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Estuarine vegetation survey – Kawhia Harbour

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Report prepared for:

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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 Waikato Regional Council to continue with this method. The estuarine vegetation of Tairua, Coromandel, Te Kouma, Manaia, Whitianga, Port Waikato, Raglan, Aotea, Kawhia, Otama, Whangapoua harbours and the inner Firth of Thames have since been surveyed and mapped. Of these harbours, Whangamata, Wharekawa, Otahu, Tairua, Coromandel, Te Kouma, Manaia, Whitianga, Port Waikato, Raglan and Aotea have been re-surveyed to determine changes in vegetation communities over time.

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

This report details the results from the second survey of estuarine vegetation in Kawhia Harbour which was first surveyed in 2005. Comments are included about the estuarine vegetation present, the threats to native estuarine vegetation communities, and other field notes of interest. This report accompanies the relevant aerial map and estuarine vegetation community overlays of the survey site.

2 Methodology

The field survey was undertaken over 16 days between the 30th October and the 5th December 2012. 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, 2010b) with a personal digital assistant (Yuma PDA) loaded with aerial photographs (WRAPS 2007) of the survey area. However seagrass could not be mapped using the same aerials due to the WRAPS 2007 aerials having been taken with the tide in over the mid-tide flats thus obscuring much of the seagrass beds. Instead seagrass beds out on the open flats of the main harbour were mapped later using WRAPS 2012 aerials once they became available. Coded polygons were drawn directly over the aerial photographs to define the spatial extent of wetland vegetation types as they were ground-truthed in the field. The use of colour pen notations on hard copy aerial photographs were reserved (but not used) as a backup for when there were instrument problems or the weather made using the PDA difficult (e.g. sun exposure made it too difficult to see the PDA screen clearly in the field).

The upper saltwater influence is usually indicated by the upstream limit of oioi, saltwater paspalum or saltmarsh ribbonwood. The limit of these plants determined the inland/upstream extent of the survey.

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 krausii* subsp. *australiensis*), oioi *(Apodasmia similis),* and generally only common on the West Coast, three-square sedge *(Schoenoplectus pungens).* Marsh clubrush *(Bolboschoenus fluviatilis /B. medianus)* is commonly found up streams and rivers at the upper estuarine limit in some harbours, although it is not generally mapped[1] 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 often common giving a patchy appearance

[1] Except where marsh clubrush is intermingled with oioi and is too difficult to separate out for mapping

compared with the uniformity of the 'rush/sedge community'. Small areas of sea primrose *(Samolus repens)*, remuremu *(Selliera radicans)*, the coast spear grass *(Stipa 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, spartina *(Spartina* spp.*)*, saltwater paspalum *(Paspalum vaginatum)* and sea meadow 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)* and alligator weed (*Alternanthera philoxeroides*)) 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.

Table 1 lists common estuarine plant species (and their associated 'estuarine vegetation community') mapped during the survey.

Mixed mapping categories are used to indicate the occurrence of 'mixed' vegetation communities. Saltwater paspalum in particular is spreading and mixing with rush/sedge, sea meadow and saltmarsh ribbonwood communities. Where vegetation was found under the canopy of mangroves (e.g. seagrass or saltwater paspalum under mangroves) this was mapped as a 'mixed' community.

Saltwater paspalum is known to co-exist with spinifex however mapping of saltwater paspalum stops once spinifex is present as it is then determined to be an 'open coastal' rather than 'estuarine' environment.

Table 1: Estuarine plant species found in Kawhia Harbour

Common/Maori name	**Scientific name**	**Estuarine Vegetation Community**
arrow grass	*Triglochin striata*	sea meadow
coast spear grass	*Austrostipa stipoides*	sea meadow
glasswort	*Sarcocornia quinqueflora*	sea meadow
leptinella	*Leptinella dioica/dispersa*	sea meadow
lilaeopsis	*Lilaeopsis novae-zelandiae*	sea meadow
mangrove	*Avicennia marina* subsp. *australasica*	mangrove
native celery	*Apium prostratum* var. *filiforme*	sea meadow
oioi	*Apodasmia similis*	rush/sedge
remuremu	*Selliera radicans*	sea meadow
saltmarsh ribbonwood	*Plagianthus divaricatus*	saltmarsh ribbonwood
saltwater paspalum *	*Paspalum vaginatum*	weed
sand buttercup	*Ranunculus acaulis*	sea meadow
seagrass	*Zostera capricorni*	seagrass
sea primrose	*Samolus repens*	sea meadow
sea rush	*Juncus krausii* subsp. *australiensis*	rush/sedge
shore lobelia	*Lobelia anceps*	sea meadow
slender clubrush	*Isolepis cernua*	sea meadow
spartina *	*Spartina anglica/ S. alterniflora*	weed
three square	*Schoenoplectus pungens*	rush/sedge

* denotes an exotic species

3 Results

Site locations within the harbour are shown in Figure 1 as well as the position of the photos that are referred to in the site descriptions below.

3.1 Overview

- Seagrass beds were found throughout the mid-harbour flats roughly from Pute Point to Te Aute Point to the east and Matatua Point to Te Motu to Te Maika in the west. Seagrass beds varied in patchiness and plant density. Small seagrass patches were also found along the upper reaches of some stream arms.
- Sea meadow communities were generally found as thin bands or mixed with rushland along the upper tidal zone. Also a few large communities were found seaward of rushland communities at stream mouths.
- Sea rush and oioi were the dominant species within the rushland communities. Three square was locally common around the harbour.
- A small number of mangroves were found around the harbour in sheltered muddy locations.
- Large saltmarsh ribbonwood communities were restricted to undisturbed stream mouths and were otherwise found as scattered individuals along the high spring tide zone. Saltmarsh ribbonwood have a very narrow habitat range. They are palatable to stock and their extent was often limited by farming activities.
- Uncontrolled and remnant fragments of spartina were found scattered around the harbour.
- Areas of rush die-back were noted around the harbour. These areas often appeared to be associated with increased wave/wind exposure following nearby spartina control.
- Saltwater paspalum was also found scattered around the harbour, generally as small pioneer populations. A large well-established population was present beside the farm causeway to Tuapu Island.
- The south-western catchments were predominantly in regenerating coastal and lowland forest. The forest canopy looked to be in good condition however the understorey was grazed. Free-ranging goats were an issue for the regeneration of native forest and riparian buffers.
- Stock access to the harbour was still a wide-spread problem causing damage to sediments, water quality and vegetation health. Some landowners however had established excellent fencing and riparian setbacks since the last survey in 2005.

3.2 Site descriptions

The estuarine vegetation in Kawhia Harbour is described below clockwise from the northern harbour mouth.

The first estuarine vegetation was encountered within the **Te Ariaotewiwini Inlet** enclosed by a sand spit at the mouth of the harbour. The three square sedge fringed a mixed band of sea rush and oioi at the head of the tidal lagoon. On raised sand banks there were large patches of sea meadow (mainly sea primrose but also some glasswort). An area of sea meadow roughly 17m x 8m wide had been invaded by the introduced grass saltwater paspalum (Figure 3 and Figure 4). Some saltmarsh ribbonwood was found at the eastern end of the rushland. A patch of sea grass and some slender clubrush were also found at the lower end of the rushland. Vehicle tracks crossed through this estuarine wetland community as it is the common ac cess point out to the open coast. A pair of NZ dotterel and a pair of variable oystercatchers were nesting at the end of the dune vegetation on the sand spit. Seagrass patches were found further east at the mouth of the lagoon. The foreshore was then bare of estuarine vegetation along Takapuahia Beach.

Seagrass lined the middle foreshore from **Matatua Point** past the Makatu Marae and town front to the museum. Vehicle tracks were common along the foreshore and either side of the boat ramp. Areas of seaweed (hormosira and *Entromorpha sp.*) were also found between the boat ramp and wharf. The upper foreshore was armoured in various forms from the Makatu marae around to the other side of town. Patches of seagrass were found in front of, or intermingled with, wide bands of three square from the indent by the museum almost to Te Puru Point (Figure 5).

On the outskirts of town around and north of **Te Puru Point** there was a band of glasswort and sea primrose as well as some slender clubrush intermingled with sea rush and three square behind the main three square fringe. The landward extent of the wetland was restricted by urban infilling. Areas of saltwater paspalum were found along the foreshore generally associated with drains/stormwater culverts etc. and mixed with sea meadow species and/or three square. Sea rush became more dominant further into Te Wharu Bay.

The TRB of **Te Wharu Bay** was characterised by thick rushland often backed by a band of saltmarsh ribbonwood. In some areas of the outer bay the seaward margin of the rushland was eroded. The estuarine edge graded into freshwater wetland usually with raupo, flax, manuka and willow. Hard bed rock was often near the surface along part of the outer coastal edge. The rushland and saltmarsh ribbonwood became wider and more mixed past the Waipapa Marae at the coastal **Orongohura Stream** flats. These flats were crossed with drains and grazed in places. Figure 6 shows a large area of rushland that had been fenced within a paddock. There was pugging of the harbour sediments and a lack of saltmarsh ribbonwood and oioi where stock had access. Away from grazing pressure, saltmarsh ribbonwood commonly lined drainage edges as well as the upper tidal edges of the wetland. A few areas of coast spear grass were also found along ridges of higher ground and sea primrose was found in places fringing the seaward edge of the rushland. Banded rail footprints were seen. Away from farmed areas the thick rushland continued along the coastal edge with freshwater wetland of manuka, flax and willows behind. Rushland and saltmarsh ribbonwood fringed Kaiwhai Island with sea meadow common along the south western side and the spit at the eastern end. Back on the mainland, the rushland continued along the northern coastal edge with scattered patches of saltmarsh ribbonwood common. This estuarine vegetation graded into regenerating coastal scrub or freshwater wetland (raupo, manuka, flax and willow) before

reaching the Kawhia Road. A fernbird was heard in the saltmarsh ribbonwood and manuka vegetation and a banded rail was seen crossing the road.

A culvert under the road linked the enclosed **Manawatuhutuha Stream** embayment with Te Wharu Bay. This embayment was primarily lined with rushland. Small amounts of saltmarsh ribbonwood were present. Back out along Te Wharu Bay there was a wide rushland band with sea rush, oioi and three square. Banded rail footprints were seen. Where the rushland narrowed there were rubbish and animal prints along the high tide flats. Vehicle tracks were noted from the road, passing through rushland and over the mudflats. These continued over the upper flats of the bay and out around Motutarakuao Point. The hooked north-eastern head of Te Wharu Bay had areas of the harbour partially fenced within paddocks (Figure 75 and Figure 76). Severe pugging of sediments and grazing and pugging of estuarine vegetation was evident in both cases, generally resulting in the loss of dense rushland and saltmarsh ribbonwood. Sparse pugged rushland often had sea meadow species established within it. Further out of the head a thin band of sea rush and oioi with scattered saltmarsh ribbonwood graded into a three square band mixed with sea primrose, slender clubrush, glasswort and remuremu mixed along the high tide beach. Boxthorn was noted along the coastline. Out around the TLB from an exposed bluff there was a raupo and marsh clubrush wetland with a band of saltmarsh ribbonwood. The saltmarsh ribbonwood was fringed with oioi and sea rush which was fringed in turn by three square. Coast spear grass was present on a sand ridge as well as mixed short three square with saltwater paspalum. Vehicle tracks continued around the coastline and had driven over the sand ridge and into the freshwater wetland behind. Further along the coastline was dominated by macrocarpa trees and eleagnus with only patches of sea primrose present. The next exposed eroding bluff supported no estuarine vegetation. The last estuarine vegetation within the bay was a coastal flat with a three square community out in front and sea rush behind. Within a swale and on a sand ridge the rushland mixed with remuremu and sea primrose. A small patch of saltwater paspalum was found mixed with sea meadow and rushland. Scattered patches of saltmarsh ribbonwood grew inland graded into tall fescue, pampas, flax and a large area of raupo. Further along the front of the coastal flat knobby rush became more predominant and only scattered fringes of sea rush and oioi were found.

The eroding siltstone tidal flats of **Motutarakuao Point** did not support any estuarine vegetation. Mexican daisy was common along the exposed cliffs. Within the embayment between the two points there was a wide band of rushland including sea rush, oioi and three square with freshwater wetland species including raupo behind. Saltmarsh ribbonwood was present around the eastern stream mouth. Coast spear grass and sea primrose were common on sandy beaches/ridges along the TRB of the bay with rushland seaward. Two patches of seagrass were found out towards **Motutarakatua Point**. Goat prints were common all along the foreshore. The coast line was exposed and eroded out around Motutarakatua Point and along the foreshore to the oyster farm. The only estuarine vegetation was scattered coast spear grass. Mexican daisy and pampas were common along the coastal edge of Motutarkatua Point but flax and toetoe became more predominant further in towards the Mangaora Inlet causeway (Figure 9). A small band of oioi and saltmarsh ribbonwood was found where equipment for the oyster farm was stored along the foreshore. Nearby was a small patch of saltwater paspalum. Vehicle tracks were noted along the foreshore. Three square was found out on the upper mid-tide flats and mixed with saltwater paspalum along the high tide beach in front of some housing. A small area of rushland, sea meadow and a saltmarsh ribbonwood bush were found at the mouth of a stream. Saltwater paspalum continued to dominate the high tide beach towards the causeway until it graded into pure *Carex pumila*.

