsh ribbonwood in the background. Wattle is present on the estuarine edge on the RHS. Stock pugging is throughout.



Figure 57: A view from a track over a saltmarsh ribbonwood edge and expansive oioi beds behind the mangrove band. Scattered large mangroves extend landward into the open oioi.



Figure 58: A newly cleared stopbank with saltmarsh on the seaward side and farmland landward. Cattle have access to the stopbank and from there out into the saltmarsh and freshwater swamp forest (left background).



Figure 59: An island amongst oioi and sea rush. Vegetation on the island includes saltmarsh ribbonwood, coastal shrub daisy, large ngaio, pampas, flax, mingimingi, *Coprosma propinqua*, *C. propinqua x robusta*, pohuehue, and red matipo.



Figure 60: Old isolated mangroves amongst mixed oioi/sea rush. The abrupt pampas edge in the background indicates the stopbank with farmland behind.



Figure 61: Sea primrose under a sparse mangrove canopy.



Figure 62: A paddock surrounded by mangroves (each side) and manuka swamp (left background). This farmland is not fenced so stock have easy access to the CMA. Recent infilling has occurred in the foreground.



Figure 63: Rubbish and spoil dumping and stock access along this saltmarsh edge has resulted in the loss of the saltmarsh ribbonwood fringe. Pugging and grazing of mangroves are common here.



Figure 64: This photo shows incomplete fencing along the harbour edge.



Figure 65: Grazed and tracked saltmarsh on the TLB of Waipakupaku creek. Saltwater paspalum present amongst saltmarsh.



Figure 66: The estuarine vegetation becomes freshwater vegetation above this floodgate. Large expanses of saltmarsh ribbonwood line the old stop banks at the head of the embayment (right of picture).



Figure 67: A band of old mangroves and dead saltwater paspalum lies between the mangal and sea rush/oioi zones.



Figure 68: A view looking south over an extensive zone of isolated old mangroves and dead saltwater paspalum. The main mangal lies seaward and sea rush and oioi are landward. Patches of arrow grass can be found amongst the dead saltwater paspalum.



Figure 69: A finger of knee-deep dead saltwater paspalum extending landward into the sea rush and oioi zone.



Figure 70: More dead thick saltwater paspalum around dead mangroves. Live stolons seaward however are establishing new healthy mats of saltwater paspalum.



Figure 71: Dead saltwater paspalum mats with lots of dead material but with live stolons underneath.



Figure 72: Saltwater paspalum and mangroves with some scattered sea rush and slender club rush patches seaward of a dense oioi zone. The oioi extends to the manuka in the background and then wattle dominates behind.



Figure 73: View of regenerating forest on a rocky bluff and scattered mangroves along the coastline north of the Waipakupaku Creek embayment.



Figure 74: A group of young mangroves are establishing out from the main mangal lining Mill Creek and Waipapa Creek mouths.



Figure 75: The head of the Waipapa Creek arm with willow, flax, manuka and tangle fern along the land edge grading into the estuarine vegetation.



Figure 76: This paddock on the TRB of Mill Creek downstream of the SH bridge is not fenced from the harbour, hence the estuarine vegetation (mangroves, saltmarsh ribbonwood, sea rush and saltwater paspalum) is grazed by stock.



Figure 77: A patch of spartina between the mangrove and oioi zones up the Owhero Creek.



Figure 78: Lush seagrass (green) and sea primrose (brown) beds occur in the back of a small mangrove embayment to the north of Owhero Creek mouth. The embayment is surrounded by bluffs and well-advanced regenerating bush.



Figure 79: Saltwater paspalum advancing seaward from the native forest land edge.



Figure 80: Another view of saltwater paspalum advancing seaward around mangroves.



Figure 81: The southern edge of the mangrove band between Te Ana Point and a headland opposite Kopaki Point. A dense band of saltmarsh ribbonwood is present under the gums.



Figure 82: Saltwater paspalum extending down into the seagrass zone at this sheltered site in behind a mangal.



Figure 83: Mangroves abut freshwater wetland (predominantly tangle fern, *Baumea juncea*). Fernbird are present in the freshwater wetland.



Figure 84: Low mangroves occur on the exposed eastern harbour-side of the small mangrove island near Te Ana Point. Note the exposed roots where the sediment level has lowered. The rest of the island supports much taller well-rooted mangroves.



