RESTORING SALTMARSH COMMUNITIES IN TASMAN DISTRICT

October, 2010

tasman district council

INTRODUCTION

Why is Salmarsh Important?

Our estuaries are hotspots of biodiversity. They form a mosaic of substrate, floral and faunal patterns found nowhere else. They also provide real value for our economy, our cultural heritage, amenity and recreation.

The salt marsh is essentially any vegetation that is regularly flooded by the tide and occurs above mid-tide, except for eel grass (*Zostera*). Saltmarsh vegetation is critical for the life of many species of bird and fish. Banded rail, marsh crake, spotless crake, fernbird, and bittern are birds for whom good saltmarsh vegetative cover is critical for their survival. Many of these species are secretive and difficult to spot. Discovering them by their tracks is a good way to work out if they are around. The whitebait (mostly inanga) use rushland near the mouth of streams flowing into an estuary for spawning.

Saltmarsh filters contaminants coming off the land and processes them before they get further in the estuary.

Tasman district has lost very large areas of saltmarsh (170ha in Waimea Estuary) which has lead to the loss of many of these values. Around the district more and more people are becoming interested in restoring saltmarsh.

Fernbird *matata*

Marsh Crake (left) and Spotless Crake (right)

Banded Rail *moho-pereru* (native)

Australasian bittern *Hurepo*


Banded rail excreta and tracks

Estuarine Ecology Overview

Estuarine Zones Controlled by the Tide

Estuaries have essentially two zones separated by mid-tide. Below mid-tide the habitat is essentially marine and above mid-tide the habitat is more terrestrial. Water in estuaries is essentially saline (3% salt), whereas lagoons (areas regularly cut off from the sea by a bar) are usually less saline.

The pattern and distribution of plants in New Zealand estuaries follows a transition over the vertical gradient from eel grass in the lower mudflats, to salt marsh and then to terrestrial communities. Even within the salt marsh there is a very predictable sequence. Most of our estuary plants are found throughout the country. The main differences are that in the north of the North Island (Ohiwa and Kawhia Harbours and north) there are mangroves, and south of Otago, the dominant sea rush (*Juncus krausii*) disappears.

Because the coastline is fragmented and estuaries are not connected, salt marsh plants have to find ways of reproducing and dispersing across big distances. Most salt marsh plants seeds float and do not germinate in salt water. Others are bird-dispersed.

Salt Marsh

As the land rises, a series of distinct zones are found: lower, middle, upper zones and on to non-flooded zones. Salt is the most important factor determining the distribution of plants.

Salt Tolerance

Of the salt-loving plants (halophytes), each has a preferred salinity range. They must take up salt to create the right osmotic gradient across the root boundary and therefore they must deal with salt in their living tissues. There are different mechanisms to remove this salt, such as excretion, storage, succulence, and high leaf turnover.

Sediment particle size in the estuary can also have a large effect on salinity, with fine sediments holding more water and salinity remaining constant. With coarse sediments such as sand and gravel the salinity fluctuates greatly. Estuarine plants in finer sediments, such as mud, have had to adapt to the lower oxygen levels. Hyper-saline patches can develop around coarse sediments where there is rapid drying in enclosed embayments. Estuarine plants in finer sediments, such as mud, have also had to adapt to the lower oxygen levels. Thus, there can be considerable differences even in estuaries close to each other that are caused by differences in sediment.

Lower Salt Marsh

In this zone there is the lowest diversity of plants, as only plants that are very salt-tolerant survive. The salinity here is close to that of sea water.

Middle and Upper Marsh Zones

There is a decreasing salinity gradient as you move up towards the land; some areas are flooded by spring tides and others not. There is higher diversity as less salt-tolerant species can become established. At the upper edge there is no influence of salt water. Above this edge there is a grade into terrestrial vegetation.

Salt Marsh to Land Transition

Away from the harsh salt environment there is greater competition and halophytes are replaced with land plants. Occasionally, salt water intrusion into the land zone can occur. This zone is usually the most modified and missing from many marsh/estuarine areas as it is easily converted to other forms of land use. Such reclamations usually preclude inland migration of salt marsh but do not necessarily affect the functioning of plants within lower zone except via secondary effects such as sediment supply rate changes, nutrient leakages or altered wave energy characteristics. The habitat of various animals of the salt marsh, particularly birds, is greatly enhanced by the full estuary riparian buffer.

