Notornis , 2001, Vol. 48: 241-244
0029-4470 © The Ornithological Society of New Zealand, Inc. 2001

SHORT NOTE

Survival and reproductive success of stitchbird (hihi, *Notiomystis cincta*) suffering from a bill abnormality (oral fistula)

ISABEL CASTRO
Department of Ecology, Massey University, New Zealand.
Present address: P.O. Box 21, Tuai, Hawke's Bay
hikihiwi@clear.net.nz

JASON TAYLOR
Department of Conservation, Auckland Conservancy, Auckland.
Present address: 21 Buchanan Street, Devonport, Auckland
jas.shaarina@hyper.net.nz

Although the scientific literature contains many papers dealing with human handicaps, little has been written about disabled animals and their survival in the natural environment. In New Zealand, we found only 2 references on wild birds surviving with handicaps. Barlow (1978) reported the survival of spur-winged plovers, *Vanellus miles novaehollandiae*, and pied stilts *Himantopus leucocephalus* surviving on New Zealand farms after losing 1 or both feet. Sutton (1973) found an Australasian harrier *Circus approximans* lacking "its feet and about one third of the tarsus". This bird was at least in average condition. The completely healed stumps suggested it had survived for a while without feet. In addition, R.M. Colbourne (pers. comm.) found that 30% of 15 brown kiwis *Apteryx mantelli* captured at Okarito, New Zealand, were blind in 1 eye and 1 bird was blind in both eyes. All the kiwi were in good condition which suggested that they can survive in the wild with this handicap.

We report here the survival and reproductive success of 5 wild stitchbird or hihi *Notiomystis cincta* with handicaps to the bill. The stitchbird is an endangered honeyeater, endemic to New Zealand with now a single self-sustaining population on Little Barrier Island. Birds were transferred to Kapiti (1991, 1992), Mokoia (1994), and Tiritiri Matangi (1995, 1996) islands from Little Barrier Island with the hope of establishing secondary self-sustaining populations (Rasch *et al* 1996; Castro *et al.* 1994a). Stitchbirds feed on nectar, fruits, and insects (Gravatt 1970; Craig *et al.* 1981; Angehr 1984; Castro *et al.* 1994b) in various proportions depending on their availability. All honeyeaters have specialised tongues that facilitate the consumption of nectar (Paton & Collins 1989; McCann 1963). Nectar is collected by capillary action and swallowed after the tongue has been withdrawn back into the beak.

Castro (1995), Castro *et al.* (1994b, 1996), and Armstrong *et al.* (1999) studied the behavioural ecology of stitchbirds on Kapiti Island from 1991 to 1994 and on Mokoia island from 1994 to 1998. Taylor (1999, 2000) observed the species on Tiritiri Matangi Island from 1998. On the 3 islands, stitchbirds were observed daily throughout the breeding months of October to March and less often during the remainder of the year. Birds were observed at nest sites, feeding stations, and wherever they were heard or seen. During the incubation and brooding periods the time spent inside and outside of the nest by individual females was also recorded (Castro *et al.* unpubl. data).

During observations on Kapiti Island in August 1992, female GY-A was observed in her traditional wintering area with her tongue hanging outside her bill. She was mist-netted and it was found that she had lost the skin and muscle of her mandible and her tongue had fallen out through this opening or oral fistula (Fig. 1). She could still feed on fruits and insects but some food was lost through the opening in her jaw. She had to turn her head to seize fruits or insects with the edge of her beak and then throw her head back to swallow them. In October 1992 she started visiting the feeder at the ranger's house (P. Daniel, pers. comm.) where she fed on sugar water served in a broad-mouthed jar. She seemed able to get some liquid in her tongue and

