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Ecology and management of the Black Stilt *Himantopus novaezelandiae*

R. J. PIERCE

Summary

New Zealand's endangered Black Stilt *Himantopus novaezelandiae* is confined largely to South Island's upper Waitaki River Basin, where it breeds on braided riverbeds and associated wetlands. It is under pressure from nest predators (particularly introduced carnivorous mammals), habitat loss and hybridization with the Pied Stilt *H. himantopus leucocephalus*. Management focuses on localized predator control, habitat enhancement, egg manipulation and cross-fostering, and more recently captive breeding and release. Future management may be extended to establish an island population.

Introduction

Double invasions of ancestral stilts from Australia have given rise to two species of stilt in New Zealand. The first invasion produced the melanistic Black Stilt *Himantopus novaezelandiae*, while the second invasion – that of the Pied Stilt *H. himantopus leucocephalus* – occurred more recently, probably in the early or mid-nineteenth century (Fleming 1982, Pierce 1984a).

Black Stilts and New Zealand Pied Stilts differ in many morphological features: the Black Stilt has a longer, broader bill, shorter legs, longer tail, longer wings and a different plumage at all ages after fledging (Pierce 1984b). Despite these and some ecological and behavioural differences, the two species hybridize in their zone of overlap.

While the Pied Stilt has adapted well to a changing landscape in New Zealand, the Black Stilt has failed to do so. In particular it has suffered through habitat destruction and predation by introduced mammals. The management of Black Stilts *in situ* is a challenging conservation exercise because of the complexities of the mainland environment.

Past distribution and numbers

Black Stilts were widespread and common in New Zealand until the late nineteenth century, nesting on riverbeds and associated wetlands from Otago north to Rotorua (Pierce 1984a). By 1900 nesting was apparently confined to the South Island, and by 1930 the only known nesting areas were on inland riverbeds in Canterbury and Otago. There, however, they were locally common, e.g. on lowland and inland rivers in South Canterbury and inland Otago, and as late as the 1940s there were an estimated 500–1,000 birds surviving. In the early 1950s, however, the population plummeted, reaching a low of 50–100

birds by 1960, most of them in the Upper Waitaki River. Over the next 25 years numbers remained relatively stable, with winter counts during the 1970s and 1980s typically revealing 30–70 birds, but only about 10–12 pairs were located annually (Pierce 1984a, D. P. Murray pers. comm.). Within this period there was a rapid decline in 1979–1980 to a low of 22 adults by 1983 (Reed *et al.* 1992).

Distribution in 1992, numbers and movements

The 1992 population comprised approximately 70 adults with fairly similar numbers in each of four subpopulations: Lower Ohau River, Ahuriri River, Tasman River and Lake Tekapo. Movements between these subpopulations are limited (D. P. Murray verbally). In contrast to Pied Stilts, which migrate to northern New Zealand, Black Stilts are mainly sedentary, most birds wintering locally within the MacKenzie Basin. Annually about 10% of Black Stilts are recorded on northern New Zealand harbours, particularly Kawhia and southern Kaipara harbours, and a few birds are also seen at coastal localities in the eastern South Island. These migrants include colour-banded individuals with hybrid or Pied Stilt mates, but no pairs of Black Stilts have been known to migrate (Reed *et al.* 1992).

Ecology

Habitat

The seasonal cycle of Black Stilts typically comprises three periods: breeding, post-breeding and wintering. Breeding grounds are occupied from August until December or January, followed by a shift to a post-breeding feeding area in the period December to April or May, followed by a shift to the wintering area. In some cases the nesting and post-breeding areas and post-breeding and wintering areas may be the same site.

The usual breeding habitat is a braided riverbed, including stable sidestreams and, if food is abundant, the main flood-prone riverbed. Other breeding habitats include heavily vegetated swamps and shallow tarns, sometimes far from a riverbed. Post-breeding habitats include shallow mud-based tarns, stable river channels and seepages including artificially irrigated areas. Wintering habitat is typically a river delta where the birds move between a lakeshore and riverbed feeding area. Stable or gradually dropping lake levels in winter usually provide adequate feeding in both the muddy and gravel margins (Pierce 1983).

Food

Black Stilts are mainly insectivorous, requiring high densities of aquatic invertebrates (Pierce 1985). The main prey in riverbeds are larvae of mayflies (especially *Deleatidium* spp.), caddisflies and stoneflies (and their emerging subadult or adult phases) and a variety of other animals including small fish and molluscs. Prey are taken either by direct pecking or by lateral probing or raking the substrate. The latter two tactile or disruptive methods are vital requirements during periods of prey inactivity, e.g. when water temperatures

are below the threshold for larval activity – as occurs for much or all of the day in winter and early spring (Pierce 1985). In the other habitats (e.g. tarns, swamps) Black Stilts feed on a variety of invertebrates, e.g. chironomid larvae, worms (both frequently obtained by scything), damselfly larvae, waterboatmen and molluscs. At river mouths and lakeshores, prey includes not only drifting invertebrates from the river channels, but also resident small fish, chironomids and worms.

