



**Figure 40:** Crushed and bulldozed mangal edge from drain clearance activities. Drain to left.



**Figure 41:** Edge of bulldozed mangal and cracked drain dredgings.



**Figure 42: Grazed and pugged sea meadow on the flat between the drain and stopbank. This area was commonly grazed and pugged around the Firth.**



**Figure 43: More grazed and pugged sea meadow on the flat between the drain and stopbank.**



**Figure 44:** Stock tracks through the sea meadow (glasswort) and stock grazing of the mangroves. The stock bank is on the left behind the mangroves. Waihou River mouth (true left bank).



**Figure 45:** Although the fence here is appropriately sited at the toe of the stopbank, it is not of a good enough standard to keep stock out of the coastal marine area. Note tracks over mud.



**Figure 46:** Fingers of saltmarsh ribbonwood extend out from the mangal boundary towards the stopbank, interspersed with marsh clubrush and tall fescue.



**Figure 47:** A bachelor's button dominated stretch of drain between the Waihou and Piako Rivers. Marsh clubrush dominated between the drain and the stopbank (left) and between the drain and mangal (right). A band of saltmarsh ribbonwood also lined a stretch of the seaward side of the drain.



**Figure 48:** Reverted sea meadow, mangroves and swamp clubrush. Tall fescue dominated the old paddock stopbanks.



**Figure 49:** Dense glasswort fields amongst swamp clubrush, scattered saltmarsh ribbonwood and mangroves on the true right bank of the Piako River mouth. The glasswort in the foreground is unfenced. It is still fairly healthy though pugged.



**Figure 50:** A patchwork of glasswort, tall fescue, swamp clubrush, spartina and mangroves. The spartina is the golden yellow patch showing in the distant centre beside a mangrove. Most of the spartina in the open was this colour presumably reflecting the effect of recent cold nights.



**Figure 51:** Spartina under a relatively dense mangrove canopy. Mouth of the Piako River (true right bank).



**Figure 52: Mangroves lining the lower Piako River.**



**Figure 53: An old bulldozed path through a mangal as part of drain maintenance. The sea meadow (reddish patches) would have extended in under a dense mangrove canopy.**



**Figure 54:** The largest patch of sea rush (dark brown in centre) found on the Piako River.



**Figure 55:** An example of the estuarine vegetation that is lost to drainage activities. The undisturbed bank has a fringe of mangroves backed by saltmarsh ribbonwood. Pampas was invading the higher ground.



**Figure 56: Large unfenced glasswort sea meadow bound by the stopbank upstream of the Piako River bridge (true right bank).**



**Figure 57: Grazed spartina and sea meadow along the true right bank of the Piako River.**



**Figure 58:** A good example of stopbank and riverside management. Here the largest band of oioi found in the Firth backed mangroves and saltmarsh ribbonwood on the edge of the Piako River (left), while marsh clubrush, tall fescue and flax grew landward towards the fenced stopbank.



**Figure 59:** This shows good fencing and river bank management. The fence is placed at the toe of the stopbank, leaving the wet flat river edge to establish a good vegetation cover. The casuarinas (in background) are being replaced with flax planted amongst the sea meadow and other wetland species.



**Figure 60:** A view of the fenced off river bank and stopbank - just upstream of the Piako River bridge.



**Figure 61:** This is an example of poor riverside management just upstream from the good example above. Here the entire river flat between the river bank and stopbank was being grazed. This has resulted in an unnatural sea meadow community that is pugged.



**Figure 62:** Photo showing the grazing effect on mangroves, saltmarsh ribbonwood and marsh clubrush presence. A dead cow was found in an open drain near the river bank.



**Figure 63:** A large ngaio on the Piako river bank downstream of the boat ramp. The river bank supported ngaio, flax, saltmarsh ribbonwood and muehlebeckia. The Piako River is to the right.



**Figure 64:** The 5 m tall mangal at the Piako River mouth has suffered because of a digger bulldozing its way to a drainage outlet to undertake maintenance.



**Figure 65:** The other end of the 770 m path above.



**Figure 66:** The channel that the path above led to, between the Piako and Waitakaruru Rivers.



**Figure 67:** Pied shags roosting in mangroves on the true left bank of the Piako River mouth.



**Figure 68:** An expanding band of young mangroves backs onto a dead band of mangroves at the mouth of the Piako River. There was an abrupt change in tree height at the boundary between the older mangroves and young trees establishing in the front.



**Figure 69:** A view inside the dead mangrove zone. The dead mangroves were between 3 and 4 m high with new 0.5-1 m high mangroves growing within the dead zone. Some scattered older trees were surviving within the dead zone.



**Figure 70:** A large dead mangrove surrounded by 1 m high mangroves in the new outer mangrove zone at the mouth of the Piako River. The surrounding sediment was very muddy.



**Figure 71:** Young mangroves and seedlings establishing amongst scattered mature mangroves on the seaward mangal boundary.



**Figure 72:** Saltmarsh ribbonwood was often found along the drain edge. A glimpse of sea meadow is seen between the saltmarsh ribbonwood and mangal edge. Young mangroves lined the landward side of the drain up to the fence line.



**Figure 73:** Sea meadow patches often dominated the zone between the landward edge of the mangal and the saltmarsh ribbonwood. Tall fescue fringes the saltmarsh ribbonwood in this photo.



**Figure 74: Stock access on the coastal marine area side of the stopbank at the Piako end. This results in destabilised and defecated drain banks, pugged sea meadow and grazed mangroves.**



**Figure 75: Poor land management leading to elevated sediment levels in drains either side.**



**Figure 76:** An access point across the stopbank drain. These access points were not appropriated fenced and gated to stop stock accessing the main Firth wetland.