Received 21 July 2000; accepted 9 December 2000

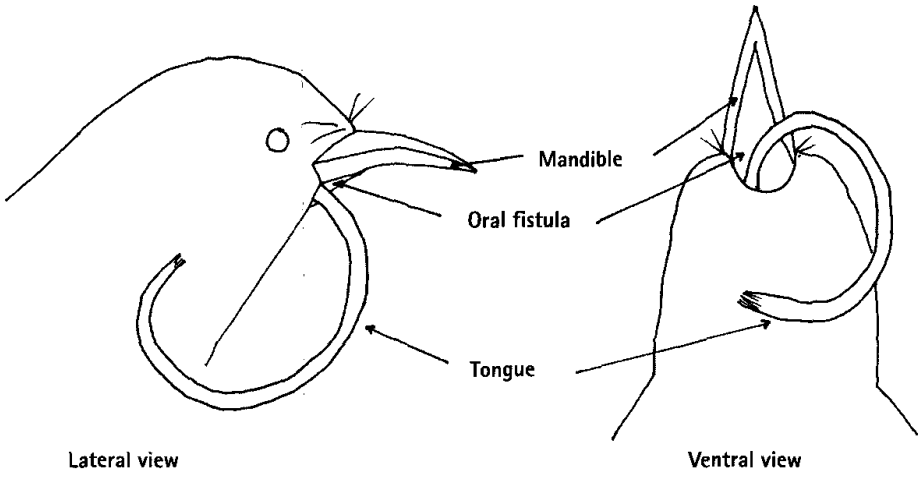

Fig. 1 Lateral (left) and ventral (right) views of a stitchbird (hihi, *Notiomystis cincta)* head showing an oral fistula and the protruding tongue.

to swallow it. Her chest feathers often looked dirty, perhaps soiled by fluid spilled while drinking.

In November female GY-A built a nest 863 m from the feeder. Her brooding times were not significantly different from those of 3 physically normal females brooding at the same time (Fig. 2) (1-way ANOVA, $P > 0.05$; significant females assigned by Tukey test). She and her mate successfully raised 1 chick. Two days after the chick fledged, she brought it to the ranger's house (I. Castro, pers. obs.) and started to feed it sugar water. Although she often dropped the sugar water or fruits outside the chick's mouth, the chick grew to independence. In 1993 she attempted to nest 790 m from the house feeder. She laid a clutch, but it failed to hatch. When she was mist-netted again we found that the mandible was very thin and broken in the centre but despite that she survived the winter of 1994 in her usual wintering area and was observed feeding on fruits.

GY-A was not seen during the breeding season in 1995 and had presumably died, at an age of at least 5 years (Empson 1996). Until 1994 her physical condition and weight were similar to those of other females (Craig *et al.*1982; Craig 1984) (mean weight 1992-1993 34.1 g, n=3; 1992 (1) 1993 (2)).

On Mokoia Island in September 1995, we observed male RA-RG (8 months old) with the same injury to the lower jaw described for the female GY-A on Kapiti Island. He was caught and found to be in good condition (weight 43 g) despite the injury, but was found dead in October by a tree near the feeder. Post-mortem examination suggested that the neck was broken, possibly from impact with a branch or the trunk.

Female GG-AG on Mokoia Island was found on 22 Oct 1997 with its tongue hanging from an oral fistula. The female was 6 months old when the injury was observed and subsequently she built a nest and laid 4 eggs, but was found dead by the box 1 week after incubation began. She was in excellent condition at the time of death and post-mortem examination suggested that she broke her neck against the rock face next to her nest.

Both RA-RG and GG-AG were observed feeding on fruits and invertebrates despite their bill abnormalities and both attempted to feed at the feeding stations. That they could do so successfully was mainly because some of the feeders had lost the small flowers used to attract birds and hence the drinking holes were larger than normal, which allowed easier access to the food.

In January 1999, a 2-year-old female, WA-RW, was seen on Tiritiri Matangi with its tongue protruding from a hole in the lower mandible. The bird was caught, and on close examination, the tongue was found to have had dried out, losing its normal feathery texture and instead being hard. The bird did not seem to be able to pull its tongue back into the mouth; but before it was released its tongue was placed back inside the beak. The procedure was not successful and the bird was seen with its tongue out a few days later.