Vegetation Succession

If estuary plants were able to colonise freely into stable intertidal areas of an estuary, herbaceous plants establish first, followed by rush zone if sediment accumulates. However, there are dynamic processes happening in estuaries and erosion near channels can remove whole swards of plants.

Sensitivity of Vegetation Sequences to Sea Level Rise

With greater tidal range, the vegetation sequence is drawn out, given the same slope. This means that the vertical distances covered by each plant sequence are greater in Nelson than in Otago. There is no reason why plants should not migrate landward as sea level rise occurs, if they have the opportunity. However, some plants (eg, coastal ribbonwood) will find it more difficult to colonise than others as it is a poor competitor with pasture grasses. High sediment supplies to estuaries could offset the effects of sea level rise to a certain degree. Many salt marsh plants (eg, glasswort and sea blite) will colonise new estuary ground very quickly and have good dispersal mechanisms.

The Influence of Groundwater Intrusion on Salt Marsh Communities

Depending on the underlying geology, fresh water springs can be present in estuaries. Raupo can usually be found to occupy these areas. Raupo is very sensitive to saline water so the groundwater flow must be constant around the root zone.

Lagoons

Lagoons are cut off from tidal influences by a bar and do not get regular tidal flushing but may be still partly saline. There is a larger variation in flooding periodicity and the plants of the lower zones need to survive long periods permanently under water. Most of the plants in lagoons are shared with salt marshes but the zonation pattern is the major difference. Contaminant discharges (such as nutrients from farm run-off) to lagoons is expected to cause more adverse effects than in estuaries due to the lack of flushing.

Common Saltmarsh Plants

Rushlands

Oi Oi,
Jointed Wire Rush
Apodasmia similis
Low salinity, fine sediments
Very slow natural re-establishment

Sea rush
Juncus krausii var australiensis
High salinity, fine sediments
Very slow natural re-establishment

Estuary needle tussock
Austrostipa stipoides Coarse sediments, low salinity
Very slow natural re-establishment

Sea Celery *Apium prostratum*

Bachelor's Button
Cotula coronopifolia

NZ Spinach (Tetragonium)

Spear-leaved Orache or 'Fat Hen'
Atriplex prostrata

Coastal Ribbonwood
Makaka
Plagianthus divaricatus
Low salinity
Very slow natural re-establishment

Knobby Clubrush Wiwi, *Isolepis nodosa*
Plant on the landward side of Ribbonwoods

Leptinella dioica

NZ Musk
Mimulus repens
Low salinity, fine sediments

Shore primrose
Maakoako
Samolus repens
High salinity, coarse sediments

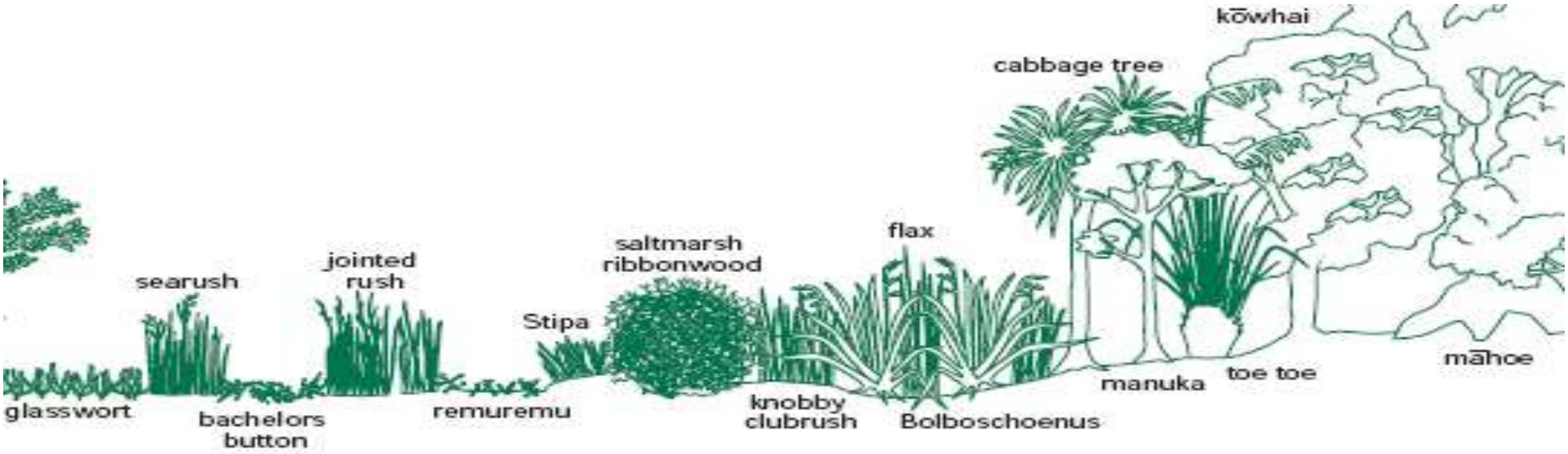
Native Iceplant
Disphyma australe
Low salinity