Pied Stilts do not exhibit similar feeding adaptability, and feed suboptimally on riverbeds during periods of low water temperatures (but generally leave to feed elsewhere).

Nesting

Black Stilts begin nesting at age two or three years and mate for life (Reed *et al.* 1992). They usually nest as isolated pairs and have a high site fidelity between years. The preferred habitat for nesting is riverbed or sidestream where the nest is placed within a few metres of water. Egg-laying occurs from August to January, peaking in October. Incubation of the four eggs takes 25 days and is shared by the sexes (Pierce 1986, Reed *et al.* 1992). Young are nidifugous, leaving the nest permanently within 2–3 days of hatching. They are not fed by their parents but are guarded continuously as they forage. Family groups remain together for 6–8 months.

Threats

The major factors which caused the decline of Black Stilts (and which continue to threaten the remnant population) are predation, habitat destruction and hybridization with Pied Stilts (Reed *et al.* 1992).

Predation

Introduced ground predators are considered to be the greatest threat to Black Stilts today and the main factor in their decline since the last century (Pierce 1986, Reed *et al.* 1992). Eggs and chicks are vulnerable to Norway rats *Rattus norvegicus*, feral cats *Felis catus*, ferrets *Mustela furo* and stoats *M. erminea*, all of which are common and/or widespread in the MacKenzie Basin. Aerial predators include Black-backed Gulls *Larus dominicanus* and Australasian Harriers *Circus approximans*. The former are becoming a greater threat as their colony numbers and densities continue to increase in the MacKenzie Basin.

Although native predators, including the Australasian Harrier, are dealt with effectively by Black Stilts, mammalian predators take most clutches that are not given artificial protection (Pierce 1986). Moreover, Black Stilts are more susceptible to predation than Pied Stilts owing to a number of life history features. These include: (1) habitat selection (Black Stilts select often dry, vegetated banks of streams or ponds which are natural pathways for predators; Pied Stilts select wetter areas); (2) solitary nesting; (3) weak distraction displays; (4) long fledgling period; (5) timing of nesting (Black Stilts begin nesting before young rabbits provide an abundance of prey for predators and buffer their

impacts); and (6) lack of a disruptive adult plumage pattern (the Pied Stilt's breaks up the silhouette of a sitting bird).

In the MacKenzie Basin, predation on waders and Black-fronted Terns *Sterna albostriata* is highest following sudden declines in rabbit numbers, rabbits being the staple prey of cats and ferrets. Following rabbit declines these predators switch their diets to alternative prey including birds, and in some instances stoats may increase and exert even greater pressure on ground-nesting birds and lizards (Pierce 1987). The sudden decline of Black Stilts in the 1950s may have resulted from a flow-on effect following the greatly intensified rabbit control which occurred in Central Otago and MacKenzie Basin at that time.

Habitat destruction

Wetlands in New Zealand have been greatly reduced and the remaining ones heavily modified over the past few hundred years. The process continues in the MacKenzie Basin today with drainage, water abstraction, overgrazing (by stock and rabbits) and invasion of former wetlands by exotic plants all contributing to deterioration of habitat quality. The combined effects of these factors force nesting swamp and river-edge birds into progressively drier areas where they are more likely to have their eggs or chicks preyed upon.

The major hydroelectric development of the MacKenzie Basin has also greatly modified lake and river habitats. Reduced flows in the rivers, for example Tekapo, mean that predators can now gain access to a greater proportion of the nesting islands (Pierce 1987). Lake levels now fluctuate greatly, turning the natural swamp and seepage margins into bare clay pans or eroded shingle banks, providing little or no food (Pierce 1983). It is not known whether these major lake-level perturbations contribute to deaths of Black Stilts, Wrybills *Anarhynchus frontalis* and other species. Research is now under way to investigate any such effects on wading birds.

Hybridization

The decline of Black Stilts has been accompanied and exacerbated by hybridization with Pied Stilts. Hybrid plumages were first observed in the late nineteenth century (Potts 1869), but were not recognized as such at the time (Pierce 1984b). As Black Stilts declined, some observers noted an increase in mixed pairs and "intermediates" (hybrids) in areas where Pied and Black Stilts had previously nested separately (Pierce 1984a).