Upstream of the causeway along the TRB of the **Mangaora Inlet** there is a large pool where water moves in and out through the three large culverts. Glasswort, sea primrose and coast spear grass are found along the rip rap of the causeway. The sediment is relatively firm along the lower TRB. Regenerating coastal forest extends up the TRB with thin bands of sea rush, oioi and some three square within the shallow scooped bays. Scattered saltmarsh ribbonwood are present along the inland edge while patchy fringes of sea meadow including sea primrose, slender clubrush, glasswort, remuremu, arrow grass and/or coast spear grass were sometimes present. Sea meadow was present around exposed land edges. Figure 10 shows a stretch of coastline that used to be grazed. There was no sign of stock access during this survey and the estuarine vegetation was looking healthy. The old fence line within the harbour however was still present. The pacific oyster beds ended where the stream channel came in close to the TRB at Figure 10. Another stretch of remnant coastal forest/wetland edge continues along the TRB until more pasture was reached. The farmland was fenced but with little room for riparian vegetation to establish. A large eleagnus patch was found eliminating all other vegetation above and below the high tide line. Rushland continued to line the coastal edge up to the head of the inlet. At the head, the rushland widened out to fill the tidal flats. Saltmarsh ribbonwood was scattered commonly around the upper TRB and also lined much of the TRB of the channel edge. The very upper TLB of the stream channel also had saltmarsh ribbonwood along it. Patches of sea primrose and arrow grass were found in areas in front of the rushland including a large community along the TLB of the channel (Figure 11). Banded rail footprints were found. The remains of a spartina bed was visible here. The green seaweed *Entromorpha sp.* was common on the upper open flats. Moving down along the TLB sea rush and oioi continued as a band along the coastline. There wasn't much protected riparian vegetation however the farmland was fenced from the harbour until the homestead bay was reached. A fence line crossed the northern head of the homestead bay leaving areas of saltmarsh ribbonwood, rushland and sea meadow communities open to grazing and pugging by stock. A patch of saltwater paspalum was found amongst three square rushland on a stream outwash. Around the stream was a mosaic of three square, marsh clubrush, sea rush, oioi, sea meadow and mercer grass. Rushland continued out of the bay until the coastline became more exposed with only patches of rushland and sea meadow present. A sharp indent sheltered a community of sea meadow, saltmarsh ribbonwood and rushland. A cow skeleton was noted. Patchy sea rush and sea meadow (including coast spear grass, sea primrose, leptinella and remuremu) continue around the coastline into the indent behind the road rest area. There was sea rush, oioi and three square present and a number of patches of sea grass on the open flats as well as a patch mixed with three square. Sea primrose was also either on the open flats or mixed with rushland. Figure 13 shows some short spartina flanked by rushland and sea meadow at the end of the indent. Rushland fringed the back of the rest area out to a point with coast spear grass, sea primrose and glasswort. There were also scattered saltmarsh ribbonwood plants. The coastal edge then became steep and eroded with willows or poplars out to the rocky causeway.

Out along the seaward side of the causeway there was no estuarine vegetation. The coast line was highly eroded around **Puti Point** and all the way along the coast line adjacent to the Kawhia Road. Oysters were present along the mid-high tide zone until the **Oihuroa Stream** mouth was reached. Upstream of where the oyster bed stopped there were patches of oioi and sea rush along the foreshore as well as patches of sea primrose, slender clubrush, glasswort and remuremu. As the land edge moved away from the Kawhia Road, flax lined an eroding coastal edge.

Around the point into the **Kawaroa Stream** arm there were patches of oioi with marsh clubrush and flax behind. The coastline then became edged by sandy beaches with three square common. The riparian edge was a mixture of exotic weeds including pasture grasses,

honeysuckle, pampas, wattle, as well as remnant native shrubs and flax. There was a large area of rushland, saltmarsh ribbonwood, sea meadow and flax in front of some paddocks. Some of the inland wetland had been fenced off from past grazing. Fernbird were heard in the saltmarsh ribbonwood communities. Sea meadow species found on sand ridges and associated with rushland included sea primrose, remuremu, coast spear grass, slender clubrush, native celery and glasswort. Oioi and sea rush were common along the TRB. A fernbird was heard in the saltmarsh ribbonwood at the head of the arm. The large saltmarsh ribbonwood communities graded into *Coprosma propinqua*, *Olearia solandri* and then into freshwater species along the channel edge.

Moving down the TLB of the Kawaroa Stream arm, saltmarsh ribbonwood lined the land edge fringing a wide sea rush band. At the end of a macrocarpa spit there was a large patch of spartina mixed with rushland. Continuing around the coastline there was mixed rushland and sea meadow. Three square was present again with the sea rush. The rushland continued out along the coastline but as a narrower band than that found at the head of the bay. The flats were silty and there were plenty of titiko present. A small indent that used to have spartina across its mouth had had the spartina controlled and the landward edge of the indent fenced from stock (Figure 14). The outer coastline of the bay was eroded with old roots and stumps still present out on the harbour flats. The land edge had flax and grasses along it, with scattered small bands of rushland and sea meadow. The harbour margin was well fenced except for a small stream mouth that was fenced within the paddock and dredged. The oyster beds that extended a third of the way into the arm, extended up to the land edge at the TLB headland. The coastline was composed of hard bedrock and cliffs with pines. There is no estuarine vegetation around the headland or along the beach up to **Ngatokakairiri Island**. The island only had a small band of coast spear grass on the eastern side. The next beach along had a mixed community of rushland (sea rush, oioi and three square), sea meadow and saltwater paspalum. The third small beach also had saltwater paspalum. The next headland (**Te Kaapi Point**) had exposed bedrock and oysters, but no estuarine vegetation, grading into muddy flats. The cliffs were topped with pohutukawa coastal forest. The next wide embayment had a few small beaches and then a long eroded coastline at the head (Figure 15). Fencing of the harbour edge continued all around the bay although sign of stock grazing and dung were noted along the coastal edge. Estuarine vegetation was limited to sheltered creek margins or over-wash areas and thin bands of sea meadow and saltwater paspalum along the front of the eroded coast line. Old tree roots were sticking out of the mudflats. A dead cow was found at the base of the cliffs that extended out to **Motukotuku Point**. It may have washed in or fallen over the cliff at one of the only points that wasn't fenced. Very little estuarine vegetation was found out to the headland. Boulders were common over the bedrock along with oysters at the lower high tide zone. Pines were common along the riparian margin.

Large oyster beds extended into the large **Oparau River** arm. The flats were very muddy. Little estuarine vegetation was found until a small pugged indent where there was pugged and/or grazed sea rush and sea meadow. An extra wire was required here to exclude stock from the harbour. Stock tracking continued along the foreshore. The riparian margin had remnant coastal forest with totara. Bands of sea meadow including sea primrose, glasswort and coast spear grass were common along the upper high tide zone. Some long thin patches of seagrass were found close up to the land edge. A cow skeleton was found and another couple of pugged rushland and sea meadow patches were found. Arrow grass was common. Stock tracking continued along the foreshore. Another indent with rushland was severely pugged with dead or dying oioi inland of the sea rush. Bands of sea meadow continued along the coastline and included shore lobelia. Figure 16 shows where stock were gaining access to the harbour. The situation could be improved by fencing around behind the remnant riparian

vegetation and the freshwater seepage, protecting these important vegetation communities while also protecting the harbour from stock. Pugging of the foreshore and pugging and grazing of estuarine vegetation continued upstream. Dung was noted within the harbour too.

The **Okiore Creek** arm had a riparian edge of totara along much of the TRB. Sea rush and some oioi lined the banks. A large patch of sea primrose was found and arrow grass mixed with sea rush in a number of places. The open flats were quite thickly covered in mats of *Entromorpha sp.* seaweed. The rushland continued up until the channel narrowed. At the top of the arm there was rushland, saltmarsh ribbonwood and marsh clubrush. Rushland fringed with saltmarsh ribbonwood extended out down the TLB with the saltmarsh ribbonwood becoming patchy out towards the mouth of the arm.

The **Waihohonu Stream** arm has a band of saltmarsh ribbonwood all along the TRB. Up near the top of the arm the saltmarsh ribbonwood mixed with swamp coprosma and *Olearia solandri* and there are wide bands of oioi. At the head of the arm the saltmarsh ribbonwood continued to edge the rushland until the road culvert was reached. Upstream of the road, the rushland was unfenced within paddocks and very little saltmarsh ribbonwood was present. Moving downstream of the road along the TLB the rushland was unfenced adjacent to pasture and saltmarsh ribbonwood was again scarce except where there was a hot wire fence along the coastal edge. The large rushland community out at the mouth of the arm was pugged and grazed giving it a patchy appearance. Arrow grass was common on the open ground amongst the sea rush. No fencing was present from the totara at the mouth of the Waihohonu Stream arm and around the coastal margin of the upper **Oparau River**.

The estuarine vegetation thinned out below the Raglan Road bridge and stopped upstream of the bridge with scattered oioi and saltmarsh ribbonwood. Moving downstream the TLB riparian margin had native trees as well as wild grape, eleagnus, rose and pampas.

None of the farmland along the TLB was fenced. Rushland and, where not grazed, some saltmarsh ribbonwood lined the shore. Riparian vegetation along the farmland was composed of either grass or gorse and some regenerating native shrubs. Further along three square became the dominant vegetation along the edge of the mudflats with slender clubrush mixed into the upper edge of the three square. Patches of saltwater paspalum were also found. Above the erosion scarp diverse sea meadow communities were common (Figure 17). Sea meadow species included slender clubrush, *Leptinella dioica*, remuremu, sea primrose, native celery and an unidentified *Plantago.* This zone sometimes included scattered sea rush. The highly grazed foreshore was also heavily tracked and pugged, and dung was common on the upper intertidal flats. A cow skeleton was also found. The land edge then became steeper with eroding cliff edges extending out to bedrock platforms or boulder beaches. Oyster beds were common fringing the upper mud flats. Pine trees were the common riparian vegetation along the cliff faces with farmland in behind. Groups of sheep were disturbed on a number of the small beaches (Figure 18) and stock tracking continued around the coastline. Some saltwater paspalum was found with sea meadow communities. Canadian geese and black-backed gulls were also disturbed. Bare coastal cliffs and beaches with no estuarine vegetation continued around into the Papakura Stream bay.

The **Papakura Stream** bay was not fenced from stock. A narrow short sea meadow band along the eroding land edge included remuremu, slender clubrush, plantain, *Leptinella dioica* and saltwater paspalum. Boggy pugged areas further inland had bachelors button. Further into the bay patches of sea primrose and sea rush were found along the eroding edge which then widened out into thick rushland including three square, sea rush and oioi. The back of the rushland was tracked, grazed and pugged especially around a freshwater seepage with raupo,

manuka and freshwater rushes. This graded out into saltmarsh ribbonwood which as heavily grazed and mixed with sea rush and diverse sea meadow. Off the land edge on the mudflats the wide sea rush and oioi band continued around and up the TRB of the bay. The flats were very muddy and stock impacts were limited to the firmer inland tidal edge. The rushland stopped around an eroded pugged headland and then continued up to the head of the bay with animal tracking at the back of the rushland and sea meadow band. A sheep skeleton was found. The rushland then thinned around a marsh clubrush and raupo wetland. A few scattered saltmarsh ribbonwood were found. Rushland continued around into the Papakura Stream mouth grading into marsh clubrush and raupo which continued up the stream margins. There was a bit of remnant kanuka and gorse within the riparian margin. There was still no fencing of the CMA.

Along the upper TLB there was a band of sea rush with sea meadow along the upper tidal edge and mixing down into the top of the rush zone. The upper rush zone was pugged and dung was present. Sea meadow species present included slender clubrush, sea primrose, plantain, bachelors button, remuremu and *Leptinella dioica*. Saltwater paspalum was present along the high tide beach around the derelict boat and further along a wide open beach used by cows and sheep. At the end of the beach were pugged rushland, sea meadow and saltwater paspalum communities that extended inland into a marsh clubrush, raupo and willow wetland (Figure 20). Tracking and pugging of the upper estuarine edge continued along the TLB (Figure 21). Saltwater paspalum was found in places along the upper tidal edge. Marsh clubrush seemed to be highly palatable as indicated by areas where heavy grazing had left just bulbous roots. Arrow grass was quite common mixed with the marsh clubrush. Another freshwater wetland was found in an indent further out along the TLB with freshwater rushes, raupo swamp coprosma, manuka and willows. The freshwater wetland continued out around a small headland with *Muehlenbeckia* along the front and copper butterflies. This was fringed by patches of saltmarsh ribbonwood, a thin band of rushland and a small patch of saltwater paspalum. Further along there was a band of three square and a pugged foreshore. Horses were encountered in the wetland and along the beach. In behind the sand ridge and extending south was another marsh clubrush wetland fringed by sea rush and with patches of oioi and saltmarsh ribbonwood further inland. In front of the sand ridge was sea rush mixed with sea meadow. Patches of saltwater paspalum were also found along the sand ridge. The remaining coastline out of the bay and out to the tip of the headland had an eroding edge with no estuarine vegetation except a small patch of coast spear grass and sea primrose. Stock tracking along the foreshore was still common.