Glasswort
Ureure
Sarcocornia quinqueflora
High salinity, coarse sediment

Remuremu
Selliera radicans
Low salinity, coarse sediments

Sea Blite
Suaeda novae-zelandiae
High salinity, coarse sediments

Typical Estuarine & wetland vegetation sequence



ESTUARY RESTORATION

Setting Objectives

Concepts of restoration within estuaries here comprise two types, desire to restore health of the intertidal part of estuaries (mudflats and lower communities) and a desire to do marginal planting for re-establishment of salt marsh. Under the objective of improving biodiversity in a highly accessible area it needs to be established whether birds or plants are the main priority. Often you can have both but not always.

Planning the Planting Programme

Shaping Your Ground, Terraforming – Starting from Scratch

Develop beaches on the estuary margins. Usually slopes are about 1:20 and 1:15 maximum. Put the soft sediment on top but add a thin layer of gravel or cobble if there is likely to be any wave action. If the sediment is very fine, test by picking up a ball of mud in your hand and if it oozes down your arm, you will have to wait longer for it to settle before planting.

The Benefits of Creating Low Islands

Constructed islands have been successful in many estuary restoration projects. In fact, some islands have been so successful in providing safe bird habitat, they have become over-populated and efforts have been made to encourage birds to use other islands.

In some situations moats have been created to protect nesting sites from dogs, cats and other pests. There are situations where dog owners deliberately release their dogs off their leash in areas that are clearly signposted as bird protection areas. Moats are totally unnatural features in estuaries. However, if your objective is to bring back bird abundance and diversity where dogs, cats or stoats are an issue, then moats are a good option.

In other situations bird habitat may not be so important and plant communities become the main driver of restoration. In these situations the landforms created will be stylistically more natural to bring back natural communities of salt marsh. In some situations you can achieve both plant and animal habitat.

What to Plant Where – Using Indicator Species

Plants that live in the environment can give very good clues as to what will grow there. So, plant the species that match those already present. This is unless the salinity or tidal regime is to change, or you are terraforming for other reasons. One of the easiest ways to establish the correct height band to plant with respect to mean sea levels, is to be on site near the high tide and use the water as your 'level'. Beforehand, find the closest naturally-occurring location of the plant species you are interested in planting and when the tide reaches those plants, stake out that tide mark in the area you wish to re-establish those plants.

A lot of restorations have wasted time and effort planting salt marsh herbs as these kinds of species will establish quickly by themselves without assistance.

Plants that will come away naturally and that you will not need to plant include:
Glasswort (*Sarcocornia)*, Sea blite (*Suaeda)*, Shore primrose *(Samolus)*, Remuremu *(Selliera)*, Sea celery *(Apium)*, three-square, New Zealand musk *(Mimulus repens)*, Marsh arrowgrass (*Triglochin)*. Use these primary colonisers for determining what plants to add once they have become established. The longer you leave it, the more accurate the picture becomes. It is suggested that leaving it 1-2 years is appropriate. Planting three-square could be useful if you do not have any nearby that will colonise naturally.

Self-establishing Glasswort Meadows

Plants that you do need to plant are: oioi, sea rush, coastal ribbonwood, estuary needle tussock.

