

ESTUARINE ECOLOGY

Are our estuaries wader-friendly?

Linking estuarine habitat characteristics and wader distributions in New Zealand

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Some wading birds fly halfway round the world to spend time in New Zealand's coastal areas, alongside many local species. Are changes to our estuarine ecosystems a threat to these remarkable birds?

NEW ZEALAND'S COASTLINE is home to a wide variety of wading bird (wader) species. Outside the breeding season, huge numbers of these birds may gather at estuaries, mudflats and other coastal areas to feed in preparation for the next breeding attempt.

The waders you see in coastal New Zealand are a mixture of local and migrant species. Many of the New Zealand waders – including rare species such as the black stilt and New Zealand dotterel – breed inland, for example on riverbeds or upland areas. They and their young then move to the coast to join Northern Hemisphere species such as bar-tailed godwit and lesser knot. After breeding in the Arctic, these northern waders migrate enormous distances to spend their northern winter here.

New Zealand a major destination

Estuaries and harbours in New Zealand are important destinations for migratory waders from the Northern Hemisphere. During our summer about 30% of the bar-tailed godwit populations that use the East Asia–Alaska–

Australasia migratory route (Sagar *et al.* 1999) end up in New Zealand estuaries. The same goes for about 25% of the lesser knot population.

Some estuaries are particularly favoured by some species. For example, almost 40% of bar-tailed godwit occupy only three sites in New Zealand: Manukau Harbour, Kaipara Harbour and Farewell Spit. Manukau Harbour is also a key location for lesser knot and, along with Farewell Spit, it accounts for over 50% of the population.

New Zealand species are also localised. For example, outside the breeding season about 85% of the relatively rare wrybill can be found at just two sites: Firth of Thames and Manukau Harbour.

Unfortunately, humans don't make life easy for waders. Our estuaries are increasingly being modified by the effects of urban development and recreation. Habitat for waders may suffer, for example, through the disturbance of feeding or roosting birds. Habitat may even be lost through land reclamation or when invasive species such as *Spartina* grass and Pacific oysters encroach onto wader feeding grounds.

What can be done to maintain this attractive and internationally important feature of our estuaries?

One important contribution towards the conservation of wading bird populations would be an ability to predict how habitat changes might affect their numbers and distribution.

Northern Hemisphere research

In the UK and north-west Europe researchers have made considerable progress on the idea of linking wader population changes with changes in their environment. Large data sets covering several decades provide detailed information on wader numbers, distributions within estuaries, diets and feeding rates, along with descriptions of estuarine characteristics. Using these data, researchers have devised models that predict how hypothetical reductions in habitat quality might affect wader numbers (Yates *et al.* 1993).

Although these models can be very complicated and require large amounts of data, they have a relatively simple basis:

- the relationships between sediment characteristics of estuarine inter-tidal feeding areas and the numbers and distributions of prey within the sediment (e.g., bivalves and polychaete worms);



- the relationships between prey and the distributions of waders feeding upon them.

It is also possible to incorporate the effects of increases in winter mortality on entire wader populations. Adding a separate model of breeding season productivity produces an integrated picture of the whole population through all seasons and breeding stages (Goss-Custard *et al.* 1995a,b).

A similar approach in New Zealand could provide regional councils and other regulatory bodies with the kind of information they require when faced with planning applications that impinge upon estuarine and coastal ecosystems.

Research for New Zealand

Unfortunately, we cannot simply apply the European models to waders feeding and roosting in New Zealand estuaries because there are too many differences between the systems. For one thing, not all waders that breed in the Arctic fly south for their winter. Imagine, from a wader's perspective, how different conditions are between a bleak, wintry estuary in the UK and a New Zealand estuary in summer. In the north, the birds must feed almost constantly when the tide recedes in order to fulfil much higher energy needs to maintain body condition. When roosting at high tide these waders are particularly vulnerable to repeated human disturbance, and their response of flying off to avoid contact uses up valuable energy.

In New Zealand we have observed that the same species might spend several hours roosting rather than feeding as the tide falls. As well, it is unlikely that energy conservation is so important to birds roosting at high tide. Thus waders in New Zealand have priorities when feeding and roosting that are different from those of their Northern Hemisphere counterparts.

So how do we begin to unravel the links between wader numbers and distributions and habitat characteristics in coastal New Zealand?

In 1998 work began at NIWA on a preliminary investigation of waders and their habitats in New Zealand. First of all, it was accepted that we could not match the scale and scope of the large and well established European studies. So the study initially focused on the links between bar-tailed godwit and lesser knot and their feeding habitats. We also conducted a pilot survey of high-tide roost-site use by waders and of the levels of human disturbance birds typically experience when roosting.

The Manawatu Estuary

The Manawatu Estuary at Foxton Beach, North Island, was chosen for the initial work because it is small enough for a study to be manageable – the accessible north side of the river covers about 68 ha. It is also inhabited by a diverse wader community of New Zealand species (including pied oystercatcher, pied stilt, banded dotterel and wrybill) and migratory species from the Northern Hemisphere (including bar-tailed godwit, lesser knot and golden plover). The area exposed at low tide consists of fine sand and mud, with anoxic conditions within a few centimetres of the surface.