Around the headland into the embayment at the base of **Tiritirimatangi Peninsula** there was a fenced band of coastal forest backing a band of marsh clubrush, sea rush, oioi and a large mangrove. This widened out into an extensive estuarine and freshwater wetland. The wide rushland included both sea rush and oioi with saltmarsh ribbonwood common on higher ground before grading into swamp coprosma, *Olearia solandri* and manuka. Fernbird were heard and seen in the saltmarsh ribbonwood. The extensive mosaic of estuarine and freshwater wetland extended along the northern side of the farm causeway. Banded rail footprints were found in the rushland. Some areas of sea rush die-back were noted (Figure 22 and Figure 23). Pugging was evident in the rushland/saltmarsh ribbonwood interface and back into the freshwater swamp land edging the farmland. The estuarine and freshwater wetland complex became even larger as it filled the coastal flats from the causeway towards Point Ellis (Otara Point) stopping south of Te Rarangi Rocks. A large sand spit which enclosed some of the wetland had a lot of saltwater paspalum on it and some sea meadow on the inshore side. Stock had access to this sand spit and had tracked and pugged the rushland north west of the spit. Cattle prints and dung were found continuing along the foreshore. Saltwater paspalum continued along the sandy coastline and extended into the pugged rushland behind. Willow

were present in the north western arm of the freshwater wetland. Opposite **Te Rarani Rocks** there was a low-lying area of pugged sea rush and sea meadow with an eroding edge. There was no estuarine vegetation along the eroding steep coastline from Point Ellis (**Otara Point**) all the way around to **Kaiwaka Point** except for one small tenacious patch of oioi and sea rush. The riparian vegetation was limited to pasture grasses, gorse and the odd scattered remnant coastal tree. Stock used the bay sheltered by Kaiwaka Point to access the coastline east and west. The foreshore was heavily pugged and the wetland draining out to the bay was pugged and grazed. Estuarine vegetation was limited to sea rush, arrow grass and bachelors button at the seaward end of this freshwater wetland in behind the beach.

A steep coastline continues along the southern side of the peninsula with regenerating native riparian vegetation often inaccessible to stock even though the land was not fenced. A few scattered patches of oioi and sea rush where found usually associated with sea meadow including sea primrose, slender clubrush or coast spear grass. There were a lot of oyster clumps scattered on the flats or lining the low tide channel. As the coastal edge became less steep the regenerating native vegetation thinned and the banks were often slumped with some of the remaining trees fallen into the harbour edge. A narrow broken band of sea rush, three square and *Baumea juncea* lined the coastal edge up towards the causeway. There was a patch of sea rush and saltmarsh ribbonwood before the eroded and armoured edge of the causeway. Small patches of sea meadow were found. Further along there was a band of saltmarsh ribbonwood mixed with tall fescue and some sea rush. A thin edge of mixed sea rush, oioi and *Baumea juncea* with sea primrose, remuremu, sea celery, and Buck's horn plantain lined much of the eroding land edge. There was another stretch of concrete rubble armouring with only scattered sea rush and sea meadow patches until a sandy point with sea rush was reached. Joining with the mainland, the coastal edge was eroding with narrow patches of sea rush with sea meadow along the high tide beach and old exposed tree roots and eroding sea rush clumps seaward on the flats. Past a treed headland the coastline returned to unfenced farmland with thin sea rush and sea meadow communities along the eroded land edge as well as exposed old tree roots on the flats with patches of sea rush. The sea rush is grazed and the three square very short and sparse. Cow and horse prints were found through the rushland. Inland behind the armoured edge there is an unfenced freshwater wetland with freshwater rushes, raupo, willow and manuka. Further on along the unfenced and pugged foreshore a cow was found casted on the beach.

Around **Motukahu Rocks** there was saltmarsh ribbonwood and a band of sea rush at the east end. Part of the eastern edge of the sea rush had died. The western end of the island had a coast spear grass and sea primrose community.

Back on the mainland north-east of the island the coastline was eroded and pugged with grazed tufts of sea rush with sea meadow amongst it. This graded into freshwater wetland. Cow dung was common along the harbour flats. A heavily grazed saltmarsh ribbonwood community was mapped as mixed saltmarsh ribbon and rushland due to the reduced size of the saltmarsh ribbonwood plants. Wide bands of rushland lined the upper northern embayment with large patches of marsh clubrush present with three square, oioi and sea rush. The coastal edge was still unfenced. Further up near the top of the embayment lake clubrush was found with marsh clubrush. Oioi was present as a patchy fringe. The rushland continued as a wide band and included some small saltmarsh ribbonwood and coastal scrub islands and marsh clubrush, around into the mouth of Te Kauri Stream. Rushland islands with some die-back were present on the flats. Up along TRB there was regenerating coastal forest and freshwater floodplain forest including cabbage trees, kahikatea, flax, manuka, swamp coprosma, and *Olearia solandri*. Fingers of marsh clubrush and oioi extended into the freshwater floodplain. The forest was still however open to stock and areas were grazed.

Patches of oioi intermingled with marsh clubrush and became quite difficult to map. Some small communities of lobelia and patches of oioi were the most upstream estuarine vegetation noted. The coastal and floodplain forest ended but a fringe of marsh clubrush and raupo backed by some manuka and swamp coprosma continued upstream along the channel bank.

Moving downstream along the TLB there was marsh clubrush, swamp coprosma and scattered kahikatea. This appeared to be grazed in the back. Scattered patches of oioi were found with the marsh clubrush and then larger patches at the mouth of the stream. Further south there was another embayment with oioi and marsh clubrush and large areas of saltmarsh ribbonwood. This graded into freshwater wetland with raupo, manuka and swamp coprosma. Back out in the main stream arm rushland continued to line the coastal edge with a band of saltmarsh ribbonwood behind. The rushland narrowed and three square was found nearer to the housing seaward of the oioi and sea rush. Only the odd saltmarsh ribbonwood plant was noted. Rubbish including white ware, tyres, plastic etc was found in the upper rushland below a pine covered bluff below some housing. Arrow grass was commonly found mixed with the upper rushland. Figure 24 shows rushland with a patchwork of marsh clubrush, oioi, sea rush and three square present. A dead rush root zone was found fringing the rushland. The dead roots appear to have been oioi. Some short three square was growing out in the dead rush zone. The paddock edge was fenced here.

Out around the headland towards the **Awaroa River** arm the coastal edge was unfenced and regenerating coastal forest was only found on inaccessible steep areas. Otherwise it was grass and eroded banks down to small beaches. A remnant patch of forest further around the headland had stock in it and a small rushland and sea meadow embayment was pugged. Past the patch of forest there was a rush-lined embayment with oioi, sea rush and three square. Small bands of marsh clubrush were present behind the rushland. Small patches of seagrass were found sometimes mixed with the seaward edge of the three square. About seven mangroves were found. Rushland continued up the Awaroa River arm. The upper TRB bank had a wide band of marsh clubrush with oioi at the back. This was fringed by raupo and manuka and then kahikatea, kowhai and rewarewa coastal forest remnant and some farmland. The uppermost estuarine vegetation included small patches of oioi and the odd saltmarsh ribbonwood bush mixed with marsh clubrush and raupo.

A pugged and grazed band of sea rush and sea meadow widened out into a large rushland community on the upper TLB with rushland extending in to fingers of higher land. Remnant totara, kowhai and kanuka were present on the higher grazed ground. Scattered saltmarsh ribbonwood fringed the land edge. The upper tidal vegetation was a mosaic of sea rush, marsh clubrush, slender clubrush, sea primrose and saltmarsh ribbonwood. Stock had access throughout the area. The sediments were heavily pugged and the plant communities tracked and pugged. Saltmarsh ribbonwood and marsh clubrush were severely grazed. Cow pats were common on the flats. Further downstream on the tidal bend a couple of cows were encountered. A few live plants of spartina were found near a previously sprayed patch. There was a pied shag colony nesting in large trees along a limestone bluff edge. Further along into a wide embayment, a mangrove was found amongst rushland near a large ngaio tree. A stump that could have been a dead mangrove was also noted nearby. The outer TLB here had a totara, kahikatea and puriri coastal forest riparian edge with a thinning rushland edge. Small patches of rushland and sea meadow were found around the limestone headland towards Uenukutuhatu Rock.

The **bay to the south-west of the Awaroa river mouth** was fenced and lined with rushland. A banded rail was heard. At the head of the bay was a large patch of spartina amongst healthy rushland (Figure 25). The wetland extended into raupo and *Coprosma propinqua* was present

in places around the margin. Figure 26 shows a repeat photo of rushland with oioi and marsh clubrush. The mangrove that was present in 2005 had disappeared. Whether this was due to past grazing, human removal or natural influences was unclear. The TLB of the bay was fenced with a lot of pampas but also totara in the riparian margin. The rushland looked healthy with mainly oioi and some sea rush and marsh clubrush. Figure 27 shows a repeat photo looking over rushland that was tracked by stock in 2005 but shows no sign of stock damage at the time of the current survey.

The **Waikorire Creek** arm was fringed with wide rushland backed by paddocks. The farmland was now fenced from the harbour (Figure 28). Into the arm there was three square and marsh clubrush mixing with the sea rush and oioi. These areas were mapped together unless there were large and clear differences between communities. Towards the head of the bay there was a significant freshwater wetland with swamp coprosma, cabbage tree, flax, manuka, *Olearia solandri* and kahikatea. Then at the top of the bay the rushland was backed by freshwater wetland (manuka, swamp coprosma, raupo and willow).

Figure 29 shows rush die back at the tip of **Mahoe Point**. There was a large significant freshwater wetland that extended around behind Mahoe Point and up towards Kopapaihekei Point. This wetland was dominated by *Olearia solandri* and *Coprosma propinqua,* often with a saltmarsh ribbonwood fringe and then a wide band of sea rush and oioi. The wetland had severe pugging of sediments and pugging and grazing of estuarine and freshwater wetland communities at the **Kopapaihekei Point** end (Figure 30). Fernbird and banded rail were heard here.

West of Kopapaihekei Point a little bay had a band of sea rush with sea primrose and lilaeopsis mixed in places.

Black-backed gulls were roosting and nesting on the **Oketu Rocks**. Cow bones were found in the bay opposite which had an eroding coastline and was not fenced. The only estuarine vegetation along the coastal edge which was pugged and grazed was the odd sea rush and a few dense short mats of lilaeopsis.

Around **Okehu Point** there was a cow grazing within the riparian margin (Figure 31). The fence line was not in good condition here.

The next little bay had eleagnus, fig, agapanthus and macrocarpa along the riparian margin. There was also quite a lot of regenerating karaka.

Around **Hikuparea Point** there was a large scooped bay with a lot of erosion of the shoreline (Figure 32) and a ragged fringe of three square often mixed with remuremu, sea primrose and sea celery along the upper high tide beach. The eastern side of the bay was unfenced and pugging of the sediments and estuarine vegetation was common around the whole bay. Dead rush root mats appeared to be from sea rush and often had short three square growing amongst them. A few patches of water celery (*Apium nodiflorum*) were noted in the large raupo wetland behind.

Further west there was a small sandy beach with little estuarine vegetation except for some rushland/sea meadow and sea meadow patches. Lilaeopsis was common. The coastal edge was fenced well back from the coastal edge with rank grass.

Around from **Taupopoki Point** there is a wide open bay. Rushland within the bay was badly pugged and grazed. An eroding edge lined much of the bay with old tree roots and stumps out

a distance on the flats. In the eastern corner of the bay there was a wide sea rush band. Along the landward eastern edge was some saltmarsh ribbonwood and swamp coprosma with a large patch of spartina near the middle. Sea primrose and some small mangrove seedlings (not mapped) were found at the western end of the sea rush band. The western eroded coastline was backed by freshwater wetland with raupo and marsh clubrush. The estuarine fringe included three square, oioi and sea rush scattered through the sea meadow which was dominated by lilaeopsis but also with sea primrose, remuremu, slender clubrush and sea celery. A small patch of saltwater paspalum was found mixed with the sea meadow/rushland. A hard rocky shore separates the western third of the bay where there is a limestone outcrop island. Figure 33 gives an overview of the eroded coastline west of the limestone outcrop. The eroded edge along the western side of the bay had rushland and sea meadow fringed with marsh clubrush in behind. Sea primrose, remuremu, glasswort and coast spear grass were common with the rushland along the eroded edge. A couple of small patches of saltwater paspalum were found.

Limestone bluffs with coast spear grass extended around to Mangakara Bay. There was no seagrass visible out on the wide relatively firm flats. **O Wiwi Ku** island was covered in grasses, pohutukawa, karo and red matipo. A black-backed gull population roosted/nested on the island as well as Canadian geese and South Island Pied oystercatchers. The estuarine vegetation fringing the island included coast spear grass, sea primrose, oioi, sea rush and a few saltmarsh ribbonwood plants. Knobby rush was also common.

Mangakara Bay was fringed by rushland (including sea rush, oioi and three square) and mixed rushland/sea meadow. The main sea meadow species was sea primrose. The bay was fenced all the way round. At the back of the bay there was rank grass, macrocarpa and the odd kanuka. Some purple pea bushes were also noted. Firm flats edged limestone bluffs with coast spear grass around to the next embayment. This embayment was completely fenced and was fringed by oioi and sea rush. Figure 34 shows a view of the excellent riparian fencing which was generally set well back from the steep coastline. No remnant forest vegetation was left around the back of the wetland in the bay. The estuarine rushland extended into marsh clubrush or rank grass.