WA-RW continued to visit the feeding stations and appeared to feed from them. During the following winter (1999) its tongue seemed to have been retracted into beak. Since then she has been observed using her tongue in a conventional manner, even though the tongue often protrudes slightly out 1 side of the beak. This female successfully bred and produced 1 chick.

A 2nd bird, a fledgling male, was observed in 2000 with a similar injury to that observed in WA-RW. Like the other stitchbirds with this handicap, the bird has been seen feeding on wild foods and using the feeder and appears to be in good condition.

The injury (oral fistula) seems to affect wild stitchbirds regularly on all of the islands to which the species has been translocated. Similar injury has also been reported at the National Wildlife Centre (Peter Morton, Rose Collen, pers. comm.) where a small captive population is held. We have seen no

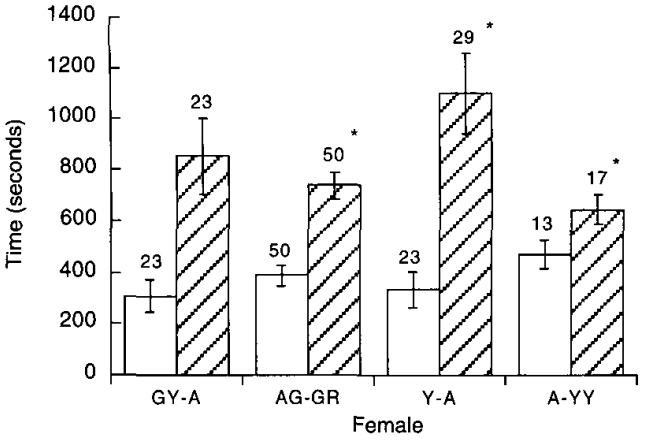

Fig. 2 Comparison between brooding times of female GY-A and three other females nesting on Kapiti Island in 1992-93. "Time in" (white bars) mean time spent by each female inside the nest during the brooding period; "time out" (hatched bars) mean period spent out of the cavity; bars standard errors of the mean. Numbers above bars are sample sizes. There were no significant differences between females in the time spent in (1-way ANOVA, $P = 0.448$). However, time spent out differed significantly (1-way ANOVA, $P = 0.047$); * difference significant, Tukey test.

reports of stitchbirds on Little Barrier Island suffering this type of injury. However, this does not imply that the injury does not happen there because stitchbirds have not been monitored there as intensely as they have on the islands to which they have been translocated.

We do not know how the fistula forms. The bird may first suffer an injury to the soft tissue of the mandible, which then becomes infected. Given the thin skin in the mandible, it is possible that the infection causes the fistula as it subsides. The acrobatic foraging of stitchbirds (Castro 2001) and their aggressive social behaviour (Castro *et al.* 1996; Craig *et al* 1981; Ewen 1998) provide ample opportunity for such injuries. The frequency of the injury suggests a predisposition to this type of damage.

There are at least 2 possible explanations for the species susceptibility to this bill abnormality. First, the fistula could result from inbreeding depression. The stitchbird has undergone at least 1 major population bottleneck recently when it was confined to Little Barrier Island by the 1800s (Oliver 1955). Further, population bottlenecks accompanied each translocation as only a few birds were taken from Little Barrier Island to the translocation sites and not all of them survived to breeding (Castro *et al* 1994a; Armstrong *et al.*1999). Reduced genetic variation may have resulted in a higher frequency of detrimental alleles, causing or predisposing the birds to oral fistulas. Alternatively, the fistula could appear as a result of nutritional deficiencies at the translocation sites that may make the birds susceptible to skin or bone damage.

This example of a handicap in a bird is extreme because it would appear to directly interfere with feeding. The most obvious problems the birds had were loss of control of their tongue and with losing food through the fistula. Because, however, nectar is collected in the tongue by capillary action, some may have reached the mouth, despite the damage particularly at feeders where the birds did not require need control of their tongues.