Rare plants: It is usually preferable to plant the rare plants later once it is known that weeds are controlled sufficiently and the site has stabilised. If you plant them too soon, there is a risk of putting these valuable plants in the wrong place where they will not survive.

The two main factors determining where plants grow are: sediment type and salinity regime. Herbaceous species would be the most difficult to determine where to plant but as they colonise naturally, there is no need to be concerned about this. They will grow where they can. Failures usually relate to plants that are planted in the wrong space.

Sediment Preferences

COARSE SEDIMENT		**FINE SEDIMENT**	
High salinity	**Low Salinity**	**High Salinity**	**Low Salinity**
Glasswort*	Remuremu *(Selliera)*	Three-square (*Schoenoplectus*)	New Zealand musk *(Mimulus repens)*
Sea Blite (*Suaeda)**	*Sea celery (Apium)*	Sea rush *(Juncus krausii)*	Marsh Arrowgrass *Triglochin*
Sea primrose *(Samolus)*	Estuary Needle Tussock *(Austrastipa stipoides)*		Silver Tussock (*Poa cita)*
	Sedge *(Schoenus consinnus)*		Oioi (*Apodasmia*)
	Oioi (*Apodasmia*)		*Leptinella*
			Carex littorosa

* Will be fine even in 5% salt

- Oioi – slow growing, slow to establish, cannot stand drying out too much, not fussy about needing coarse or fine sediment.
- Sea rush – slow to establish.
- Coastal ribbonwood – patchy self-establishing – low salinity (not fussy about sediment).

- Inland from the coastal ribbonwood use the following plants: *Coprosma propinqua* (mingimingi), *Coprosma crassifolia*, manuka, ngaio (in more exposed sites). *C. crassifolia* is often not available due to the paucity of seed-bearing plants from which to raise seedlings.

The Salt Marsh Boundary

A good restoration project tries to restore the whole sequence to land and thus includes non-estuarine coastal plants. For this you will need to work out what the adjacent system is or should be – eg, wetland, forest, shrubland or dunes. Develop a typical land-based restoration for the adjacent area and interleave the salt marsh with it.

A big clue is to look for indicator species. If you find only one species that is normally associated with one or two other species in same habitat, then it is fairly safe to plant the missing species in that zone. The plants will be responding to the local conditions and we must use existing plants as our primary guide. It is advisable to carry out a detailed botanical survey of your estuary. From this you will get good idea of what plant associations are present or should be present in the estuary.

Note: Silver tussock is found in many of Tasman-Nelson's estuaries but further up the sequence from estuary needle tussock. Coastal ribbonwood has marked good and bad years for seedling survival, usually related to moisture content of the soil.

Comments by Roger Gaskell from Department of Conservation regarding local planting in estuaries: Revegetation of rare plants (eg coastal peppercress (*Lepidium*) has been undertaken in various locations (eg Sandy Island in Moutere Inlet). Planting the rare plants first was not a good idea because of weed invasion. Tall fescue was the worst weed, sprayed it out, much to benefit of the cress once planted. Lupin has to be hand-pulled. NZ Spinach (*Tetragonia)* arrived by itself. If the seed stock is in the ground, it will grow when conditions are right. Knobby clubrush (*Isolepsis nodosa)* has established itself by seed. Shore convolvulus filling space tall fescue occupied. It is hoped that sea holly, *Schoenus concinnus*, will recolonise by themselves.

Propagation and Acclimation of Estuary Plants

One option for propagation is to create in-estuary plant nurseries in order to better-acclimatise estuary plants. Collecting divots may be the easiest way to go as it avoids as much disturbance of the estuary and the need for resource consents.

Availability of Estuarine Plants in Nelson-Tasman

Provided you plan ahead and get orders in a year or two in advance, Titoki or Mainly Natives nurseries can supply the numbers of plants needed. Anything rare or very difficult to cultivate is purchased from the Department of Conservation nursery.

Acclimation

No benefits have been found from trying to acclimate plants with appropriate concentrations of salt water and can be a big problem if there is over-spray that gets onto other plants that do not tolerate such salt water. Hydroponics can be a very successful method of growing halophytes providing you get the appropriate salinity range. It is not really known how important it is to establish mycorhyzal (symbiotic fungi growing on the roots of plants) associations in the propagation and establishment of salt marsh plants.