The limestone coastline from Mangakara Bay had oysters on the flats and remnant coastal forest species including puka, astelia, kowhai, tree daisy and further inland kanuka. The only estuarine vegetation was scattered coast spear grass, a few patches of seagrass and a small patch of mixed sea rush and sea primrose.

Moving into the **Rakaunui Inlet** along the TLB there were limestone stacks at the mouth with thick Pacific oyster beds at their base and deep mud flats. Coastal plants common on the limestone stacks included puka, *Astelia* and *Collospermum*. Agapanthus was also present on some stacks. Coast spear grass was found along exposed rocky outcrops and some sea primrose was present in sheltered sandier high tide areas. The coastal edge was well fenced from the farmland with some plantings including flax. Small patches of seagrass were found along the first beach stretch. A small patch of saltwater paspalum was also found. Some of the coast spear grass was found at different heights up the limestone cliffs/stacks. Further upstream rushland patches were found. The high tide edge had sea rush and oioi with three square in between and seaward. The seaward three square had died back. Possible pig wallows were also noted in the three square. Flax, totara and cabbage tree had been planted along the coastal edge. Four mangroves were present in the embayment. Seagrass and three square were found fringing the sea rush and oioi. Sea meadow within and behind the rushland was commonly sea primrose but sea celery, remuremu and slender clubrush were also found. Coast spear grass was also found out towards the end of the embayment. Stock had accessed

the riparian zone near some limestone islands and where a track came down to a beach. Pugging and grazing was noted in the rushland there. Pampas was relatively common along disturbed coastal edges and cotoneaster was present in places. Around into the small embayment with a house and urupa above the harbour, there was wattle and periwinkle along the coastal edge as well as more plantings including totara, red matipo and cabbage trees. Groups of young mangroves around 1m tall were common in the southern half of the embayment either on the open flats or within the seaward fringe of the rushland. A few cut mangrove stumps were noted. Three square was common along the southern side with oioi. Remnant coastal forest was present on the headland at the 'narrows'.

Around into the **Rakaukeke Creek** arm there are a few plants of the threatened species *Scandia rosifolia* (Figure 35) along the coastal cliff edges that also support karaka, rewarewa, kowhai, tawa, puriri, broadleaf and mangaeo forest. Poor quality rushland was noted relatively commonly around the **Tawairoa Stream** arm. Figure 36 shows an example with clumps of oioi and dead oioi root masses. There were signs of grazing of oioi and animal prints in the mud (goat?). Mexican daisy was noted along some of the coastal forest edges and bluffs. Oioi, three square, sea rush and marsh clubrush are all present along the TRB. Patches of sprayed spartina were noted (Figure 37 and Figure 38). There was a large wetland at the head of the arm. The TRB of the mouth of the Tawairoa stream was dominated by marsh clubrush with fringes of oioi and some saltmarsh ribbonwood along the upper channel banks. Figure 39 is a repeat of Figure 17 in the 2005 survey report looking over a mix of oioi and marsh clubrush with coastal forest (includes large kahikatea along the coastal edge) in the background and farmland. There seemed to be less marsh clubrush in the recent photo but this may be due to winter die back of marsh clubrush. The marsh clubrush has new growth but it isn't as tall as mature plants such as present in the January 2005 photo. The TLB of the mouth of the Tawairoa Stream had more oioi rushland further upstream than the TRB.

The TLB is not fenced at the stream mouth but was fenced once some deer paddocks are reached. Rushland continues to line the coastal edge out along the arm and up into the **Ngahuinga Stream** arm. There was marsh clubrush up both heads of the arm and also raupo up the eastern fork. Figure 40 is a repeat of Figure 18 in the 2005 report with silver tussock lining the intertidal edge with oioi bands at either end of the sea meadow community. The coastal riparian forest includes kanuka, kowhai, hangehange, red matipo and rewarewa. Rushland lined the little embayment. Sprayed spartina patches were found with some live spartina found at the back of one patch where the plants were shaded by a kanuka canopy. Small areas of rush die back were found out around the coast line.

The next small embayment had healthy wide rushland along the TRB with young oioi noted along the seaward edges. However the high tide zone is often tracked, pugged and gazed as the paddocks were not fenced from the harbour. Live spartina plants were found in a number of places mixed with rushland. Oioi and sea rush mixed with patches of arrow grass and bachelors button towards the back of the embayment surrounded by marsh clubrush and raupo. Stock appeared to have access to the back of the wetland. Along the inner TLB areas of sprayed spartina were found backed by rushland. At least five different sites with scattered live spartina mixed in with the rushland and along the landward edge were noted.

More sprayed spartina associated with three square and marsh clubrush were found along the coastline as well some saltmarsh ribbonwood and a mangrove. The foreshore was also characterised by large trees fallen into the harbour edge.

The **Awaawaroa Stream** embayment was not fenced from the harbour and stock tracking, pugging and grazing was noted in many places wherever the land allowed easy access to the

harbour. Rushland edged much of the embayment. Remnant kowhai and young regenerating totara, kanuka and red matipo were noted in some gorse edges which will provide a native cover if the gorse is left uncontrolled. Banded rail footprints were noted near rushes towards the head of the embayment. At the head of the embayment the rushland mixes and grades into marsh clubrush and raupo further up the stream. Down along the TLB there are bands of sea meadow along the high tide line. Sea meadow species noted included sea primrose, slender clubrush, celery, remuremu and *Leptinella dioica*. Cow bones were noted in the harbour. Rush die-back was also a feature. The coastal edges along the TLB were slumping due to stock trampling and lack of vegetation and the few remnant native trees were falling in.

There was a lot of rush die back in the next embayment which often had patches of surviving oioi amongst it (Figure 41). Banded rail footprints were seen here and live spartina was also found.

There is more rush die back in the next embayment (Figure 42). While the coastal edge wasn't fenced, the stock damage appears to be mainly limited to the upper tidal edges rather than the middle and seaward edge of the rushland. Cow bones were found in the harbour at the point. Around into the next embayment the TRB was not fenced from stock and stock pugging and grazing of the immediate rush and/or sea meadow edge was common all along the coastline (Figure 43). More oioi die-back on the seaward edge was noted. The head of the embayment appears to be fenced and included raupo and marsh clubrush. Out along the TRB there was some live spartina mixed with rushland. Rushland continued with a forested riparian margin further along the coast line. Marsh clubrush mixed with rushland around into the next embayment with oioi fringing the marsh clubrush and quite often showing signs of die-back.

Spartina had been controlled at the mouth of the indent separating **Tuapu Island** from the mainland. Some scattered oioi had been left exposed out on the mudflats after the spartina had died. There were sign of root die-back and the remaining oioi may still not survive the exposure. Some spartina that hadn't been sprayed by helicopter due to a kanuka canopy cover had been recently sprayed and the blue dye was still visible. Rushland fringes the indent including both oioi and sea rush. A few patches of three square were also present. A mangrove was found. The flats were very muddy. At the stream mouth between Tuapu Island and mainland there was a wide thick band of rushland with some large sea primrose patches and a small area of remnant live spartina beside the stream exiting the rushland. More dead sprayed spartina patches were noted within the embayment and a few areas of live spartina plants were also found. A patch of spartina mixed with oioi and backed by marsh clubrush was found out towards the mouth of the embayment. Some saltmarsh ribbonwood was present along the land edge. There were a number of garden escapee weeds along the coastal banks toward the Inlet junction including Mexican daisy, ivy and a type of honeysuckle. Wattle trees were also common.

The coastal limestone cliffs around Tuapu Island into Rakaunui Inlet had little estuarine vegetation but did have remnant coastal forest along the land edge. A large mangrove was found along the coastline opposite the house embayment. Rushland then became a feature again. The pasture on the island however was not fenced from the harbour and the rushland was pugged and grazed in places (Figure 44). Further around into a large embayment there was seagrass in front of bands of rushland. A patch of healthy spartina was found intermingled with the sea rush. A few mangroves were found along the seaward edge of the rushland which was mainly sea rush where the coastline was more exposed and oioi and three square further in the embayment. Marsh clubrush and raupo were also present. A predominantly oioi band extends out of the embayment and out towards the main harbour. Wattle and pampas were present along the disturbed coastal edge. Rushland, a bit of seagrass and two mangroves were

present in the last little embayment on the TLB of the Rakaunui Inlet. Puka, puriri, hebe and akeake grow on the limestone stacks at the mouth of the Inlet together with coast spear grass and Mexican daisy.

Pacific oysters extended up into the lower Awaawaroa Stream arm and Rakaukeke Creek arm as well as down into the Rakaunui Inlet and over the large intertidal island at the bend in the Inlet and out along the channel edges to Motukaraka Island.

Motukaraka Island had coast spear grass and sea primrose on the limestone stacks. The seagrass came right in to the island on the NW side. The island also supported wind-blown coastal forest with puka, tree daisy, mingimingi, totara, kanuka, red matipo, pampas, knobby rush and native ice plant.

Back on the mainland, around from Rakanui Inlet, there was a sandy beach with patches of rushland. Around the next limestone point and into the **Tuapua Creek** arm there was very thick mud and oysters and the odd patch of sea meadow and rush. There was a little beach before a small peninsula that had pugging from stock and a patch of sea rush mixed with sea primrose that was grazed. There was also lots of footprints and dung from Canadian geese too. Around the small peninsula there was lovely native forest along the riparian margin that was too steep for stock to access. Further on there was a thick rush band fringing the coastline and then some seagrass along the front of the rush band which had narrowed. The rushland then thickened out towards where a patch of spartina had been sprayed. In the back was grazed oioi and sea meadow with oioi and three square seaward. A patch of live grazed spartina was found mixed with three square. Another tall patch of live spartina occurred out at the seaward point of a sprayed patch. Further on there was a diverse mix of oioi, three square and some marsh clubrush. Some areas of oioi die-back were noted. Three mangroves were found along the rushland edge on the bend in the creek. The native riparian vegetation finished and became an edge of gorse with regenerating young native species. This was the start of the riparian restoration process but fencing was needed to protect the regenerating species from stock. There was quite a bit of pampas in with the gorse further along the coast line which would hinder native forest regeneration. More oioi die-back was noted next to healthy growing oioi along the seaward edge and within the oioi band. Around the corner into the next small embayment there was a sprayed spartina site. Figure 45 shows the remains of a spartina plant sitting on top of a mass of dead oioi roots. The spartina roots show how deep the oioi root mass must have been and how much sediment must have been washed away that had built up around the spartina. The last little embayment was fringed by rushland with young oioi present along the seaward edge and healthy patches of sea rush. The thick protective band of gorse had gone and stock now had easy access to the harbour edge. Pugging and grazing was common. Around the point there was more oioi die-back in the middle of the rushland. There was sign of pugging and grazing of the oioi. Generally where ever there was stock access to the landward edge of the rushland there was also sea meadow present as the ground was more open due to grazing, pugging and tracking. Up toward the head of the arm the flats were quite dry as the tides had not recently covered them. There was quite a bit of pugging of the tidal flats (Figure 46). Figure 47 shows a view of saltwater paspalum behind the farm causeway. The causeway has disrupted the natural flow of water around Tuapu Island. The saltwater paspalum pond and rushland are at the head of the wide rushland extending from the Rakaukeke Creek arm. None of the island pasture was fenced from the harbour edge.

Moving up along the TLB of Tuapu Creek there were wide rushland communities which were predominantly sea rush. Old fence lines crossed through the rushland so that significant areas of the harbour were fenced within the paddocks (Figure 48). A mangrove was present in the

first embayment on the way out. Raupo was found at the head of this embayment. Banded rail footprints were found leading into the next small embayment. The little indent had some marsh clubrush. The next headland had some remnant coastal forest including kamahi, rewarewa and kanuka. In another little indent with some marsh clubrush and three square, there was some die-back of sea rush along the sea edge of the rushland. A nearby sprayed spartina patch may have caused increased exposure for the sea rush resulting in the die-back. There was also oioi die-back around the spartina site. More oioi die-back was found with no sprayed spartina nearby but stock and geese tracking prevalent. The oioi band around towards the end of a large peninsula had oysters present along its seaward edge. There were also areas of oioi die-back. The flats here were very muddy. There was stock tracking along the back of the rushland. Around the point into the large side arm it was muddy. There was a rush band all around the arm, predominantly oioi but also patches of sea rush and three square. One mangrove was found. There was a bund at the head of the arm with raupo upstream. Some sea meadow was present along an eroded firm edge of the harbour which included sea primrose, arrow grass and scattered sea rush. None of the harbour margins were fenced. There was scattered remnant kanuka, kowhai and gorse as the only riparian vegetation until the limestone bluffs were reached and which protected native forest including puka and puriri. Further out along the TLB limestone bluffs had little estuarine vegetation except coast spear grass on exposed faces together with Mexican daisy and native rengarenga, puka, astellia and hangehange. The flats were extremely muddy and oysters common. Stock accessed the sandy beach out near the entrance (prints indicated sheep). The banks were eroding or slumping due to a lack of large vegetation. There were some gorse and remnant kanuka trees. There was rush in the last embayment out towards the point and rush was found amongst limestone stacks with sea grass patches seaward. This then became a rush-lined beach with some coast spear grass and sea primrose. Further on lots of coast spear grass and scattered sea grass patches were noted amongst limestone stacks. There was a band of seagrass further out on the flats in a line with the island and the limestone stacks. Sparse sea grass scattered throughout the bay.