Figure 85: A typical coastal edge on the TRB of the Whangamaroro River mouth with seagrass under mangroves. The mangroves generally extend right up to the coastal forest except for scattered small pockets of rush/sedgeland as pictured here.



Figure 86: A marooned boat in mangroves south-west of Te Ana Point. Note the dense seagrass bed in the foreground.



Figure 87: *Machaerina* on the harbour edge immediately south-west of Te Ana Pt.



Figure 88: A dredged channel with infill connecting the farmland to the CMA and allowing stock access.



Figure 89: Farming rubbish dumped in the CMA.



Figure 90: Saltwater paspalum surrounding large dead (or dying) mangroves and mixing with sea rush, oioi and small mangroves.



Figure 91: A saltwater paspalum-free area of the embayment showing open mud flats, mangroves, sea rush, oioi and a fringe of saltmarsh ribbonwood along the landward edge.



Figure 92: Fill (concrete etc) dumped along the Whangamaroro River. The banks are highly eroded with thin patches of oioi or saltwater paspalum. Generally the banks are not well fenced from stock. Some new willow stakes have been planted along the upper TRB.



Figure 93: Site of a pied stilt colony on the TLB of the Waimaroro River mouth. At least 25 pied stilt were seen as well as some nests. Saltwater paspalum is prevalent.



Figure 94: Large isolated mangroves up to 9m high are common scattered along the landward fringe of the mangal.



Figure 95: Saltwater paspalum and arrow grass in an open patch amongst saltmarsh.



Figure 96: Here saltmarsh ribbonwood forms a band backing the saltmarsh and grades into manuka forest with a thick montbretia understory. Stock access is a problem.



Figure 97: Earthworks along the golf club boundary has destroyed threatened back-swamp vegetation and fernbird habitat. The wetland here is composed of *Baumea juncea*, *Coprosma propinqua*, *Coprosma propinqua x robusta*, manuka and flax.



Figure 98: Cat prints amongst mangroves near the Moewai Park Rd rubbish dump.



Figure 99: Rubbish is spilling out from the poorly contained Moewai Park Road rubbish dump into the CMA.



Figure 100: Banded rail footprints were present here in the area of low young rush and saltwater paspalum.



Figure 101: A view east over the saltmarsh zone. A thin band of saltmarsh ribbonwood and manuka along the saltmarsh edge hides development along Moewai Park Road and enhances the natural character of the area.



Figure 102: Mixed *Baumea juncea* and raupo amongst short 1-1.5m tall mangroves. A wide oioi zone occurs landward of here.



Figure 103: A raised walkway through the saltmarsh and mangroves.



Figure 104: Cleared mangroves and a dredged channel to reclaimed land on the esplanade reserve.



Figure 105: Looking east along the saltmarsh ribbonwood, oioi and sea rush zone behind mangroves. Saltwater paspalum is mixed through this zone.



Figure 106: A reef heron, pied shags and mallard ducks on the TRB of the Waterways canal development entrance.



Figure 107: TLB of the Waterways canal entrance. Saltwater paspalum occurs near the sign with sea primrose and glasswort intermingled. Sea rush, oioi and saltmarsh ribbonwood are present behind the mangroves. Builders rubbish has washed into the mangroves.



Figure 108: A view of approximately 100 dead mangroves along the TLB of the Waterways canal entrance. They have all been drilled and poisoned. The trees are generally greater than 5m high.



Figure 109: A dead mangrove with drill holes. The hole shown in the middle of the photo has been 'plugged'.



Figure 110: A mangrove that has been ring-barked but is not dead.



Figure 111: Another view of the stand of dead mangroves along TLB of the Waterways canal entrance.



Figure 112: Piles of garden waste occur along the coastal edge of Whitianga township (here backing onto a few mangroves).



Figure 113: The shoreline becomes armoured around the township. Weeds such as agapanthus are prevalent.

3.2 Threats

There are several significant existing and potential threats to the native estuarine vegetation communities of Whitianga Harbour.

Weeds

Estuarine weeds already dominate large areas of the estuary at the expense of estuarine vegetation and wildlife habitat, and will lead to a further loss of plant and animal biodiversity in the estuary as they continue to expand.