Native ice plant – not found naturally occurring in estuarine habitats. Mainly found on cliff faces or rocky shores. This plant is good in gravel situations where the salt can leach out. It grows extremely fast on shell banks.

Timing of Plantings

Dry summers and very frosty winters can result in high percentage die-off of recently-planted plants. Even though the saltmarsh is wetted twice a day by the tide all year round, hot, dry summers can increase salinity in the soil. Some of the greatest success can come from planting in spring when good rainfall occurs the following summer. However, in sites that wet from fresh groundwater most or all year-round, it can be best to plant in drier periods. Planting in autumn with a hard winter following can lead to widespread plant deaths. Writing-off some seasons is just something that needs to be factored into the budget.

If earthworks (terraforming) is to be carried out it should be done in one concentrated effort and then avoid further tinkering. Such work requires resource consent from Council. Once set up, avoid adjusting parameters, such as tidal flush, as this will make it more likely that failure will occur. If doing restoration or planting of sea rush in conjunction with increased flush of culverts, you should wait until the earthworks settle down and you can work with a steady system. The longer you leave it to naturally re-establish the more chance you have, unless you get weed invasion. Once the primary colonisers have established you have a reference point for where to plant other plants that will not establish well on their own. This is especially important to visualise the zone boundaries as defined by the adventives.

Restoring Inanga Spawning Habitat

Inanga spawning habitat is grassland or rushland on the floodplains of streams around the upper limit of the salt water wedge associated with high tides and particularly spring tides. Low velocity hydraulic zones are preferred by inanga. These include pools, slow runs or backwaters. Meanders and floodplain vegetation play important roles in reducing water velocities.

The amount of inanga spawning habitat in an area usually correlates with the productivity of whitebait runs. This is true in Golden Bay where there is a much greater amount of habitat available for spawning and there are much higher numbers of inanga coming upstream in the spring runs. Following spawning, the hatchlings get washed out to sea. The coastal circulation pattern in Golden Bay is likely to keep much of the inanga population within this bay. This same is probably true for Tasman Bay. Inanga are not known to seek the same stream year after year, like salmon, so the population will disperse and colonise restored streams.

The inanga spawning zone in many urban streams has been severely modified, particularly around Nelson and Richmond. The following creeks around Waimea Estuary have been mostly denuded of inanga spawning habitat: Borck Creek, Saxton Creek, Orphanage Creek, Poormans Stream and Jenkins Creek. Many creeks flowing into Nelson Haven have likewise been denuded. Often, the streams in this zone have been straightened and the riparian zone mown or lined with rock.

Access to habitat is often an issue, particularly around Motueka and Riwaka, with the number of tidal flapgates on small streams. For example, there are several on creeks in the Motueka River delta, Ferrier Creek, Little Sydney Stream and Hamilton's Drain. Not only is access prevented but this blockage to tidal flow causes stagnant water to build up behind the flapgate and poor water quality, particularly low dissolved oxygen and high water temperatures, often results.

While inanga are surprisingly robust to mild pollution, discharges of contaminants, particularly sediment, should be kept to a minimum and particularly during the summer months.

Pests such as cats, rats and mice that eat the fish or eggs may need to be controlled. Farm stock that feed on the riparian grass should be excluded from inanga spawning areas, at least from late December to end of April. While inanga spawning occurs on spring tides from February to April, it is important to allow 1-2 months of growth of grasses or rushland prior to the spawning period so the habitat is available. Most resource consents for works in the beds of streams required that this whole period be avoided and revegetation as soon as possible after the earthworks. Where excessive weed (either aquatic or riparian) growth is a problem, spraying or mechanical clearance may be needed, but again outside the spawning season.

Native rushes and grasses that are commonly associated with inanga spawning include: Oioi, *Juncus*, Raupo, Flax, Umbrella sedge. Introduced grasses and herbs also provide good habitat. These include: Tall fescue, Yorkshire fog, Lotus, Buttercup, white clover. Eggs are usually laid on lower stems and roots of these plants as well as leaf litter.