**Figure 77:** Recent fencing within the coastal marine area at the Waitakaruru end of the stopbank.



**Figure 78:** Grazing of the coastal marine area. Fence in background shown in Figure above.



**Figure 79:** An abrupt transition from mangrove swamp to pasture where the stopbank encroaches into the floodplain at the mouth of the Waitakaruru River (true right bank).



**Figure 80: Mangroves lining the lower Waitakaruru River.**



**Figure 81: Grazed and pugged sea meadow and mangroves on the true right bank of the Waitakaruru River downstream of the SH bridge (Maukoro Canal).**



**Figure 82:** More pugging and grazing within the coastal marine area on the true right bank of the Waitakaruru River downstream of the SH bridge (Maukoro Canal).



**Figure 83:** Heavily grazed spartina and sea meadow banks along the Waitakaruru Canal upstream of the SH bridge.



**Figure 84:** Mangroves along the Waitakauru Canal upstream of the SH 25 bridge displaying their bank stabilisation characteristics. No bank protection is provided where channel dredging has removed all natural vegetation. Further downstream where mangroves have been removed, spartina has taken over the bank protection role.



**Figure 85:** The unfenced banks of the upper Waitakaruru Canal edged by grazed marsh clubrush and mangrove seedlings.



**Figure 86:** A dead cow found on the river bank of the upper Waitakaruru Canal near the upper reach of the saltwater influence. The unfenced banks were predominantly covered in marsh clubrush with some bachelor's button.



**Figure 87:** Mangal edge along the open Firth between Waitakaruru and Miranda Stream. The outer mangroves ranged from 1.5 to 4 m tall.



**Figure 88:** A white goat and kid across the stopbank drain in the main Firth wetland near the Waitakaruru River mouth (true left bank). Various access points from the stopbank existed between Waitakaruru and the Karito Canal.



**Figure 89:** A particularly bad example of grazing in the coastal marine area. This extensively grazed spartina patch was seaward of the new storage sheds on the Miranda road (E2721398 N6439648) and was seaward of the stopbank drain.



**Figure 90:** Another view of the grazed and pugged spartina described above. Also present was bachelor's button and a band of dead mangroves lining the mangal in the background.



**Figure 91:** The dredged banks of the Karito Canal covered in sea meadow. Note the mangroves suddenly appearing upstream (in the distance) on the true right bank where dredging has only taken place from the true left bank.



**Figure 92:** Sea meadow north-west of Karito Canal with a large patch of spartina near a maimai (orange patch abutting mangroves on left) and along the stopbank drain (orange patch extending up right hand side of photo). A white heron is standing at the end of the spartina along the drain.



**Figure 93:** A new stopbank and drain that has been formed since 2002, which, based on undisturbed vegetation communities to the south east, has resulted in a loss of sea meadow and open mud flat.



**Figure 94:** A view of the new stopbank shown above and the narrow strip of grazing between the bank and the Miranda road right. The pasture appears to be poor quality and has a mix of sea meadow species in it.



**Figure 95:** A large patch of spartina (centre background) in the mangal opposite the new drain and stopbank.



**Figure 96:** A view over the new stopbank looking north. The northern existing stopbank is further seaward and two thirds of the landward paddock was covered in sarcocornia sea meadow.



**Figure 97:** A dense spartina patch lay within a curve of the stopbank. Sea meadow and scattered mangroves are visible seaward.



**Figure 98:** *Sarcocornia* sea meadow and scattered mangroves covered the tidal flats of the Miranda Stream immediately upstream of the road bridge. Saltmarsh ribbonwood and silver tussock line the landward edge of the road.



**Figure 99:** Patches of glasswort, sea primrose, remuremu, mangroves and open mud flat characterised many of the low-lying swales formed between chenier ridges.



**Figure 100:** In less frequently inundated and/or freer draining areas behind chenier ridges, the vegetation was characterised by silver tussock and saltmarsh ribbonwood. Note the golden oioi in the foreground.



**Figure 101:** *Carex divisa* has invaded the higher land above high water spring. Scattered tall fescue was found amongst the *Carex divisa*. A glasswort sea meadow dominated the tidal depression in the background before the Miranda road.



**Figure 102:** This photo shows the effect of drainage and farming on the distribution of native estuarine vegetation communities. The glasswort sea meadow on the right behind the chenier stopped suddenly at a stopbank. The low-lying land to the left of the stopbank was separated from normal tidal inundations and now supports pastoral grasses. The pine trees are beside the Miranda road.



**Figure 103:** A view along an active frontal chenier on the Miranda coast. Note the mangroves that are being subsumed by the advancing chenier. Various weed species colonise the chenier bank. In this photo pampas and African iceplant are visible.



**Figure 104: Eroding mangroves on the seaward side of the active chenier ridge.**



**Figure 105: Sea rush edged by glasswort dominates the edges of the 'Fairview Road' canal stream mouth and further upstream towards the Miranda Shorebird Centre.**



**Figure 106: Newly established mangroves near the mouth of the 'Fairview Road' canal stream mouth.**



**Figure 107: Sea blite (*Suaeda nova-zelandiae*) is a localised succulent herb found amongst the sea meadow on the Miranda coast.**



**Figure 108: Sea meadow extends out onto the free draining chenier edges. The golden patches amongst the glasswort, orache, and silver tussock are sea blite. The bright green patch near the pampas in the middle ground is the green succulent shown below.**



**Figure 109: The fleshy rosette herb (sp?) that was found on the chenier banks.**



**Figure 110: A view of mangroves backed by saltmarsh ribbonwood, tall fescue and pampas just south of Kaiuaa. The coastal zone has been in-filled to the north of this estuarine vegetation community.**