Saltwater paspalum is the most significant weed as it is present throughout the harbour amongst all estuarine vegetation communities (even amongst seagrass). Saltwater paspalum is an introduced grass that it is extremely efficient at stabilising sediments and building up bed levels. This can cause more severe flooding upstream as water is unable to be released as quickly. Saltwater paspalum competes for space with native estuarine vegetation and colonises open mudflats. Due to its climbing ability and formation of dense beds up to half a metre deep, it can smother sea meadow, saltmarsh ribbonwood and rush/sedgeland communities to form dense mono-specific mats. Observations made in this and other Coromandel Peninsula estuaries and harbours indicate that saltwater paspalum may also affect the health of mature mangroves. Saltwater paspalum mats on open mudflats may also enhance mangrove seedling settlement in open areas.

Currently no control of saltwater paspalum is being undertaken in Whitianga Harbour. The die-off of saltwater paspalum observed in the harbour, apparently from frost, may not actually completely kill the grass, and it is expected to grow back from stolons underneath the substrate.

Spartina has been found at only one site in the harbour. Spartina is an introduced grass that can colonise vegetated and non-vegetated estuarine flats. It is extremely efficient at stabilising sediments and building up bed levels. Spartina competes for space with native estuarine vegetation or changes an open mudflat into a vegetated flat.

The Department of Conservation has been controlling spartina in other Coromandel estuaries by spraying the grass with the herbicide Gallant. As with any weed control, repeat spraying is necessary to ensure remnant populations are entirely controlled.

Coastal edge weeds are scattered along the harbour edge (i.e. immediately above the saltmarsh ribbonwood zone). Weeds noted include pampas, wattle, willow, wilding pine, gorse, tamarisk salt cedar and tall

fescue. These species can suppress natural regeneration of the native communities along the harbour edge, and in places compete with saltmarsh ribbonwood. Tamarisk hasn't been noted as a common estuarine weed before. It is a deciduous genus from southern and western Europe, India, North Africa and Asia that occurs on coastal flats, river estuaries and other coastal environments (Paddison & Bryant, 2001). Dumping of garden waste can spread a plethora of different weed species along the coast line.

Stock access

While stock access to the CMA is not a huge issue in Whitianga Harbour, there are still areas which require fencing to ensure estuarine areas are not grazed (even if these lie within private property boundaries). Where stock (cattle and sheep) have access to estuarine vegetation they have damaged it directly through trampling and pugging. The disturbance encourages the establishment and spread of weeds such as saltwater paspalum. Weeds can also be spread in the hooves of stock or by fragments being dislodged by stock. Pugging also creates habitat suitable for the Southern saltmarsh mosquito (*Aedes camptorhynchus*), for which there is recently been an eradication programme on the Coromandel Peninsula. Stock also increase the levels of sedimentation in the estuary via pugging and stream bank erosion, and they pollute water with urine and faecal matter. Stock will browse mangroves and if really hungry also saltmarsh ribbonwood. These effects can be detrimental to the native vegetation communities and wildlife in these areas.

Feral pigs have a similar effect as stock in the harbour. Pig damage (mainly in the rush/sedge communities) was particularly prevalent along the Kopaki to Kaitoke foreshore.

Clean waterways

Land activities such can have significant adverse effects on water quality. The fencing and planting of stream banks helps filter land runoff and reduce the effect of elevated nutrient levels (nitrogen and phosphorus) and sediment from farm and forestry activities.

Infilling

Stopbanks have transformed large areas of what would have been estuarine and freshwater vegetation into paddocks, with the associated loss of this habitat for wildlife. Stopbanks form un-natural boundaries to the remaining native harbour vegetation. The largest areas of estuarine wetland loss has occurred either side of the Waiwawa River. No further stopbanking should be allowed to occur, and all opportunities taken to restore lost wetland areas where possible.

Armouring

Armouring of the foreshore around Whitianga is prevalent where buildings and services are located too close to the active coastal edge. Long-term solutions, such as appropriate relocation of buildings, are required to protect the natural character of the coastal edge.

Mangrove clearing/poisoning

Mangrove destruction has occurred at a number of places including around the Whitianga Waterways entrance and further upstream. Education and enforcement are required to ensure the public understanding the importance role of mangroves in the harbour ecosystem and it is not acceptable to take self-interests into ones own hands.