The former geographic separation of Pied and Black Stilts has been of insufficient duration for reproductive isolation to be completed. Courtship behaviour is relatively similar for different members of the Recurvirostridae and hybridization has been recorded amongst different forms of *Himantopus* (Blake 1977) and between captive individuals of different genera (Principe 1977). Because Pied and Black Stilts respond to similar courtship cues (Reed 1986) and because of the small size of the Black Stilt population, mixed matings frequently occur. Black Stilts do mate assortatively; for example, in 1980 Black Stilts comprised 3% of MacKenzie Basin stilts, but 70% of them occurred in black–black pair bonds. Where potential black mates are not available, Black Stilts

tend to mate with a bird of dark plumage "node" (see below), and if none of these is available, then a pied bird (Pierce 1984b). Sexual imbalances in any one of the subpopulations increases the chances of mixed pairs forming (Reed *et al.* 1992). This is reduced only slightly by a late winter to spring pair formation period, when Pied Stilts are absent or scarce.

Offspring from mixed matings are fertile and the types of nesting failure they experience are similar to those for Black Stilts, i.e. predation and flooding. Introgressive hybridization has given rise to a range of stilt plumages and structural morphologies in New Zealand. Adult plumages can be classified according to "nodes" based on extent and location of black markings (Pierce 1984b). Plumage node has an approximately linear relationship with other Black Stilt features including bill, tail, wing (all longer in Black Stilts) and tarsus (shorter in Black Stilts) (Pierce 1984b, Green 1988).

Node A (Pied Stilt) parents produce node A offspring and node J (Black Stilt) parents produce node J offspring – offspring from backcrossing are intermediate between the plumages of their parents, and no throwbacks to either parental phenotype nor any evidence of sex linkage has been found (Pierce 1984b, Green 1988).

In an electrophoretic study, Green (1988) found evidence of two distinct populations among New Zealand stilts. Of the common electromorphs mannose phosphate isomerase (Mpi) was in equilibrium at polymorphic loci within all populations, but frequencies of phospholuconate dehydrogenase (Pgd) departed significantly from Hardy-Weinberg predictions. The Pgd difference occurred between Pied Stilts (noted A, B, C_1 and C_2) and Black Stilts (including dark hybrid nodes G, H and I). It was evident that gene flow occurred across nodes D^2, E and F, the approximate = F_1 hybrids (Green 1988).

The genetic distance between Black Stilts and Australian Black-winged Stilts was similar to that between separate species, while that between Black Stilts and New Zealand Pied Stilts was similar to that of hybridizing species rather than that between populations of the same species. Genetic distance between Australian Black-winged and New Zealand Pied Stilts was least of the three values, similar to that between conspecifics, although there has been genetic as well as morphological change in New Zealand Pied Stilts (Green 1988).

Management

During the 1980s Black Stilts were managed by the Wildlife Service, and from 1987 by the Department of Conservation. This management aimed to increase breeding output (through predator control, egg manipulation and cross-fostering), to increase population recruitment through release of captive-reared birds, and to enhance existing habitats for Black Stilts. Increased productivity was also seen as the key towards overcoming problems of interbreeding (Reed *et al.* 1992).

Predator control

Predator control has involved combinations of gin-trapping over wide areas, localized ring-trapping around nests, and constructing predator exclosures. All

of these methods are labour-intensive and have drawbacks. For example, permanent exclosures rely on pairs of birds actually returning to breed in those sites, and often this does not occur, while other pairs can move their young outside a ring-trapping area and perhaps into one with a destabilized predator regime.

Egg manipulation and cross-fostering

All Black Stilt pairs are given dummy eggs for the course of the incubation period. The real eggs are kept in an incubator. Just before hatching the real eggs are returned to the nest. This reduces risks to the eggs from flooding or predation.

In some instances first clutches have been removed to an incubator and eventually cross-fostered to hybrid or mixed pairs. In nearly all cases the original pair has subsequently re-nested, thus increasing breeding output for the year. However, only 7% of cross-fostered fledglings have subsequently entered the Black Stilt breeding population, owing to high post-fledging mortality and high dispersal characteristics. After 1987 cross-fostering was restricted to pairs composed only of Black Stilts, because non-black partners migrated, as did the fostered young of mixed pairs (Reed *et al.* 1993).

Captive breeding and release

The captive breeding programme began in 1979 when eggs were taken to the National Wildlife Centre. Between 1983 and 1987 eggs from 16 early clutches of captive birds were cross-fostered to wild birds, and eight one-year-old birds were released into the wild. The one-year-old birds were tame and none survived for long after release. Subsequent releases were more successful, including one bird which was subsequently recruited into the breeding population.