There may be several explanations as to how stitchbirds can survive with oral fistulas. Where selection pressure is not intense, for example where predation and food availability are not limiting, birds could survive permanent injuries and even reproduce. It is possible that the birds described here survived for long periods with their handicap because they had access to supplementary food when their energy demands were highest (breeding season and periods of food shortage).

Although the 3 females were in good physical condition and attempted to breed while injured, their reproductive success was lower than that of healthy females (Castro 1995; Taylor 1998). The 2 birds that died after colliding with obstructions on Mokoia Island may have had their vision impaired by their tongue flapping in front of their face. In 1 instance the fistula was apparently reversed by possibly either the hole in the lower mandible healing and closing or the protruding end of the tongue drying and dropping off.

Stitchbirds may be adapted to survive with injuries because, particularly during the breeding season, they are very aggressive and high speed chases ending in fights (and possibly crashes, as suggested by the 2 birds on Mokoia) are not uncommon (Castro *et al.* 1996). Males are also known to force copulations, which can cause injuries to females (Alley *et al.* 1999) that they need to be able to survive to reproduce successfully.

We have recorded several stitchbirds surviving with other types of injuries, particularly broken bones and infected eyes. For example, 1 of 25 males caught in 1991 on Little Barrier Island for translocation had an old fracture in 1 of his legs (I. Castro, unpub. data). On Kapiti Island a female (RW-A) was found with a rib protruding through the body wall during egg laying. The female (and mate) successfully raised 3 chicks to independence although she did not survive to the next breeding season. Also at Kapiti Island, a male (A-BW) blind in the right eye had to modify his behaviour to see other males and competitors in his territory during the breeding season. The handicap did not prevent him from mating with several females, chasing birds out of his territory, or feeding his chicks. On Mokoia Island to which stitchbird were transferred in 1994, a female survived for 2 years with a broken leg which hung towards the rear of her body. Her movements

were, however, greatly restricted by her injured leg and she did not attempt to breed.

Wild birds can sustain permanent injuries as well as contract diseases. However, detailed descriptions of such injuries and their effects are possible only during long term studies or surveys specifically targeting injuries. Injuries may well be as common in other, less well-studied, species. Observations on Little Barrier Island would be necessary to differentiate between the possible causes of the fistulas. If inbreeding depression or nutritional deficiencies are involved in the appearance of the fistula, management could be modified to minimise the occurrence. For instance, additional transfers to new populations may be necessary to minimise inbreeding depression, or the nutritional quality of the food offered to the birds may need to be enhanced.

ACKNOWLEDGEMENTS

We thank Peter Daniel and Shona Pengelly on Kapiti Island, and Barbara and Ray Walters on Tiritiri Matangi for information on the whereabouts and activities of some of the birds mentioned in this paper. Jonathan Miles and Brian Springett commented on an earlier draft. Jim Briskie and anonymous referee provided useful comments on the manuscript. Research on Kapiti took place while I. Castro held a Vice-Chancellor's award, and work on Mokoia was fully funded by research grant MAU512 from the Royal Society of New Zealand's Marsden Fund to I. Castro.

LITERATURE CITED

Alley, M.R.; Castro, I.; Hunter, J.E.B. 1999. Aspergillosis in hihi (*Notiomystis cincta*) on Mokoia Island. *New Zealand veterinary journal 47*: 88-91.

Angehr, G.R. 1984. Ecology and behaviour of the stitchbird. Internal report, New Zealand Wildlife Service, Wellington.

Armstrong, D.P.; Castro, I.; Alley, J.C.; Fenestra, B.; Perrott, J.K. 1999. Mortality and behavior of hihi, an endangered New Zealand honeyeater, in the establishment phase following translocation. *Biological conservation 89*: 329-339.

Barlow, M. 1978. Deformed feet of spur-winged plovers and pied stilt in Southland sheep country. *Notornis 25*:150.

Castro, I. 1995. Behavioural ecology and management of hihi *Notiomystis cincta*, an endemic New Zealand honeyeater. Unpubl. PhD thesis, Massey University, Palmerston North.