Around the limestone outcrops at the mouth of the **Kaitawa Inlet** estuarine vegetation was limited to coast spear grass. The first large embayment had a wide rushland band of mainly sea rush. An area of fairly short spartina was found mixed with the sea rush at the head of the bay with an animal track coming from the unfenced farmland out through the rush and spartina patch to the open flats. In the southern corner of the embayment there was another patch of tall healthy spartina mixed with sea rush near a large boulder. Before leaving the embayment a patch of saltwater paspalum was found mixed with sea rush, three square and sea primrose. Another smaller patch was found nearby with sea rush and sea primrose. Some remuremu and slender clubrush were also present in the sea meadow community. Around the limestone headland there was unfenced coastal forest. The next embayment had scattered sea rush amongst limestone rocks and a patch of saltwater paspalum on the beach. Further in there was a sandy beach with sea rush and three square backed by pasture, gorse and pampas which allowed unrestrained access of stock to the beach. The next limestone headland had no estuarine vegetation except for a few clumps of sea rush and patches of sea grass. The oyster band ended around this point. The next bay had mainly three square and a scattered band of oioi. There were dead root bases on the seaward edge as well as a lot of geese footprints around large holes along the rushland edge. Seagrass was intermingled with the three square along the rushland edge. Stock had easy access to the harbour and stock pugging along the upper foreshore was noted. There was a small mangrove in the indent. The embayment was dominated by three square communities which then turned into a solid oioi band out towards the main channel. Scattered small mangroves were present along the fringe of the oioi band. The riparian vegetation had been sprayed killing kanuka, gorse and some unidentified native trees, however the pampas was still healthy. Figure 49 shows more

oioi die-back associated with large holes in the sediment and goose footprints around them. Patches of oysters were found again associated with the limestone headland at the mouth of the eastern upper arm. High and dry flats. A few mangroves were scattered along the outer edge of the wide rushland band around the arm. Relatively large freshwater wetlands backed the saltmarsh further up the drainage valleys within the arm. A large portion of the land at the head of the Inlet is being used for cropping. Thick gorse band provides a riparian buffer along the coastline at the head. Past the cropping land there is a lack of riparian vegetation around the western upper arm. This arm is also lined with a wide rushland community and has a number of mangroves along the north-western side. Moving out of the western upper arm along the TLB there is a kanuka riparian edge that is fenced. The rushland band thins out toward the mouth of the inlet with only coast spear grass and sea rush clumps present out around the limestone headland. Rengarenga was noted along with the usual coastal shrub/forest species present on these limestone blocks.

Moving west from the Kaitawa Inlet there was scattered coast spear grass mixed with sea rush amongst the limestone blocks around the headland. The bay had quite firm mudflats with a lot of cow bones washed up along the tide mark. The eastern side of the bay had an eroding rushland edge of oioi and sea rush and a scattered fringe of saltmarsh ribbonwood backed by marsh clubrush, flax, manuka, pampas and a few coastal daisies. On the western side where the creek enters the bay the freshwater wetland had been drained in behind for farming. Raupo and giant umbrella sedge were present. This large degraded freshwater wetland system would be a good candidate for a restoration project. Whitebait were seen in the tannin-stained water draining the wetland. Out at the mouth there are scattered clumps of saltmarsh ribbonwood and a manuka riparian margin where fernbird were heard.

Moving along the foreshore inland from the Opeope Rocks there were nocks and crannies with saltwater paspalum mixed with sea meadow or rush. Out on the **Opeope Rocks** there was a patch of saltmarsh ribbonwood and sea meadow. Along the foreshore between the Opeope and Tokapiko rocks was a sandy shelly beach with clumps of sea rush present. Sea meadow species were often found mixed in with the sea rush and included sea meadow, coast spear grass, slender clubrush, remuremu and lilaeopsis. Oioi was also present in cracks in the bedrock. On the **Tokapiko Rocks** there were sea meadow communities and roosting white fronted terns, spoonbills, variable oystercatchers and black-backed gulls. The rocks had seagrass growing up to and around them. Past the Tokapiko Rocks was a sandy bay with sea rush present. Seagrass extended up to the coastline at the beginning of the bay before **Manaua Point**. Oioi and sea meadow were found amongst the rocks leading around to the beach. The beach had mixed rushland and sea meadow with three square dominant to the northeast (and with a small patch of saltwater paspalum) and then a band of mainly sea rush and oioi along the middle and southwest end of the beach. Saltmarsh ribbonwood was found at the mouth of the stream. The rushland edge was rather eroded along the middle section of the beach. Marsh clubrush and raupo were found behind the estuarine edge. More saltmarsh ribbonwood was present at the south-western end. Patches of three square, sea rush and oioi were found around Manaua Point in the shelter of the limestone blocks. A wide band of oioi then lined much of the next bay. Three patches of saltwater paspalum were found mixed with rushland at the end of this bay. While kanuka within the fenced paddocks were sprayed along with the gorse, the kanuka within the riparian margin hadn't been sprayed indicating good land management. Seagrass extends across the outer bay to the next point. Around the point a large ngaio tree was noted at the entrance to a pointed embayment. Figure 50 shows pugging over the embayment flats and a new fence line currently being established along the coastline. The fencing will soon stop the pugging of sediments and vegetation and direct defecation into the harbour. Areas of dead rushland were noted up the head of the arm lined with three square and sea rush (Figure 52).

Seagrass extended out across the mouth of the embayment and around the limestone blocks at the TLB point and along the base of a beach towards **Okura Point**. Other estuarine vegetation was limited to coast spear grass amongst the limestone blocks at both ends, and some sea rush on the sandy beach. Remnant riparian coastal forest backed the beach although it appeared some of it has been sprayed. Past Okura Point the bay was not fenced. There was no estuarine vegetation in the bay and only pasture grasses extended down to the beach with no riparian vegetation. **Puketoa Point** also lacked riparian vegetation on its northern side. The only estuarine vegetation around the point was knobby rush and *Baumea juncea* which formed a thin band around the upper high tide zone edging the pasture and scattered remnant kanuka (though many sprayed) and tree daisy and gorse.

Into **Arapatiki Bay** the flats are relatively firm. A large wetland edge characterised this bay which was predominantly freshwater communities with an estuarine edge. At the northern end three square and sea rush was found seaward, grading into a mixed community of sea rush and sea meadow which was then backed by a fringe of saltmarsh ribbonwood before freshwater plants dominated (Figure 53). A large wallow was found at the inland edge of the estuarine vegetation (at the oioi/marsh clubrush interface) together with chewed flax and extensive pugging indicating that pig and/or stock access was an issue here. The seaward edge of the rushland was eroded around a creek mouth with an extensive area of rushland in behind. A small patch of spartina was found with sea rush where an animal track leads inland. A narrower rushland edge backed by manuka continued on past the large rocks out on the flats. At another stream outlet there was a badly pugged raupo wetland in behind. More spartina plants were found at a sprayed site further along the coastline. The rushland edge was ragged and eroded with three square and sparse sea rush plants characterising the seaward edge. The rushland became denser along the high tide beach and was backed by a wind-swept edge where estuarine vegetation including saltmarsh ribbonwood mixed in with raupo, flax and manuka. Another patch of spartina was found. At the south western end of the bay was a smaller wetland of oioi on a shell beach with saltmarsh ribbonwood and coast spear grass in behind. The oioi graded into sea rush out towards the point.

Regenerating coastal forest covered the headland south west of the Arapatiki Bay wetland. Around toward **Te Umuroa Point** the exposed siltstone bedrock fringed the coastal edge with only the scattered coast spear grass present and the odd patch of rushland mixed with sea meadow. South of Te Umuroa Point the coastline was lined with oioi and sea primrose. Around into the embayment south of the point a distinctive feature of the coastal riparian edge was the presence of *Machaerina sinclairii* just above the high tide mark (Figure 54). Totara was common in the riparian forest here. There was a wide rushland band at the head of the embayment with coast spear grass present on shell banks within the oioi and sea rush. Behind the rushland was a manuka and flax wetland backed by regenerating coastal forest. The coastal forest did not have a healthy understorey. There was sign of goats and pigs in the area. Live spartina was found lining an animal track from the seaward edge of the rushland to a couple of wallows in the back of the rushland. Spartina was also found nearby not associated with wallows or tracking. In the southern corner of the embayment there were rushland and sea meadow communities as well as a patch of saltwater paspalum.

Moving around the steep eroding siltstone headland towards and around **Te Rangiora Point** scattered coast spear grass was present and more *Machaerina sinclairii* and *Gahnia* grasses along the riparian edge. The next embayment contained rushland, sea meadow and saltmarsh ribbonwood on shelly ridges, saltwater paspalum, a mangrove and sea grass (Figure 55). Pig wallows were noted again along the inland edge of the rushland. Flax and manuka wetland was present at the head of the embayment. Regenerating coastal forest edged the harbour. Goat prints in the mudflats were noted.

Goat tracking continued around an eroding coast line into another small embayment fringed with rushland and with raupo at the back (Figure 56). A band of saltmarsh ribbonwood lined a sand ridge within the rushland on the TRB. Sea meadow communities were found with rushland towards the mouth of the bay on either side. Animal tracks (goat) were common over the flats seaward of a fence across the middle of the embayment. It was unclear if the head of the bay was fenced from the farmland. Riparian kanuka had unfortunately been sprayed around the top half of the bay. An animal wallow was found in the rushland.

Goat tracking continued around the foreshore into the next large bay. This bay was dominated by a rushland fringe (sea rush, oioi and three square) backed by the odd saltmarsh ribbonwood. In many of the indents there were large areas of dead spartina root masses and in some more exposed areas there was also associated rushland die-back (Figure 57). Arrow grass was commonly noted in front of, or mixed with, sea rush behind sprayed spartina areas. A few mangroves were present. Sea meadow species were present particularly associated with sandy ridges. Stock tracking, pugging, grazing and defecation were noted at the western head of the bay and were wide spread around the eastern head of the bay. Patches of live spartina were found mixed with three square and sea rush at the head of the eastern arm where rushland graded into marsh clubrush and raupo wetland. Banded rail footprints were found here. Figure 58 shows an area of eroding oioi that had sprayed spartina root masses seaward. The landward edge was unfenced and the back of the rushland was pugged by stock. The oioi band along the opposite bank of the small indent was quite healthy. The land edge from here was backed by pine forest and a regenerating edge of coastal forest. There was little estuarine vegetation around the exposed coast line until the last indent within this large bay was reached. This indent was fronted by a sand spit covered with saltmarsh ribbonwood and sea meadow and which enclosed a large area of rushland. The rushland extended inland to a drained freshwater gully surrounded by pine forest and regenerating native riparian forest.

Further out around the rocky coast line, sea meadow bands were found around the headland and within the small embayments towards the causeway.

Upstream of the causeway the **Waiharkeke Stream** estuarine vegetation was limited to scattered clumps of sea meadow and some oioi along the rocky armoured road edge until the first little embayment was entered. Here a large patch of spartina had been successfully sprayed except for some plants mixed in with oioi and marsh clubrush against the road edge. The seaweed *Entromorpha sp.* was common over the mud flats as well as marsh clubrush at the head of the embayment. Climbing asparagus and Mexican daisy were noted in the bush edge. Out of the small embayment the rocky coastline was characterised by bands of sea meadow at the high tide line including coast spear grass, sea primrose and glasswort. There were lots of titiko out on the flats where spartina used to dominate. At the mouth of a small creek a couple for live spartina plants were found amongst the rushland. Short arrow grass was often found in front of the rushland where spartina used to grow. A few areas where oioi had died back also had arrow grass present. Glasswort was the common sea meadow species present out on the coastal edge until the next small embayment was reached. In the northern corner of this embayment a saltmarsh ribbonwood sand bank was fronted by sea rush and sea meadow. In behind was more rushland that graded into marsh clubrush and a freshwater wetland. Sea rush and sea meadow (sea primrose, slender clubrush, leptinella, glasswort and a little bachelors button) extended around to the southern corner of the embayment which had some rushland but was mainly marsh clubrush. Further on two dead cows (and some separate bones) were found at the base of a steep bush-covered bank. Thick glasswort beds continue around the high tide mark. More cow bones were found where the coastal forest edge thins out and pampas dominated. Around the headland, seagrass was found on the tidal

flats along the coastline. A thick band of marsh clubrush was fringed by oioi and sea rush with sprayed spartina root masses seaward. A few live spartina plants were found on the edge of the marsh clubrush. Oioi and sea rush patches were found up to the point. Around the point there were seagrass beds along the upper tidal flats but they were very hard to see with the dirty water at high tide. The coastal forest edge looked healthy and the trees leaned over the coastal edge. Estuarine vegetation was limited to narrow bands of sea rush together with scattered sea meadow. In a bay there was a marsh clubrush wetland with a fringe of oioi and sea rush in front and a lone mangrove (Figure 59).

Near the upper reaches of the salt influence, marsh clubrush wetland dominated with a thin scattered fringe of oioi and scattered clumps of saltmarsh ribbonwood (Figure 60). Further upstream the marsh clubrush and saltmarsh ribbonwood started giving way to raupo wetland with some kahikatea swamp forest in between the wetland and the Owhiro Road. Moving back downstream along the TLB there was a larger kahikatea/manuka swamp forest that appeared not to be fenced from the farmland and had a few willows established. Scattered saltmarsh ribbonwood and oioi were also found along the river edge here. The next large wetland embayment was half dominated by rushland and saltmarsh ribbonwood on the upstream side of the side creek and marsh clubrush on the downstream side. Stock had access to the upstream half and the area was highly grazed and pugged. Moving further downstream there were more large marsh clubrush beds mixed with oioi and sea rush. Scattered sea meadow and rush patches are found along the coastline downstream until the stream channel starts to widen out.