Spawning sites can be registered by completing an inanga spawning survey form and submitting this to the Department of Conservation regional conservancy office.

For more information refer to Richardson and Taylor 2002. A Guide to Restoring Inanga Spawning Habitat. NIWA Science and Technology Series No. 50 ISSN 1173-0382.

Pest Plant Management

Weeds can destroy your plantings, especially at the low salinity upper marsh end. The worst weeds in this upper marsh zone include **tall fescue, creeping bentgrass, couch**.

Couch is bad because it is reasonably salt-tolerant and has rhizomes that form a deep mat that is almost impossible to control by spraying. Scraping with a digger is the best method. The mat of couch breaks down very slowly and composting is not a good option. Scraping usually needs to go right down to Mean High Water Springs.

Buck's horn plantain is found in both low and high saline areas (in higher saline areas it takes on a redder colour). It is often found on disturbed ground and in between the lower and upper marsh zone. It is usually outcompeted by taller vegetation.

Indian doab and **kikuyu** are problem weeds of the North Island (and top of the south). **Sea lavender** (*Limnolium*) is not in Nelson-Tasman yet but a real problem in Christchurch. It can even displace the hardy Glasswort.

Exotic jointed rushes have been planted is several locations around New Zealand thinking they were native – this shows the importance of using scientific names for the plants as well.

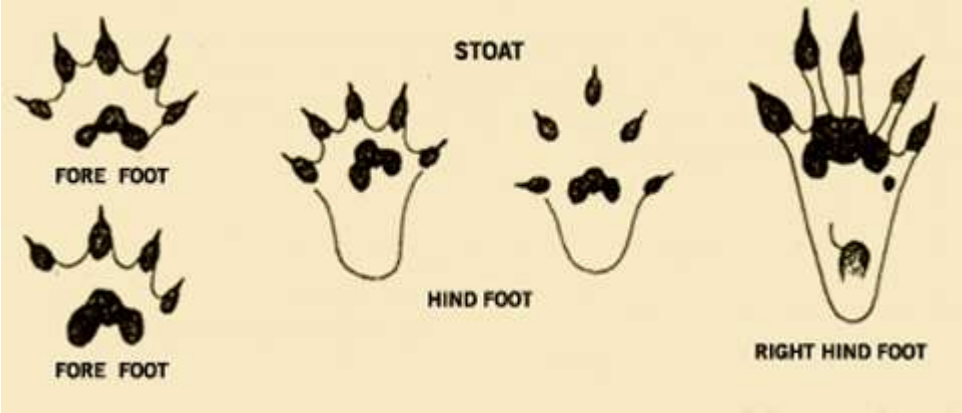
Spartina - In Waimea Inlet and other sites in Tasman eradication of *Spartina* has been largely successful, with any plants found through the annual survey process easily recognised and removed. Most weeds of the lower marsh zone are usually less of a problem but *Spartina* is a notable exception. Ongoing weed management is important in ensuring that the plants survive. Never turn your back on a weed. It was thought that *Spartina* was eradicated around Christchurch but, no!
There were no native plants that grew in the zone where *Spartina* established. This plant can spend a long time under water and it has an incredible salt excretion system.

Before and after Spartina eradication in Neimans Creek (lower Queen Street, Waimea Inlet)

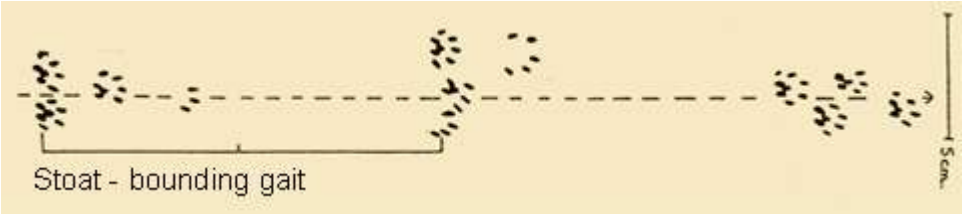
Weeds that were originally thought to be a problem but are not include: Barley grass and sickle grass.

Animal Pests

Feral cats, stoats and rats are the most significant threats to birds of the estuary. While you may not see these predators very often, look in the estuary mud to see any evidence.