Diet studies

We looked at what godwits and knots eat by analysing prey remains in faecal samples collected at low tide. The results were unexpected. At the Manawatu Estuary the birds didn't seem to eat the prey types identified as "favoured" in previous work elsewhere in New Zealand and overseas – that is, small bivalve molluscs for knot, and polychaete worms and bivalves for godwit. Instead we found remains of minute gastropod molluscs (1–2 mm long) in 76% of knot faecal samples and remains of crustaceans, most likely the burrowing crab *Helice crassa*, in 76% of godwit samples (with polychaete jaws, probably from *Nicon aestuariensis*, in another 15% of godwit samples).

It turned out that the "favoured" prey types were just not widely available in the Manawatu Estuary. The next step in the work – now under way – is exploring further whether the prey available at a site actually makes any difference to wader densities, or whether bird numbers and densities are simply a function of estuary/harbour size.

A mixed flock of bar-tailed godwit, lesser knot and Pacific golden plover roosting at high tide on a beach at the mouth of the Manawatu River, Foxton Beach.

*far left:
Map showing the East Asia–Alaska–Australasia migratory route taken by the Northern Hemisphere waders that spend the southern summer (northern winter) in New Zealand.
Modified from Riegen (1999).*

Relatively common wader species in New Zealand, estimated coastal populations, key sites† and status*

Species	NZ coastal population	Key sites	Status
Pied oystercatcher <i>Haematopus ostralegus</i>	113,000	MH, KH, FoT	Native
Variable oystercatcher <i>Haematopus unicolor</i>	3,400	Many sites throughout NZ	Endemic
Pied stilt <i>Himantopus himantopus</i>	28,000	FoT, MH, KH	Native
Northern New Zealand dotterel <i>Charadrius obscurus aquilonius</i>	1,000	Many sites, N and NE North Island	Endemic
Banded dotterel <i>Charadrius bicinctus</i>	11,000	FS, LE, PH	Endemic
Wrybill <i>Anarhynchus frontalis</i>	5,000	FoT, MH	Endemic
Pacific golden plover <i>Pluvialis fulva</i>	650	Many sites throughout NZ	Migrant
Turnstone <i>Arenaria interpres</i>	5,100	PH, FS, IE	Migrant
Lesser knot <i>Calidris canutus</i>	59,000	MH, FS, KH	Migrant
Bar-tailed godwit <i>Limosa lapponica</i>	102,000	MH, FS, KH	Migrant

† When combined, holding > 25%, often much more, of coastal population.

* Endemic: breeds nowhere else other than New Zealand. Native: breeds in NZ and elsewhere. Migrant: occurs in NZ only seasonally, breeds elsewhere. Note that endemic and native NZ species often migrate within NZ between breeding and non-breeding seasons.

Sites: MH, Manukau Harbour; KH, Kaipara Harbour; FoT, Firth of Thames; FS, Farewell Spit; LE, Lake Ellesmere; PH, Parengarenga Harbour; IE, Invercargill Estuary. Sites are listed in order of abundance of the wader species.

Wader distributions

At the Manawatu Estuary it proved difficult to map wader distributions across the inter-tidal area at low tide because the birds were so often disturbed by people fishing, walking their dogs, and driving vehicles across the sand and mud. At high tide, waders and other shorebirds tend to congregate at well-defined sites, often sand or shingle banks, to roost above the high water mark. The birds are sometimes disturbed at these sites as well and this has implications for the "attractiveness" of a site for the birds.

Nationwide survey

Human disturbance was one aspect of our pilot survey of high-tide roost-site use by waders. We wanted to assess what sort of places waders used as roost sites, how often they are occupied, and types and level of human disturbance. Wader enthusiasts throughout New Zealand contributed to a questionnaire, enabling us to cover a wide range of shorebird roost sites. Returned questionnaires covered roost sites from around Whangarei Harbour in the north to Invercargill estuary in the south.

A total of 39 species of wader was recorded, ranging from the relatively common species listed in the table (left) to rare species like large sand dotterel (*Charadrius leschenaultii*) and sanderling (*Calidris alba*).

Nearly 60% of roost sites were sand or shingle banks, but 45% were also vegetated to some extent. Roosting birds also used man-made structures. Thus pied oystercatchers were found roosting on boat sheds in Dunedin, and wrybills used factory roofs in Auckland. The majority (74%) of roost sites were within 5 m of the high water mark, and most (over 70%) were farther than 150 m away from buildings.

The most common cause of disturbance of birds at roosts was "human on foot" (at 52% of roosts covered by the survey). Other important disruptions were motor vehicles (at about 25% of sites) and domestic animals (about 40% of sites). More unusual sources of disturbance included helicopters, jet-skis and dragon boats!

Despite the varied array of disturbance experienced by roosting waders, most respondents thought that the likelihood of disturbance at roost sites was either only "possible" or "very unlikely, almost never" (over 70% of sites). However, 30% of sites were "very likely, almost certain" to experience disturbance.

Future work will add more details to what we already know about how waders use estuarine and coastal ecosystems and will help to refine the relationships between waders and their feeding and roosting habitats in New Zealand.

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Further reading

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