Seagrass beds were found on the tidal flats backed by coastal native forest that was loud with bird song. Around the headland was a small rushland community in an embayment with seagrass fringing the shoreline. Further downstream the seagrass disappeared and the estuarine vegetation was generally limited to bands of sea meadow along the high tide rocky edge and scattered clumps of rushland largely where small indents provided some shelter.

Downstream of the Waiharakeke Stream road bridge a relatively thick band of sea meadow (glasswort and coast spear grass) lined the seaward side of the road. This band thinned towards where the road became a causeway. Upstream of the causeway was an impounded small embayment with restricted water flow through a small culvert under the causeway. This embayment used to have a lot of spartina. The spartina had been sprayed and no live plants were seen. Marsh clubrush and raupo were present around the eastern side of the embayment and scattered sea rush, oioi, a band of seagrass, arrow grass and sea primrose around the western side. The seaward side of the causeway had a high fringe on top of glasswort and coast spear grass. A patch of saltwater paspalum was found at the very end of the causeway.

Rushland with patches of seagrass seaward extended out towards **Waipuna Point**. Waipuna Point was fringed with coast spear grass, glasswort and some sea primrose. Rushland and sea meadow lined the coastal edge further south-west of the point.

The embayment **east of Paparoa Point** had rushland with oioi and sea rush, sprayed spartina areas (but no live spartina), sea meadow, small patches of saltwater paspalum and some saltmarsh ribbonwood.

The TRB of the **Kinohaku arm** is edged by the Kawhia Harbour Road. The exposed outer coast line was often un-vegetated or had scattered glasswort patches. Further into the arm the coastline had exposed un-vegetated stretches interspersed with more sheltered areas supporting bands of oioi and sea rush. The occasional saltmarsh ribbonwood was also found.

Honeysuckle, ginger, wattle, eleagnus, wild rose and poplar were common along the riparian edge. More patches of saltwater paspalum were found either growing by themselves or mixed with three square or sea meadow.

Pied stilts were roosting on a sand bank seaward of the causeway. Oioi and sea rush filled much of the harbour flats upstream of the causeway. Dense saltmarsh ribbonwood lined either side of the **Opounae Stream** channel. A large bed of glasswort fronted the rushland near the causeway culvert. The farmland was fenced although hard against the wetland edge which meant there was generally no riparian vegetation between the pasture and rushland. The upstream edge of the causeway had scattered saltmarsh ribbonwood and flax. The downstream edge of the causeway supported a band of glasswort with some sea rush.

Rushland and sea meadow (arrow grass and sea primrose) communities lined the shoreline around into the head of Kinohaku Bay. Honeysuckle was common and extended out over the rushland in places. A large rushland community filled the head of the bay at the mouth of **Oteke Stream**. Large sea primrose beds were common intermingled with the seaward fringe of sea rush and along the gravel outwash plains of the stream. A patch of spartina had been sprayed and no live plants were found. Some saltmarsh ribbonwood was found around the stream mouth. On the TLB of the stream mouth there had been a fire in the rushland (Figure 61 and Figure 62). Lifestyle paddocks abutting the rushland were unfenced and the pasture generally extended right to the land edge with the rushland. Moving out along the TLB, the rushland became patchy fringing a coastal forest edge.

Below farmland and a house there was rubbish dumped over the edge into the harbour. Bad pugging, tracking and grazing of the estuarine edge extended from the remnant coastal forest block all the way along the upper foreshore for the TLB out to **Maire Point**. The lack of fencing meant that there was no protective riparian buffer. The coastal edge sometimes stunk due to the amount of cattle dung along the foreshore. Instead the coastal edges were predominantly pasture grass and eroding badly. The few scattered remnant riparian trees present on steep banks were falling into the harbour. Cow bones were found along the foreshore.

Cattle tracking, pugging and dung continued around Maire Point and around along the upper tidal zone into the **Huhutahi Stream** embayment. The smell of dung in the CMA was again quite strong in places. Many of the coastal edges were eroding from stock access and a lack of stabilising riparian vegetation. Remnant kanuka were found along the coastal edge but the understorey was grazed and tracked. The tidal edge was generally heavily tracked and devoid of estuarine vegetation except for scattered small populations of glasswort. In the odd sheltered area there were patches of grazed sea rush often mixed with pugged sea meadow including remuremu, shore lobelia, native celery, sea primrose and/or bachelor's button (Figure 63). Old fence lines extended out perpendicular into the tidal flats but the harbour edge was left unfenced and unprotected.

A thin rushland band widened out to extensive rushland (sea rush and oioi) at the head of the bay. A patch of sea rush had die-back along its seaward edge. Scattered sea rush clumps were present out on the flats along the gravel outwash banks of the **Huhutahi Stream** channel. Some of the inland rushland was fenced within paddocks and freshwater rushes dominated the pasture on slightly higher ground. Rushes were grazed within the paddocks and arrow grass, slender clubrush, bachelor's button and mercer grass on floodplain gravels around the stream mouth were pugged. Cattle tracks were also present over the upper tidal flats seaward of the fence line crossing the rushland. Only a couple of saltmarsh ribbonwood were noted at the head of the bay.

Arrow grass was commonly mixed with rushland along the upstream TLB. Patches of rushland including sea rush, oioi and three square were found scattered along the TLB on sheltered sandy beaches. Saltmarsh ribbonwood was often found in behind the rushland. Glasswort and slender clubrush were common either as a band along the high tide line or mixed with rushland. Sea celery and some sea primrose and remuremu were also found. A band of eleagnus was smothering kanuka along the riparian edge causing the trees to fall into the CMA as well as dominating the upper tidal zone and excluding estuarine vegetation. Rubbish was found along the high tide zone as well as varying types of armouring (including stacked tyres and bath tubs) below houses. An area of rubbish and dredged material was found covering part of a saltmarsh ribbonwood community. Garden plants were common along the foreshore near **Te Waitere** including wild rose, eleagnus, macrocarpa, grape and banana passionfruit. There was little estuarine vegetation along the armoured shoreline around Te Waitere boat club and ramp.

A patch of seagrass was present immediately west of the boat ramp at Lemon Point and a band of Asian date mussels was noted along the low tide mark also west of the boat ramp. The north-western coast line from Lemon Point was exposed and did not support any significant amounts of estuarine vegetation. The coastal edge was dominated by garden escapees such as cotoneaster, ginger, eleagnus, sweet pea, pampas, pines and Chinese privet.

A few clumps of sea rush were found along the foreshore towards houses associated with native plantings. There was some foreshore armouring in front of the houses towards the point. Saltwater paspalum was found mixed with sea primrose and slender clubrush and sea rush. Scattered patches of saltwater paspalum were found around into the inlet (Figure 64) as were scattered sea meadow and rushland communities. Lumps of Pacific oysters remain attached to disintegrating spartina mats out in the middle of the open flats (Figure 65).

Figure 66 is a repeat of Figure 29 in the 2005 survey report taken beside a gate and fence that extended across the harbour flats. There were stock footprints in the mudflats on the upstream side of the fence and through the back of the rushland and sea meadow community behind. At the head of the bay, the stream mouth had heavy pugging around it and the sea rush and arrow grass was invaded by saltwater paspalum (Figure 67). Marsh clubrush dominated inland of the rushland. Mixed rushland and sea meadow dominated along the TLB. Some of the sea rush looked rather exposed after the seaward spartina had been controlled. Figure 68 shows a patch of short sparse spartina found on the mudflats. Tall spartina was also found mixed with rushland north of the **Ohau Stream** mouth. Figure 69 is a repeat of Figure 30 in 2005 survey report looking across the tidal flats towards Te Waitere peninsula. There was not any current stock tracking visible however the coastal edge was not fenced off and stock pugging and dung was common further out along the bay. The lumps on the mudflats were oyster clumps presumably left behind after the sprayed spartina plants have eroded away. The vegetation became limited to small patches of sea rush and thin bands of sea meadow either scattered along the open eroded coast line or as a fringe along grazed freshwater wetlands. Figure 70 shows are patch of rushland within the shelter of an indent. There was some spartina mixed in the rushland and two dead sheep. Cow bones were also found along the foreshore. The eroded shoreline was predominantly edged by pasture grasses. The odd patch of oioi was generally grazed. Cow and sheep tracking along the high-mid tide line was still common until the forested edge of **Ohaua (Nathan's Point)** was reached. A lot of the grazed coastal edge was slumping into the harbour. The coastal edge was not usually very high and would most likely benefit from riparian fencing and planting as would the many freshwater seepage wetland along the coastal edge. The forested edge of Ohaua (Nathan's Point) had the weedy periwinkle present. Seagrass was present along the low tide mark south of Ohaua (Nathans Point) and also came in close to land at the point.

Around the point, the foreshore was exposed with only scattered patches of sea rush and sea meadow (coast spear grass out near the point and sea primrose and slender clubrush further along). Goats were seen along the coastal edge and the farmland wasn't fenced. Horses were also free ranging along the coast line. A couple of eleagnus plants were noted about to be eroded into the sea. A small patch of saltwater paspalum was found along the exposed coast line towards **Kowhai Point**. Remnant kanuka, kowhai, rewarewa and tree daisy were found along the eroding mudstone cliff headland along with gorse and kikuyu. The weedy periwinkle and eleagnus were also present along the cliff. A thin band of sea meadow was found around the corner. Horses were present at a grassed clearing with a couple of shacks. The coast line had a ragged thin rush edge with some pugged and grazed saltmarsh ribbonwood and freshwater rushes in behind. A tiny bit of saltwater paspalum was found in front of buildings and some sea meadow along a sheltered section of bank. A dead goat was noted. There were a number of freshwater seepage wetlands together with eleagnus along the coastal edge. Figure 71 shows an example of how eleagnus restricts the presence of estuarine vegetation along the high tide mark. There was not a lot of pampas along the coastal edge but gorse was plentiful (and more supportive of native regeneration). Sea meadow in the area included mixes of sea primrose, remuremu, slender clubrush, lilaeopis, sand buttercup and native celery.

A large animal wallow was found along the inland estuarine wetland edge of a freshwater wetland area. There were horse, goat and cattle prints around the wallow and lots of animal tracking along the foreshore. Coast spear grass joined the sea meadow community with slender clubrush, remuremu and oioi and sea rush. Three square was present at the head of stream mouth of first small embayment. The next embayment (**Rangitaiki Stream**) had a thin band of sea rush and bits of coast spear grass. A goat was seen. The dense forest edge precluded estuarine vegetation growth where the harbour narrowed to a stream mouth. Out at a hooked tip of the embayment there was sea rush and sea meadow and dead spartina patches still visible on the flats. The coast line became more exposed again around towards **Waikiekei Stream** bay. More goats were seen in the coastal forest. Figure 72 shows a little arm at the mouth of the stream with saltmarsh ribbonwood islands and sea rush, oioi and flax behind. Saltmarsh ribbonwood and *Olearia solandrii* lined the upper stream mouth. The headland around **Heteri Point** was exposed with little estuarine vegetation until a shell bank provides shelter for a patch of rushland and saltmarsh ribbonwood. Thin bands of rushland and patches of sea meadow extend around the tidal line of the **Waikutakuta Inlet**.

At the southern end of the **Kirikiri Stream** bay there was sign of stock pugging (goats?) amongst patchy sea rush, saltmarsh ribbonwood, mixed sea meadow/sea rush and coast spear grass communities. A small bit of saltwater paspalum was found with sea meadow. The estuarine vegetation was restricted to narrow bands of sea rush and patches of sea meadow around the shallow bays up to **Totara Point**. Goats were seen along the forested edge of this peninsula. Around past Totara Point the estuarine vegetation was mainly thin bands of rushland and scattered saltmarsh ribbonwood. Down towards **Waipapa Point** the rushland started to thicken and larger populations of saltmarsh ribbonwood were found. Near an old house there was grazed and pugged rushland, sea meadow (remuremu sand buttercup, sea primrose, leptinella) and saltmarsh ribbonwood in front. Figure 73 shows a band of sea rush with a patch of oioi in front. The oioi looked like it has been 'mown' as all the tops are missing. Another similar patch was also found in this estuarine arm. Rushland continued around lining the coastal edge backed by regenerating coastal forest and scattered grass clearings.

In the **Opungo Stream** bay west of **Waipapa Point** there were signs of stock damage to the coastal edge. An eroded pugged edge with sea meadow included leptinella, sand buttercup, remuremu, arrow grass and sea primrose. Eleagnus was a feature along the coastal edge near

a derelict house with sea meadow in the low pasture. Figure 74 is a repeat of Figure 32 in the 2005 survey report looking up towards the mouth of the **Opango Stream**. Saltmarsh ribbonwood lines the mouth of Opango Stream. There was little estuarine vegetation out around the point into the **Waitapu Stream** bay which had sea rush and oioi present. Spartina had been present near the mouth of the Waitapu Stream but had since been controlled. No live spartina was seen however sign of die-back along some of the rush edge (mainly oioi) was noted. Further out a pig wallow was found in the rushland.