In 1986 a captive facility was established near Twizel in the McKenzie Basin, and 16 birds (including four breeding pairs) were transferred there from the National Wildlife Centre. These birds are now the nucleus of a captive breeding programme at Twizel (Reed *et al.* 1992). Up to 32 juveniles (eight clutches) are also scheduled to be hand-reared at Twizel each year, in isolation from humans, for release into the wild at nine months of age. This "pulsing" of captive releases every year or alternate years will concentrate a large number of juveniles in one area where they can locate mates of the same species. Enhancement of habitat around the release area will increase food availability and the juveniles will be conditioned to living in the wild.

Habitat enhancement

Additional ponds have been created in two predator exclosures at Lake Tekapo, with the new habitat being used in some years up to 1985. A river terrace adjacent to the Twizel captive facility was flooded in 1989 and both wild adults and captive-released juveniles have used this habitat. Project River Recovery,

sponsored by Electricorp, has continued clearing willows from the lower Tekapo riverbed.

Future management

The Department of Conservation has developed a recovery plan for Black Stilts which has set a long-term goal of "establishing self-sustaining populations of Black Stilt to ensure the species's survival without a continuing need for intervention" (Reed *et al.* 1992). The plan has five aims in its short-term programme: (1) maintain and if possible increase the productivity of breeding pairs in the wild; (2) maintain the breeding population in the wild at a minimum of 10 pairs, then increase this; (3) maintain a captive population and improve its productivity to provide the maximum number of birds for release into the wild; (4) establish a self-sustaining population on a predator-free island; (5) encourage public interest in and support for the programme through advocacy and education.

Aim 4 requires a predator-free island with suitable wetlands but distanced from the mainland to minimize movements by Black and Pied Stilts. These requirements appear to limit options within the New Zealand region, the Chathams being the most likely. Even here, however, some predator control (cats and rats present) will be needed, and possibly also habitat manipulation.

Aims 1, 2, 3 and 5 will continue to focus on the MacKenzie Basin, combining the field and laboratory techniques of egg manipulation, (limited) cross-fostering, predator control in priority areas, investigating long-term solutions for predator control, investigating food requirements, evaluating means of recruiting unmated birds into the population, improving specific and general habitat quality, e.g. through continued willow/lupin control and improving invertebrate supplies at exclosures, developing the captive population at Twizel to a minimum of six pairs, and public participation in management programmes.

These actions will build on the existing positive features of the MacKenzie Basin including the extensive areas of actual and potential habitat, generally good winter food supplies, and the departure of Pied Stilts in autumn/winter, which reduces contact between members of the two species during the period of pair formation.

References

Blake, E. R. (1977) *Manual of Neotropical birds*, 1. Chicago: University of Chicago Press.

Fleming, C. A. (1982) *George Edward Lodge: the unpublished New Zealand bird paintings*. Wellington: Nova Pacifica.

Green, B. S. (1988) Genetic variation and management of Black Stilts, *Himantopus novaezealandiae* and Pied Stilts, *H. h. leucocephalus* (O. Charadriiformes). M.Sc. thesis in Zoology, Victoria University.

Pierce, R. J. (1983) The Charadriiforms of a high country river valley. *Notornis* 30: 169–185.

Pierce, R. J. (1984a) The changed distribution of stilts in New Zealand. *Notornis* 31: 7–18.

Pierce, R. J. (1984b) Plumage, morphology and hybridisation of New Zealand stilts *Himantopus* spp. *Notornis* 31: 106–130.
Pierce, R. J. (1985) Foraging responses of stilts (*Himantopus* spp.; Aves) to changes in behaviour and abundance of their riverbed prey. *New Zealand J. Mar. Freshwater Res.* 20: 17–28.
Pierce, R. J. (1986) Differences in susceptibility to predation between Pied and Black Stilts (*Himantopus* spp.). *Auk* 103: 273–280.
Pierce, R. J. (1987) Predators in the MacKenzie Basin: their diet, population dynamics, and impact on birds in relation to the abundance and availability of their main prey (rabbits). Wellington: Wildlife Service report.
Potts, T. H. (1869) On the birds of New Zealand. *Trans. New Zealand Inst.* 2: 40–78.
Principe, W. L. (1977) A hybrid American Avocet x Black-necked Stilt. *Condor* 79: 128–129.
Reed, C. E. M. (1986) The maintenance and reproductive behaviour of Black Stilts (*Himantopus novaezealandiae*) in captivity and implications for the management of this rare species. M.Sc. thesis in Zoology, Massey University.
Reed, C. E. M., Murray, D. P. and Butler, D. J. (1992) *Black Stilt Recovery Plan.* Wellington: Department of Conservation.
Reed, C. E. M., Nilsson, R. J. and Murray, D. P. (1993) Cross-fostering New Zealand's Black Stilt. *J. Wildl. Mgmt.* 57: 608–611.

R. J. PIERCE
Department of Conservation, PO Box 842, Whangarei, New Zealand