The bounding gait of a stoat:



Source: http://www.doc.govt.nz/conservation/threats-and-impacts/animal-pests/animal-pests-a-z/stoats/you-can-help/

Managing Wildfowl

In Christchurch the main problem is Canadian geese. Within restoration sites the numbers that use them are fortunately nowhere near the numbers that use the sewage treatment area. On a former fill site adjacent to the restoration site there are thousands of Canadian geese at night. Chicks and eggs were removed from areas to keep numbers low. One interesting observation emerged from improving Scaup habitat. Once Scaup numbers built up, Canadian geese moved out. It seems that they do not like the darting movements of the Scaup. The high numbers of mallards can be a problem with their grazing and clearing areas of the salt marsh. Paradise ducks and Scaup are becoming pests and a lot more bold and have learned to co-exist with the mallards.

Pukekos appear to be the biggest problem in Nelson-Tasman as they rip out newly planted plants. Various ways of addressing this problem (in order of escalating severity) have been tried:

- Wiring and anchoring plants into the soil.
- Bend no. 8 wire into a U shape and put two of these perpendicular to each other over the plant and put sleeve of net (use orange net bags) over it.
- Use small weed mat with pins.

- Plastic sleeves with bamboo stakes.
- Plant larger plants with larger root mass so that the plants will more rapidly gain a hold.
- Trench traps. Dig a trench narrow enough so the Pukeko cannot turn around, ramp the entrance down from the surface to a deep point at about 500 millimetres. This allows the pukekos to be caught live and transferred elsewhere.
- Shooting. Permits are issued by Fish and Game to various landowners to control these birds.

Follow-up

- Learn from mistakes.
- Get the public involved.
- Maintenance, maintenance, maintenance! - is the mantra during the early stages.
- Celebrate your success.

This estuary in Christchurch was reclaimed land dug up and reshaped.The islands were planted up with bird habitat in mind. On the mainland opposite the island a walking track was constructed and waist-high plants established adjacent to the track on the estuary side so birds cannot see the lower part of the people or dogs. This was created because the movement of people's legs was found to upset the birds. Birdlife returned in good numbers. Now efforts are being made to try to get them to go to other restored sites.

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Grooved surface assists plant colonisation

Divots planted in Charlesworth wetland, Christchurch

Tidal connection was restored to part of the wetland area. Initially, it looked like hypersaline conditions were developing, with the scraped area looking white with salt. Most of that salt gradually leached out with

rain and was colonised quickly by salt marsh species such as glasswort. Freshwater springs adjacent to the contaminated site were very polluted but are now clean.

The initial aim of the project was to restore full tidal flushing to the estuary by disestablishing the causeway that bounded the excavated and restored wetland. However, forming the walkway prior to the causeway removal meant that a loop walk was created, which led the local Community Board to turn down the project to remove the causeway or even develop more culverts to increase tidal flushing. It turned into a defining issue where the Bexley Wetland Trust members resigned in full and the trust was disestablished. The current situation is that at two low points on the walkway the tidewater overtops at high tide. The lesson from this is that public expectation of usage was predominant. If this project was to start over, the recommendation would be to take down the causeway first then build a walkway.

The area was scraped, tidal connection returned and many Glasswort and sea primrose meadows established within 18 months.

Sea rush was planted from nursery but most of them died, probably due to salt shock. However, divots (small clods taken from a large natural mass of rushes) can work well. Of all estuary plants, sea rush is the most sensitive to salinity fluctuation.

The budget Christchurch City Council has outlaid over the last 10 years was $2.5 million for the Avon Heathcote estuary and includes restoration, recreation, pathway construction. Councillors are very much in favour of this work, which is why it received a reasonable budget. Arrival and departure of godwits has been handed to the Christchurch events co-ordinator and they make a prominent feature of it, including ringing the Cathedral bells. If you develop iconic events like this and increase its profile, it makes to easier to attract the money to progress the initiative.

Estuary Restorations in Nelson

Hoddy Estuary Park Development, Waimea Estuary

This 6 hectare park has been gifted to the people of Tasman/Nelson by Peter Owen. Maybe part of this park could be set aside for the restoration of estuary and margin. A lot of habitat that has been lost could be returned. Tasman District Council's policy in relation to ponds in parks meant that it had to be fenced like a swimming pool. A compromise has been worked out to fence the whole park into two parts, that with the pond being turned into a wildlife reserve with some bird protection, with the other part for recreation.