Castro, I. 2001. Hihi (stitchbird) *Notiomystis cincta* (Meliphagidae). pp. 954-966 *In:* Higgins, P.J.; Peter, J.M.; Steele, W.K. (*ed.*). *Handbook of Australian, New Zealand and Antarctic Birds, vol. 5. Tyrant flycatchers to chats.* Melbourne, Oxford University Press.

Castro, I.; Alley, J.C.; Empson, R.A.; Minot, E.O. 1994a. Translocation of hihi or stitchbird (*Notiomystis cincta*) to Kapiti Island, New Zealand: transfer techniques and comparison of release strategies. pp. 113-120. *In:* Serena, M. (*ed.*) *Reintroduction biology of Australian and New Zealand fauna.* Chipping Norton, Surrey, Beatty & Sons.

Castro. I.; Minot, E.O.; Alley, J.C. 1994b. Feeding and breeding behaviour of hihi or stitchbirds (*Notiomystis cincta*) recently transferred to Kapiti Island, New Zealand, and possible management alternatives. pp. 121-128. *In:* Serena, M. (*ed.*) *Reintroduction biology of Australian and New Zealand fauna.* Chipping Norton, Surrey, Beatty & Sons.

Castro, I.; Minot, E.O.; Fordham, R.A.; Birkhead, T.R. 1996. Polygynandry, face-to-face copulation and sperm competition in the hihi *Notiomystis cincta* (Aves: Meliphagidae). *Ibis 138*: 765-771.

Craig, J.L. 1984. Wing noises, wing slots and aggression in New Zealand honeyeaters (Aves: Meliphagidae). *New Zealand journal of zoology 11*: 195-200.

Craig, J.L.; Stewart, A.M.; Douglas, M.E. 1981. The foraging of New Zealand honeyeaters. *New Zealand journal of zoology 8:* 87-91.

Craig, J.L.; Douglas, M.E.; Stewart A.M.; Veitch, C.R. 1982. Specific and sexual differences in body measurements of New Zealand honeyeaters. *Notornis 28*: 121-128.

Ewen, J.G. 1998. A genetic and behavioural investigation of extra-pair copulation in stitchbirds (*Notiomystis cincta*) breeding on Tiritiri Matangi Island. Unpubl. MSc thesis, Massey University, Palmerston North.

Gravatt, D.J. 1970. Honeyeater movements and the flowering cycle of vegetation on Little Barrier Island. *Notornis 17*: 96–101.

Ingram, K.A. 1983. Release and survival of a one eyed golden eagle. *Annual proceedings of the American Association of Zoo Veterinarians 1983.*

McCann, C. 1963. Observations on the tongues of some New Zealand birds. *Notornis 11*: 36-45.

Oliver, W.R.B. 1955. *New Zealand birds, 2nd. ed.* Wellington, A.H. & A.W.Reed.

Paton, D.C.; Collins, B.G. 1989. Bills and tongues of nectar feeding birds: a review of morphology, function and performance, with intercontinental comparisons. *Australian journal of ecology 14*: 473-506.

Rasch, G.; Boyd, S.; Clegg, S. 1996. A recovery plan for the Stitchbird (*Notiomystis cincta*). Unpubl. report, New Zealand Department of Conservation, Wellington.

Sutton, R.R. 1973. Harrier without feet. *Notornis 20*: 74.

Taylor, J. 1999. Monitoring of the Tiritiri Matangi Island stitchbird (*Notiomystis cincta*). *New Zealand Department of Conservation, Auckland Conservancy, technical report series no. 18.* Auckland, New Zealand Department of Conservation.

Taylor, J. 2000. Monitoring and management of Tiritiri Matangi Island stitchbird (*Notiomystis cincta*): 1999-00 breeding season. *New Zealand Department of Conservation, Auckland Conservancy, technical report series no. 20.* Auckland, New Zealand Department of Conservation.

Keywords hihi; stitchbird; *Notiomystis cincta*; handicap; injury; survival; bill abnormality