A lot of the thinly vegetated edges were mixed sea meadow and rushland with sea rush, oioi, sea primrose, slender clubrush and some coast spear grass. Titiko disappeared once the flats became more exposed and sandy. The coastal edge was still forested in regenerating coastal forest that started at Kowhai Point. Sheep were seen on the foreshore of **Kaipekepeke Beach** and scattered cow bones were also noted. Eleagnus was found along the foreshore near an old building and scattered sea rush, oioi and a small community of saltmarsh ribbonwood.

A grazed freshwater wetland with *Baumea juncea* and *Cyprus ustulatus* had a few scattered sea rush and oioi along its coastal edge.

The dunes at the southern side of the harbour mouth have been converted to pasture with knobby clubrush and marram grass common along the foreshore together with areas of *Carex pumila*, muehlenbeckia and *Cassina leptophylla*. The last estuarine vegetation mapped along the foreshore was at the southern end of the **Te Maika** beach baches. This included patches of sea meadow (primarily sea primrose and some little plants of slender clubrush). One of the sea meadow patches had saltwater paspalum establishing within it. There was also a patch of sea rush at the mouth of a small creek draining a freshwater wetland area in behind the baches. Seagrass extended out along the tidal flats as far as the jetty at Te Maika.

Out in the middle of the lower harbour there is a sand island **Te Motu** which sheltered a large, healthy mixed rushland/sea meadow community (Figure 75 and Figure 76). Coast spear grass dominated on drier high sand ridge and also mixed with sea rush and oioi on the lower tidal flats together with sea primrose. Some areas had denser coast spear grass than rushland while other areas where dominated more by rushland. Out in front of the enclosed rushland community there were large concentric patches of sea primrose with scattered coast spear grass and glasswort on the open flats. Most of the sand island had an eroded coastline and was dominated by pampas, knobby clubrush, short kanuka and pines. There was a small patch of saltwater paspalum together with *Carex pumila* along the eastern exposed foreshore. The north-western side of the island supported a black-backed gull colony.

Figure 1a: Map of northern Kawhia Harbour with points of interest and photo points

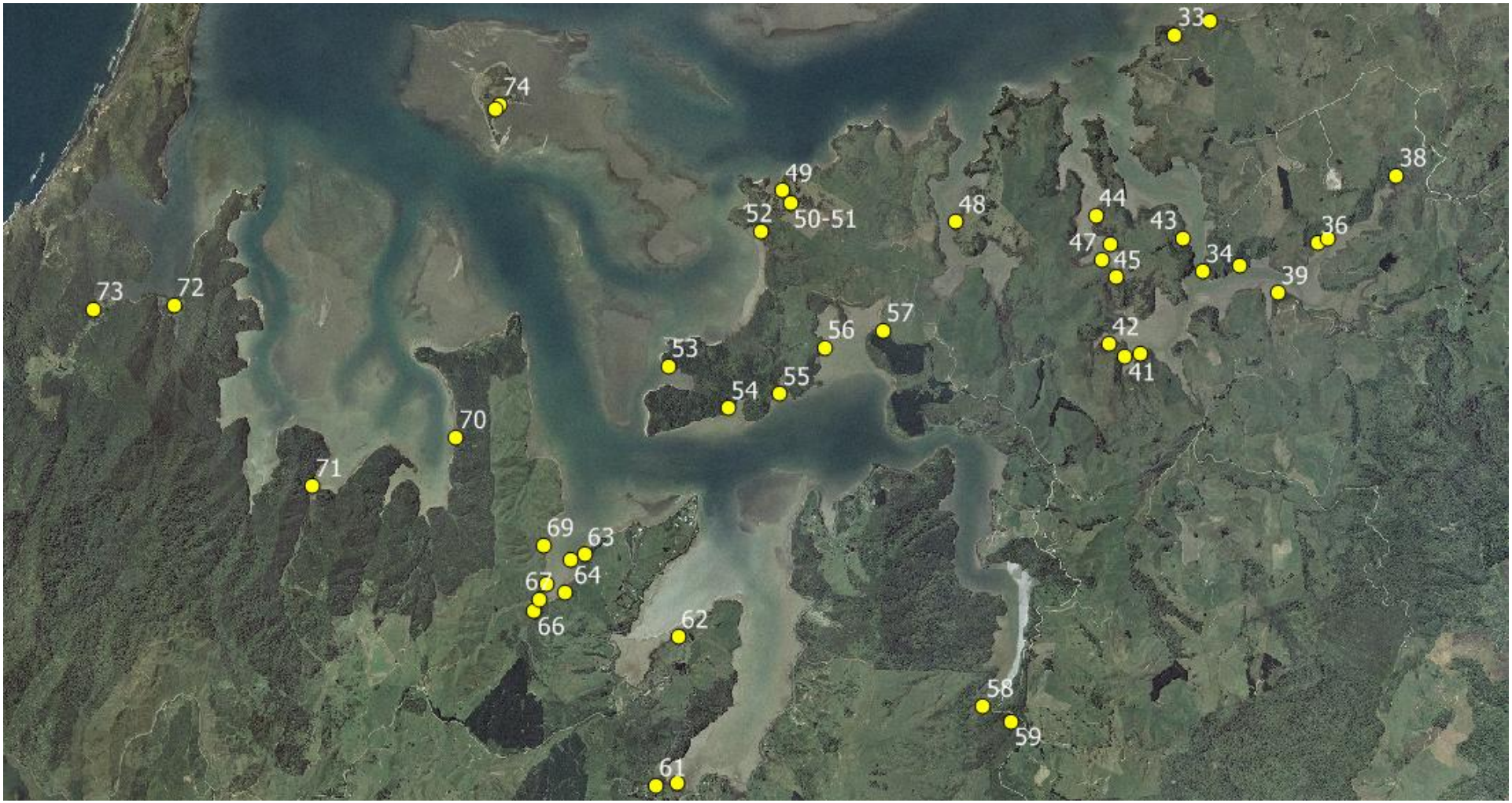

Figure 2b: Map of southern Kawhia Harbour with points of interest and photo points

Figure 3: Sea primrose and small areas of glasswort were invaded by saltwater paspalum on a sandy ridge within Te Ariaotewiwini Inlet.

Figure 4: A close up view taken within the sea meadow bed shown in Figure 2 showing scattered sea primrose with saltwater paspalum beginning to establish.

Figure 5: A view looking along the mixed interface of sea grass and three square in the village bay.

Figure 6: A fenced area of rushland where stock have access. Note the pugged sediments and lack of saltmarsh ribbonwood and oioi within the grazed area.

Figure 7: This is a repeat view of Figure 3 from the 2005 survey report in the upper east arm of Te Wharu Bay. The spartina had been eradicated from here but stock still had access to the harbour and had pugged the banks and flats as well as grazed and pugged the estuarine vegetation.

Figure 8: A panorama looking at an unprotected head of a bay. The unprotected harbour margins were characterised by eroded banks, slender clubrush communities along open high tide lines, patchy sea rush communities and grazed scattered saltmarsh ribbonwood bushes. The rushland to the right (downstream of the fence line) was protected from stock access.

Figure 9: Flax, toetoe and pampas lined the eroding siltstone cliffs of Motutarakatua Point. The eroding siltstone beach did not support any estuarine vegetation.

Figure 10: A repeat view of Figure 5 from the 2005 survey report showing an old fence line with sea rush, sea primrose and some glasswort in the foreground. At the end of the sandy beach there was a large patch of healthy glasswort and sea primrose.

Figure 11: A repeat view of Figure 6 from the 2005 survey report looking over the remains of a sprayed spartina patch. The healthy sea primrose and arrow grass behind intermingled with the seaward sea rush community at the mouth of the Mangaora Stream.

Figure 12: A repeat view of the head of the Mangaora Inlet as shown in Figure 7 of the 2005 survey report. Saltmarsh ribbonwood lined the upper channel edge and was scattered primarily around the TRB of the rushland.

Figure 13: Some short spartina was found by the wooden fence at the end of the road rest area. Sea rush, sea primrose and arrow grass line the left foreground.

Figure 14: A small indent within the Kawaora Stream arm has remnant root masses of a spartina patch in the foreground. The rushland was fenced around the landward edge, replacing the fence line that crosses the harbour flats.

Figure 15: A view along the eroded coastline at the head of a south-west facing embayment. The only estuarine vegetation present was rushland up along inland creeks or overwash areas and thin bands of sea meadow and saltwater paspalum along the eroded edge.

Figure 16: Severely pugged sediments, rushland and sea meadow communities were present where a gap in the fencing allowed stock access to the harbour. A bachelor's button and marsh clubrush wetland was present landward of the fence.

Figure 17: An eroding coastal edge along the outer TLB of the Oparau River embayment with heavy pugging along the high tide beach and a sea meadow community on the upper wave-swept flats.

Figure 18: A flock of sheep disturbed on a sandy unfenced beach. The eroded low flats at the head of the beach supported grazed sea meadow communities including *Leptinella dioica*, *Plantago* sp., bachelor's button and saltwater paspalum.

Figure 19: *Leptinella dioica* and a *Plantago* species.

Figure 20: A view looking over a pugged area of sea rush that extends landward into saltwater paspalum with some sea meadow and three square present. Marsh clubrush, raupo and willow extended further inland. Papakura Stream embayment.

Figure 21: Stock tracking and pugging along the coastal edge was a common occurrence in this bay. Saltwater paspalum was present along the land edge here as well as mixed rushland and sea meadow communities, with oioi and three square seaward. Two cows and their calves were in the background rushland.

Figure 22: A view looking over rushland along the Tiritirimatangi Peninsula causeway to rush islands showing areas of die-back. Die-back of the central sea rush island was mainly restricted to the northern seaward side but the two rush islands behind and either side of the central island had died back completely.

Figure 23: A close up of the remnants of the inner island as discussed in Figure 21 above. Note the rushland backed by coastal shrub daisy (*Olearia solandri*), manuka and swamp coprosma wetland communities to the left and saltmarsh ribbonwood to the right.

Figure 24: A photo of mixed rushland - bright green marsh clubrush in the left background, blue-green three square and golden oioi in the foreground, light brown sea rush in the right background and a zone of dead root masses fringing the seaward edge of the rushland.

Figure 25: A view looking over healthy patches of sea rush and oioi and a large patch of spartina (centre right) at the head of the arm between the Awaroa River and Waikorire Creek.

Figure 26: In this repeat photo of Figure 10 in the 2005 survey report the rushland with oioi and marsh clubrush looked the same. The only difference was that the mangrove in the 2005 photo had gone.

Figure 27: A repeat of Figure 11 from the 2005 survey report. There was no sign of stock damage in the rushland in November 2012.

Figure 28: A repeat of Figure 12 in the 2005 survey report. The coastal margin was fenced well back from the harbour edge and dominated by pampas. Scattered native riparian vegetation was also present.

Figure 29: Sea rush die-back at the tip of Mahoe Point.

Figure 30: The northern end (towards Kopapaihekei Point) of a significant freshwater and estuarine wetland sequence that had a stock access problem. The rushland, saltmarsh ribbonwood (inland of the grassed spit) and freshwater wetland communities were badly pugged and grazed.

Figure 31: A cow grazing in the riparian margin around from Okehu Point. Note the rocky coastline and the few patches of rushland in the shelter of the boulders.

Figure 32: Along this exposed section of coastline there were old tree roots exposed and dead rush root bases with live short three square growing amongst them. Sea rush was present in the distance in the more sheltered corner.

Figure 33: A view of the eroding coastline with a limestone island in the middle background. Note the old tree roots out in the flats.

Figure 34: Te Aute Point in the background has excellent riparian management with a large set back from the coastal edge protecting the remnant coastal forest and allowing further riparian forest regeneration.

Figure 35: A number of plants of the threatened species *Scandia rosifolia* were found along the coastal cliff edges of the Rakaukeke Creek arm near the Narrows.

Figure 36: An example of poor quality rushland with clumps of oioi and dead oioi root masses, signs of grazing of oioi and animal prints in the mud (goat?).

Figure 37: Behind the sparse oioi patches in the foreground was a mat of dead spartina roots. Marsh clubrush and oioi lined the foreshore.

Figure 38: A sprayed spartina site covered in seaweed *(Entromorpha sp.)* with sparse oioi at either end. Some dead oioi bases were also present.

Figure 39: A repeat of Figure 17 in the 2005 survey report looking over a mix of oioi and marsh clubrush with coastal forest and farmland in the background.

Figure 40: A repeat photo of Figure 18 in the 2005 survey report showing a mixed coastal forest edge including live kanuka and possibly a dead kanuka amongst kowhai and akeake. Coast spear grass (silver tussock) lined the intertidal edge with rushland to the left and right.

Figure 41: A patch of live spartina extending seaward of a dead rush zone. Scattered oioi plants were present seaward and within the dead oioi root mass. Oioi, sea rush and marsh clubrush were present along the landward edge.

Figure 42: Dead rush bed mats with healthy oioi seaward and landward. Marsh clubrush was in the background and the pasture was not fenced from the coast.

Figure 43: Tracked rushland at the high tide zone and sprayed kanuka along the riparian margin with no fencing. Dead root masses of oioi are visible along the seaward edge of the rushland.

Figure 44: A small unfenced indent along the eastern side of Tuapu Island with a grazed edge of sea meadow (sea primrose and slender clubrush) and sea rush in front of the pasture. A small patch of seagrass was found lower on the tidal shore abutting a sea primrose bed. The rushes in the background were mainly three square and oioi.