Predators

Cats are predators of banded rail and fernbird. The expansion of human habitation around the harbour edge increases this predatory pressure unless housing near wildlife habitat have restrictions on keeping cats (and dogs – a predator of bittern).

Rubbish

Rubbish in the CMA is an issue where it is illegally dumped (this usually has involved farming rubbish such as silage wrapping and old machinery or appliances); or is leaching and eroding out from old dump sites (e.g. Moewai Park Road refuse centre).

3.3 Birds

Birds seen or heard in the harbour environment during the survey are:

Threatened species – pied stilt, reef heron, fernbird, banded rail, pied shag, little pied shag, little black shag.

Other species – White faced heron, kingfisher, pukeko, paradise duck, mallard duck, spur-winged plover.

Australasian bittern (threatened species) have been reported from various sites over time (e.g. they were historically plentiful around Hodges Road) however none were heard or seen during this survey.

4. Discussion and Recommendations

Comparison of this survey's results with those of the 1999 survey will highlight any changes in the spatial extent of the estuarine vegetation communities.

Significantly, no spartina was recorded in the 1999 survey whilst this survey found a patch at the mouth of Owhero Creek.

The extensive areas of die-off of saltwater paspalum around the Whenuakite, Waiwawa River and Waipakupaku Creek mouths was particularly interesting. This was most likely due to frosts coinciding with low tides on calm early mornings. The only other vegetation noted as affected where a few young mangrove seedlings out in the open. It is anticipated that the saltwater paspalum will grow back from underneath.

Seagrass was either found on its own or associated with mangroves. In a couple of areas saltwater paspalum was seen mingling with the upper edge of some seagrass beds lining the inshore edge of a mangal. In most instances where seagrass was associated with mangroves, it was under the canopy of tall mature trees. However, in some places e.g. along the TRB of the Wangamaroro River mouth, seagrass was found under a wide range of tree heights including stands of only 0.5m tall mangroves. The absence of large seagrass beds on the intertidal flats of Whitianga Harbour could be due to high freshwater flushing or wind/wave exposure. It is noted that seagrass occurring up small creeks may have been overlooked as these areas were generally surveyed at high tide for ease of access.

Historically, the extensive native forest clearance (logging and burning) in the Whitianga Harbour catchment would have delivered huge amounts of sediment into the harbour, accelerating the infilling of the upper tidal arms. The current main contributors of elevated sediment delivery to the harbour are most likely to be from farming and forestry activities.

The following are recommended actions to maintain and restore the native estuarine vegetation communities of Whitianga Harbour:

1. Continue encouragement and requirements for the protection of riparian edges to limit bank erosion and land run-off of sediment and nutrients. In particular, all of the CMA adjacent to farmed land needs to be fenced from stock. This will avoid the significant adverse pugging and grazing by stock that is still occurring within the harbour environment.
2. Ensure farmers adjacent to the harbour are aware of their legal obligations to keep stock out of the CMA.

3. Undertake a feasibility study to control saltwater paspalum within the harbour.
4. Encourage property owners, Thames-Coromandel District Council and community groups to control wilding pines, willow wattle and other coastal weeds around the harbour margin.
5. Encourage animal pest control around the harbour margin to protect the estuarine vegetation as well as fernbird, bittern and banded rail populations where there is property owner and/or community support to do so. Pig damage to saltmarsh vegetation was quite severe in places (particularly between Kopaki and Kaitoki Points).
6. Encourage landowners to protect and restore pockets of historic coastal floodplain forest, and other native vegetation sequences that extend from the sea to land.
7. Remove the infill on the public reserve adjacent to DPS5809 Lots 39 and 41 at Moewai Park Road, and re-instate the estuarine vegetation communities.
8. Investigate methods such as land purchasing to address flooding issues, and restore the flood plain vegetation communities around the Weiti Stream road bridge on SH25. This will allow for a wider flood path under the SH and out over the low-lying land.
9. Investigate potential ecological restoration of the spit end of Whangamaroro River, as this has excellent potential as a relatively straightforward restoration project.
10. Undertake weed control on the harbour islands, including the removal of the Tamarisk salt cedar (see Figure 9).
11. Check the containment of the Moewai Park Road rubbish site immediately adjacent to the harbour edge. There is rubbish loose in the intertidal soils and vegetation, indicating poor containment of the site. This needs to be rectified.
12. Check and enforce a clean-up of farmer's rubbish and infills around the harbour edge (e.g. Figures 63 and 89).
13. Encourage cat control around the coastal margin of the rubbish dump site. Cat sign within the CMA was noted in this area. Cats will be preying on wetland birds (particularly banded rail and fernbird) which are present in this area.
14. Monitor the mangroves near the Waterways canal entrance to ensure no further illegal poisoning or felling of mangroves occurs. Consider an investigation into the illegal poisoning that has occurred.
15. Raise awareness of the value of estuarine vegetation. Perhaps an interpretation board illustrating the plants and animals living in the harbour could be sited at the Robinson Road boat ramp.