Hoddy Estuary Park

There is ongoing discussion about creating habitat to try and reintroduce some of the species lost, such as Banded Rail. Department of Conservation (Graham Elliot especially) has supported this. The plan is to batter the slope to recreate the upper salt marsh so we have the right species being planted for at least 10 metres around the estuary. Some edge has been orchard and there is grass right to the estuary and then a gap where rushes, sedges are growing and then mudflats.

Hoddy Peninsula and O'Connor Creek Delta

Where there has been a lot of disturbance to an estuary in the past, such as siltation and run-off of pesticides from orchards, undertake some trial plantings and see what happens. Let plants tell you. If they survive in some areas and not in others with all habitat parameters the same, then it could be worth taking samples to confirm the issue then undertake remediation as necessary. The alternative is sample the estuary for these chemicals, but that is very expensive. "State of the Environment" monitoring of estuaries generally looks at representative habitat, including bulk vegetation units. Detailed information about discrete or isolated areas of the estuary affected by point-source discharges is done as part of the resource consent process. Toxic chemicals in sediments at concentrations above guidelines should be considered for restoration in areas around major industrial areas such as near the mouth of Jimmy-Lee Creek in lower Beach Road in Richmond.

Access and Dogs

A Solution for Reducing Bird Disturbance by People and Dogs

Research has clearly shown that birds are only scared off by people walking dogs around wetlands when they detect quick movements. If the rapid movement of people's legs and darting of dogs was screened by waist-high vegetation, birds are remarkably undisturbed. This appears to be a win-win situation because people walking past can still look over the higher plants. The combination of seeing dogs and people together was also more disturbing than each individually. Studies have shown people with dogs were more of a problem rather than dogs on their own.

Case Study: Sponge Gardens of Waimea Inlet

Through broad-scale mapping of Waimea Inlet as part of Nelson City Council/Tasman District Council estuary monitoring programmes carried out by Cawthron, two areas of biologically diverse sponge-associated communities were discovered. One area is located in the Saxton-Monaco channel and the other near the western end of The Traverse between Rabbit and Rough Islands.

Prior to 1998 the presence of causeway in The Traverse between Rabbit and Rough Islands in Waimea Inlet caused restriction of tidal flows and resulted in a lagoon where thick algal mats of *Enteromorpha* and *Gracilaria* dominated. After the removal of the western causeway in 1998, natural flushing was restored, which has removed much of the mud that covered the naturally stony substrate on which the sponge gardens grow on the spring low tide level. In this narrow arm of the estuary the water velocity is high and flows north-west towards Mapua. One hundred and fourteen species of animal and plants are found in these sponge gardens, making this area a hot spot of biodiversity.

The sponge garden near Monaco has a lower diversity (69 species). This also exists where there are strong current flows passing over shallow sub-tidal cobble-shingle substrate.

By comparing 1940s aerial photos with later ones it was shown that forestry had been established on what was once estuary. Now that the trees have been removed, salt marsh (mainly glasswort and sea blite) has naturally re-established. There has been discussion about opening the remaining causeway under the main access road to Rabbit Island. Replacing that with a bridge would not change tidal range but would affect flushing regime to some extent. An additional benefit of opening this remaining causeway to a full channel would be that flooding risk from the Waimea River could be reduced. When the Waimea River is in flood The Traverse has an outflow gradient towards western Mapua of approximately 1 metre difference. This may not lead to a significant ecological benefit because at the eastern end reasonable depths of fine sediments exist.

The Traverse is also affected by other activities such as water craft and jet skis. Their propellers directly disturb the muddy bottom when the tide lowers and birds get scared away. There is a need to consider conflict between uses and question what it is that the community wants for that area. A rowing course for this area was proposed but now such a course is suggested for construction on the island itself.

A full report on this topic is available: Asher R, Clark K and Gillespie P 2008. Waimea Inlet Sponge Gardens. Prepared for Tasman District Council. Cawthron report No. 1467.