Figure 45: The remains of a spartina plant sitting on top of a mass of dead oioi roots indicating the amount of sediment build up and subsequent loss.

Figure 46: The western side of Tuapu Island had stock pugging out over the flats and grazed oioi (and some sea rush) along the landward margin of the rushland. The pasture on the right side of the photo is the mainland.

Figure 47: A view over the end of the Tuapu Creek embayment with sea rush and a patch of saltwater paspalum to the left. Across the causeway there is extensive saltwater paspalum beds lining the 'pond' either as a mono-specific fringe or mixed with sea rush or oioi. Marsh clubrush was present as well as raupo behind the 'pond' and edged with manuka and willow.

Figure 48: Ungrazed rushland next to short grazed rushland fenced within a paddock at the head of the Tuapu Creek.

Figure 49: Clumps of dying oioi in the foreground have large holes in the nearby sediment with goose footprints around them. Three square and oioi were in the background.

Figure 50: An embayment with pugging over the flats and a new fence line currently being established along the coastline

Figure 51: Three square and sea rush line the head of this arm with some oioi in the foreground. In front of the three square along the near bank is a dark patch of dead root bases.

Figure 52: A view looking out of the arm over a three square band and then a sea rush band. Stock tracking, pugging and defecation was common in the harbour here. Note the bulldozed track and fence posts laid out for the new fence line which will address the stock access problem.

Figure 53: A view of rushland composed of three square, sea rush and oioi up into a margin with patches of saltmarsh ribbonwood, flax, swamp coprosma, manuka and some coastal swamp daisy. The corner of a large wallow within oioi and marsh clubrush is visible in the bottom left corner.

Figure 54: *Machaerina sinclairii* with coast spear grass along the high tide mark south of Te Umuroa Point.

Figure 55: A view showing saltwater paspalum (reddish colour) backed by sea rush, coast spear grass and some saltmarsh ribbonwood in a small bay between Te Umuroa Point and Pakingahau Point. Seagrass fringes the edge of the flats. There is new sea rush in the central saltwater paspalum bed and a new patch of oioi in the distant right compared with Figure 22 from the 2005 survey report.

Figure 56: Rushland fringes this embayment with raupo often behind. Riparian kanuka had unfortunately been sprayed at the head. Animal tracks (goat) were common over the seaward flats seaward of the fence line crossing the embayment.

Figure 57: Exposed bases of sea rush and *Baumea junecea* behind an area of sprayed spartina. Note the soft anoxic sediment which had a strong sulphur smell.

Figure 58: An area of dying oioi with sprayed spartina patches seaward. The landward edge was unfenced and the back of the rushland pugged by stock.

Figure 59: Native forest riparian margins along the upper tidal reaches of the Waiharkeke Stream. In this view looking upstream there is a lone mangrove out in front of a band of marsh clubrush with a thin fringe of oioi and sea rush.

Figure 60: This view is a repeat of Figure 25 from the 2005 survey report looking upstream at a marsh clubrush wetland with some saltmarsh ribbonwood on the TRB and the odd fringe of oioi and sea rush. Waiharakeke Stream.

Figure 61: A burnt area of oioi and a thin fringe of manuka in the background. Kinohaku hall and school are visible to the left.

Figure 62: A view looking over the rushland at the head of Kinohaku Bay. The blackened area is where a fire had burnt a large area of oioi back to a manuka fringe. The furrowed land is a wet area of rushland and freshwater wetland that has been farmed or cultivated.

Figure 63: A view looking seaward over a highly pugged stream mouth. Sea rush lies in behind a sandy ridge and to the right is sea rush mixed with slender clubrush and bachelors button.

Figure 64: This sandy stretch of foreshore had a couple of patches of saltwater paspalum (the larger patch being ~9x3m wide). There was also the odd patch of sea rush and sea meadow. The forested headland in background is Te Rangiora Point.

Figure 65: Pacific oyster patches around remnant spartina root clumps.

Figure 66: A repeat of Figure 29 in the 2005 survey report taken beside a gate in a fence that extended across the harbour flats. There were stock footprints in the mudflats on the upstream side of the fence however the sea rush in the foreground looked a bit healthier in comparison to 2005.

Figure 67: The mouth of this stream had heavy pugging around it and the sea rush and arrow grass was invaded by saltwater paspalum. Marsh clubrush dominated inland of the rushland.

Figure 68: Short sparse spartina was found on the mudflats (in foreground) near Ohau Stream. Tall spartina was also found behind and to the right of the photo mixed with sea rush and oioi.

Figure 69: A repeat of Figure 30 in the 2005 survey report looking across towards Te Waitere peninsula with the forested headlands of Te Rangiora and Pakingahau Points in the background. There wasn't any current stock tracking visible however the coastal edge wasn't fenced off and stock pugging and dung was common further out along the bay.

Figure 70: A patch of rushland with some spartina within the shelter of an indent. Two dead sheep were found along this unfenced coastal edge.

Figure 71: Sea rush, some sea meadow (slender clubrush and sea primrose) and saltmarsh ribbonwood were found in between two large eleagnus plants. Regenerating kanuka coastal forest lines the coastal edge with some kowhai.

Figure 72: An enclosed arm at the mouth of the Waikiekei Stream with saltmarsh ribbonwood islands and sea rush and oioi behind. Flax and manuka are common around the edge.

Figure 73: A sea rush band with a patch of oioi in front. The oioi looked like it has been 'mown' as all the tops were missing. Another similar patch was also found in this estuarine arm.

Figure 74: This is a repeat of Figure 32 in the 2005 survey report looking up towards the mouth of the Opango Stream. The estuarine vegetation looked similar to that in 2005 however the regeneration of the coastal forest in the background has increased over time, some sea rush appeared to have died back a bit in foreground but grown in the background. Sea meadow mixed with pasture grasses around the edges.

Figure 75: A repeat of Figure 31 from the 2005 survey report showing coast spear grass and sea primrose along the stream banks with coast spear grass and sea rush in the background.

Figure 76: A view over the large mixed rushland/sea meadow community within the shelter of Te Motu. Sea primrose is also common (but not visible) amongst the rushland.

3.3 Birds

Birds seen/heard during the estuarine vegetation survey:

- Banded rail
- Barnyard goose
- Bar-tailed godwit
- Black-backed gull
- Black swan
- Canadian goose
- Caspian tern
- Fernbird
- Gannet
- Kingfisher
- Mallard duck
- NZ dotterel
- Paradise duck
- Pied shag
- Red-billed gull
- Spoonbill
- South Island Pied oystercatcher
- Spur-winged plover
- Variable oystercatcher
- Welcome swallow
- White faced heron

3.4 Threats

Threats to the native estuarine vegetation communities in Kawhia Harbour include weeds, wild animals (mainly goats), and poor agricultural land use (including lack of fencing of stock from the CMA and lack of provision of vegetated riparian buffers).

WEEDS

Spartina - Uncontrolled sites and remnant fragments of spartina were noted scattered around the harbour. In a few cases grazing of the spartina was noted.

Saltwater paspalum - Small populations of saltwater paspalum were found scattered around the harbour with the head of the Tuapu Creek embayment having the largest infestation (which was also noted in the earlier survey).

WILD ANIMALS

Wild goats are common around the coast line and are not only restricting natural riparian/coastal forest growth but are also damaging saltmarsh communities and exacerbating the spread of weeds with their tracking around the harbour.

Wild pigs are not as common as goats but their presence was noted by the number of 'wallows' and diggings seen along the inland edges of saltmarsh communities.

AGRICULTURAL LAND USE

Stock tracking, pugging and defecation along the coastal edge is still a common occurrence in Kawhia Harbour. Apart from the destruction of estuarine vegetation and the exacerbating the spread of weeds around the harbour, stock tracking and pugging of the upper tidal zone and coastal edge is helping accelerate erosion of the coastline.

Farming practises along the peninsula south of the Oparau River and including the Papakura Stream embayment; the coastline near Motukahu Rocks (northern Kauri Stream embayment); areas of the Tapua creek embayment; the western side and outer eastern side of the Maire Point peninsula; and the coastline from the Ohau Stream out towards Nathans Point (Ohaua) stood out as having particularly poor riparian management.

Further education is needed of land owners about the importance of riparian vegetation, including kanuka. A well-managed farm should be able to support a healthy riparian buffer along the coast and around waterways while keeping kanuka regeneration out of highly productive pasture areas. However, some land owners were still spraying kanuka right to the water's edge (e.g. Figure 55).

4 Discussion and Recommendations

The results from this GIS survey will be useful to highlight any changes in the spatial extent of the Kawhia Harbour estuarine vegetation communities since the 2005 survey, keeping in mind the difference in survey techniques.

Technical problems encountered included seagrass being unable to be mapped using the 2007 aerials provided by Waikato Regional Council due the aerials being taken with the tide covering much of the seagrass habitat. It was decided to wait for more recent WRAPS aerials to become available that gave a clearer view of the seagrass with the tide out. The sedge three-square which is relatively prevalent in Kawhia Harbour does not stand out well in aerial photography and so its mapping relies heavily on field surveys.

The common threats of weeds and inappropriate land use where again the main issues to the health of estuarine vegetation within Kawhia Harbour. Wild goats were also a problem around the coastal edge.

The Department of Conservation has done a great job at attempting to eradicate spartina from the harbour. There are still populations of spartina that have been overlooked and areas that require re-spraying however eradication of this weed is entirely feasible. It is noted that this vegetation survey is likely to have missed some short statured spartina populations if they were present out on the tidal flats and were under water while the area was being surveyed.

Saltwater paspalum, another weedy grass, is starting to get a hold within Kawhia. Due to its competitiveness and wide ranging effect on estuarine biodiversity, saltwater paspalum is a greater threat than spartina to the ongoing health of the native estuarine communities. It would be most effective and efficient to undertake control now while the infestations are small. Both saltwater paspalum and spartina are controlled using the same grass-specific herbicide. Canadian geese were common around the margins of the harbour and potentially could be vectors for transferring saltwater paspalum within the harbour. Together with wandering stock they could enhance the spread of saltwater paspalum.

The prevalence of rushland die-back is a concern. It seems to be predominantly occurring with oioi and may be due to changes in bed level heights and wave exposure following spartina control. Sites where spartina had historically provided shelter to neighbouring rushland communities commonly coincided with oioi die-back. However this was not always the case. Another reason for the die-back could be associated with stock grazing and pugging but stock access did not always coincide with oioi die-back either. Observations indicate that oioi is particularly susceptible to damage from pugging and seems to be preferentially grazed before sea rush.

Poor land management that does not ensure waterways are fenced and vegetated results in increased sedimentation and eutrophication of streams and estuaries and degradation of freshwater and estuarine habitats. Increased pressure on land owners to sustainably manage their land is needed to ensure adverse effects from farming are not passed onto the local communities and the environment.

A primary goal for coastal landowners is to ensure stock are fenced from the harbour and that coastal riparian vegetation is enhanced. There are also various freshwater wetlands adjoining the coast that would make excellent wetland restoration projects.

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Appendix A – Photo waypoints

Photo number	Latitude	Longitude
2-3	-38.0802	174.7911
4	-38.0642	174.8240
5	-38.0485	174.8283
7	-38.0456	174.8425
8	-38.0595	174.8491
9	-38.0463	174.8553
10	-38.0393	174.8565
11	-38.0358	174.8584
12	-38.0526	174.8587
13	-38.0506	174.8861
14	-38.0562	174.8900
15	-38.0559	174.9034
16	-38.0637	174.8957
17	-38.0676	174.8941
18	-38.0682	174.8944
19	-38.0672	174.9051
20	-38.0674	174.9042
21	-38.0755	174.8956
22	-38.0759	174.8949
23	-38.0821	174.9102
24	-38.0903	174.9054
25	-38.0906	174.9043
26	-38.0904	174.9030
27	-38.0892	174.8975
28	-38.0875	174.8988
29	-38.0861	174.8962
30	-38.0883	174.8914
31	-38.0904	174.8894
32	-38.0947	174.8748
33	-38.0958	174.8712
34	-38.1148	174.8745
35	-38.1143	174.8783
36	-38.1123	174.8862
37	-38.1120	174.8873
38	-38.1068	174.8940
39	-38.1164	174.8822

Photo number	Latitude	Longitude
40	-38.1215	174.8683
41	-38.1218	174.8668
42	-38.1208	174.8651
43	-38.1121	174.8724
44	-38.1105	174.8636
45	-38.1128	174.8651
46	-38.1153	174.8657
47	-38.1140	174.8642
48	-38.1112	174.8493
49	-38.1090	174.8316
50-51	-38.1100	174.8324
52	-38.1123	174.8295
53	-38.1232	174.8204
54	-38.1265	174.8265
55	-38.1253	174.8318
56	-38.1215	174.8362
57	-38.1200	174.8422
58	-38.1501	174.8531
59	-38.1512	174.8560
60	-38.1567	174.8221
61	-38.1569	174.8199
62	-38.1450	174.8219
63	-38.1385	174.8122
64	-38.1390	174.8108
65	-38.1416	174.8103
66	-38.1431	174.8072
67	-38.1422	174.8078
68	-38.1410	174.8084
69	-38.1378	174.8080
70	-38.1293	174.7989
71	-38.1334	174.7844
72	-38.1191	174.7700
73	-38.1196	174.7618
74	-38.1025	174.8027
75	-38.1029	174.8022