5. Bibliography

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Appendix 1: GPS locations of figures

Figure no.	Longitude	Latitude
2-3	175.7122	-36.8369
4	175.7095	-36.8411
5	175.7063	-36.8484
6	175.6922	-36.8715
7	175.6934	-36.8651
8	175.6961	-36.8669
9	175.6919	-36.8710
10	175.7068	-36.8700
11	175.7113	-36.8708
12	175.7116	-36.8688
13	175.7137	-36.8702
14	175.7163	-36.8727
15	175.7162	-36.8741
16	175.7158	-36.8747
17	175.7136	-36.8783
18	175.7118	-36.8793
19	175.7091	-36.8791
20	175.7103	-36.8744
21	175.7085	-36.8795
22	175.7101	-36.8768
23	175.7108	-36.8772
24	175.7057	-36.8806
25	175.7075	-36.8823
26	175.7051	-36.8843
27	175.7008	-36.8843
28	175.6992	-36.8892
29	175.6985	-36.8891
30	175.7055	-36.8884
31	175.7064	-36.8884
32	175.7068	-36.8886
33	175.7080	-36.8917
34	175.7082	-36.8925
35	175.7102	-36.8941
36	175.7120	-36.8966
37	175.7103	-36.8956
38-39	175.7107	-36.8978
40	175.7108	-36.8976
41	175.7118	-36.8992
42-45	175.7157	-36.9059
46	175.7086	-36.9029
47	175.7071	-36.8927
48	175.7054	-36.8905
49	175.7055	-36.8908
50	175.7053	-36.8918
51-52	175.7053	-36.8922
53-54	175.7023	-36.8955
55	175.7001	-36.8969
56	175.7004	-36.8965
57	175.7021	-36.8920
58	175.6984	-36.8932
59	175.6967	-36.8923

60	175.6966	-36.8915
61	175.6966	-36.8908
62	175.6925	-36.8886
63	175.6892	-36.8919
64	175.6888	-36.8925
65	175.6868	-36.8940
66	175.6859	-36.8955
67	175.6865	-36.8924
68	175.6860	-36.8915
69	175.6857	-36.8911
70	175.6856	-36.8900
71	175.6858	-36.8897
72	175.6855	-36.8895
73	175.6895	-36.8874
74	175.6793	-36.8785
75	175.6747	-36.8877
76	175.6731	-36.8804
77	175.6679	-36.8723
78	175.6785	-36.8668
79	175.6809	-36.8651
80	175.6809	-36.8652
81	175.6851	-36.8602
82	175.6853	-36.8560
83	175.6852	-36.8556
84	175.6900	-36.8527
85	175.6812	-36.8503
86	175.6819	-36.8493
87	175.6838	-36.8483
88	175.6722	-36.8559
89	175.6717	-36.8554
90	175.6726	-36.8546
91	175.6715	-36.8541
92	175.6690	-36.8450
93	175.6733	-36.8526
94	175.6746	-36.8520
95	175.6712	-36.8417
96	175.6703	-36.8394
97	175.6712	-36.8331
98	175.6749	-36.8369
99	175.6757	-36.8375
100	175.6772	-36.8382
101	175.6780	-36.8382
102	175.6796	-36.8393
103	175.6805	-36.8400
104	175.6816	-36.8407
105	175.6845	-36.8418
106	175.6867	-36.8424
107	175.6874	-36.8421
108	175.6881	-36.8425
109-110	175.6876	-36.8424
111	175.6888	-36.8435
112	175.6965	-36.8450
113	175.7009	-36.8423