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Coexistence of two species of *Halipeurus* (Phthiraptera) on Chatham Island taiko (*Pterodroma magentae*) (Aves)

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Abstract Feather lice (Phthiraptera) were collected from 14 Chatham Island taiko (*Pterodroma magentae*). These included two species of *Halipeurus* (Phloptoridae) in the ratio of two *H. procellariae* to one *H. theresae*. So far as we know, the regular occurrence of two *Halipeurus* species on a host is unique. *H. procellariae* is likely to have been acquired from the taiko's ancestors, but *H. theresae* probably derives from a secondary infestation through close association of the host with Chatham petrels (*Pterodroma axillaris*), probably in mixed breeding colonies. From sub-fossil evidence, Chatham petrels formerly bred on the main Chatham Island, to which *P. magentae* has, from such evidence, always been restricted.

Keywords Phthiraptera; *Halipeurus procellariae*; *H. theresae*; *Pterodroma magentae*; *P. axillaris*; Chatham Island

INTRODUCTION

The Chatham Island taiko (*Pterodroma magentae*), which is endemic to Chatham Island east of New Zealand, is presently recorded as hosting six species of lice (Phthiraptera) in five genera, including two species of *Halipeurus* (Phloptoridae) (Pilgrim &

Palma 1982; Palma 1999). We know of no previously recorded instance of two *Halipeurus* species established with self-sustaining populations on the same host species. We present the evidence and discuss its significance in relation to the ecology of taiko.

METHODS

Lice were collected during the course of studies on taiko on south-west Chatham Island. Birds were caught for delousing at the Tuku Valley light (a temporary upwardly-directed floodlight at a permanent site, which seems to attract some taiko and where most have been caught: Crockett 1994), or at the burrows further inland. Collecting was intermittent from 1978 until 1997, when 8 of 12 taiko handled during October–November were deloused.

Lice were obtained initially using an anti-waxing agent, but in 1987 and since, most have been obtained using the insecticide Nuvan® in aerosol form. After application of the agent to the petrels' upper and lower plumage (taking care to avoid the eyes, nostrils and bill), birds were held in a box for up to 10 min.; then their feathers were ruffled to dislodge lice onto a white surface. Lice were then collected in vials containing ethyl alcohol (70%) and slide-mounted in Canada balsam following the technique published by Palma (1978). All the specimens were prepared and identified by RLP and deposited in the collection of the Museum of New Zealand Te Papa Tongarewa.

RESULTS

Six species of Phthiraptera were collected from 14 living taiko (and from one of these also after death). They include the three species listed by Pilgrim & Palma (1982): *Ancistronea vagelli* (J. C. Fabricius, 1787) [species level identification by Palma (1999)], *Austromenopon popellus* (Piaget, 1890) *sensu lato*, *Halipeurus procellariae* (J. C. Fabricius, 1775); to-

gether with three reported by Palma (1999): *Halipeurus theresae* Timmermann, 1969, *Longimenopon* sp., and *Saemundssonina* (*Puffinocetus*) sp. The lack of necessary systematic revisions prevented the latter two species being confidently identified.

Detailed records of the two species of *Halipeurus* are given in Table 1. Not only do the two species co-exist within the taiko population, but also both have been collected from the same bird (from 3 of 14 birds sampled). The overall ratio of the two louse species in this collection was 2:1 (34:17), with *H. procellariae* prevalent. In the single instance where lice were collected from a known parent (# 7) and her offspring (# 6), both carried the same species (see Table 1: South 1 burrow).

DISCUSSION

Petrels hosting congeneric *Halipeurus* lice

Finding two species of *Halipeurus* regularly parasitising the same host species is unique. There are about 30 species of *Halipeurus* recorded from 92 petrel hosts, yet no species or subspecies of petrel has ever been shown regularly to host more than one species of *Halipeurus* (see Edwards 1961; Timmermann 1965; Pilgrim & Palma 1982; Zonfrillo 1993; Palma 1999). Bourgeois & Threlfall (1979) reported *Halipeurus gravis* Timmermann,

1961 and *H. diversus* (Kellogg, 1896) from greater shearwaters (*Puffinus gravis*) but only *H. gravis* is established and widespread on that host, while *H. diversus* is regarded as a straggler (Foster et al. 1996). Zonfrillo (1988) reported a male and female *H. gravis gravis* from a sooty shearwater (*Puffinus griseus*), which is regularly parasitised by *H. diversus*, but he regarded the *H. gravis* as natural stragglers from another host. Similarly, Jensen et al. (1999) regarded a male *H. g. gravis* from a *P. griseus* also as a straggler. We also consider these three reports of two *Halipeurus* species from the same petrel species as the result of natural straggling. The samples reported here, collected over a period of 20 years, are evidence that both *Halipeurus* species have self-sustaining populations on taiko, a situation different from that described in greater and sooty shearwaters.

Mixed colonies of taiko and Chatham petrel

The *Halipeurus* species inherited by taiko from its ancestors is very likely to be *H. procellariae*, and this is the commoner of the two congeners on this host. Close relatives of taiko, as determined by bones and external morphology (Bourne 1964), intestinal anatomy (Imber 1985; Imber et al. 1998) and/or DNA studies (Nunn & Stanley 1998), include grey-faced (*Pterodroma macroptera gouldi*), great-winged (*P. m. macroptera*), white-headed (*P. lessonii*) and Atlantic (*P. incerta*) petrels. All of these

Table 1 Records of *Halipeurus procellariae* and *H. theresae* from Chatham Island taiko (*Pterodroma magentae*) by date, sex, age, and place of capture (– = unknown; M = male; F = female; North 1 and South 1 are burrows).

Bird #	Date	Sex	Age	Locality	<i>Halipeurus</i> species	
					<i>H. procellariae</i>	<i>H. theresae</i>
1	2/1/78	–	Adult	Lights	1F	
2*	3/12/78	–	Adult	Lights	1M	
3	11/11/87	–	Adult	Lights		1M, 1F
4	10/12/87	–	Adult	Lights	4F	2M, 3F
5	22/4/95	M	Adult	North 1		1F
5 (dead)	14/11/96	M	Adult	North 1	2M, 2F	
6	26/4/95	M	Juvenile	South 1		1M, 1F
7	13/10/97	F	Adult	South 1		1F
8	20/10/97	M	Adult	Lights	2M	
9	20/10/97	M	Adult	Lights	2M, 2F	
10	21/10/97	M	Adult	Lights	1F	
11	22/10/97	F	Adult	Lights	1M, 2F	
12	21/11/97	M	Adult	Lights	1F	2M, 4F
13	23/11/97	M	Adult	Lights	1M	
14	24/11/97	F	Adult	Lights	4M, 8F	

* Host #2 also yielded 3 nymphs of *Halipeurus* (the only nymphs in all the samples).

host only one *Halipeurus* species: *H. procellariae* (see Edwards 1961; Pilgrim & Palma 1982; Furness & Palma 1992). *Halipeurus procellariae* is also the only *Halipeurus* sp. found so far on soft-plumaged petrels (*P. mollis*) (Pilgrim & Palma 1982; Furness & Palma 1992), whose close affinity with the above-mentioned larger petrels, including taiko, has been revealed by intestinal anatomy (Imber 1985; Imber et al. 1998) and by DNA studies (Nunn & Stanley 1998), with supporting evidence from the other louse species it hosts (Pilgrim & Palma 1982; Furness & Palma 1992).

In the Pacific Ocean, the louse *H. theresae* is hosted by the Chatham petrel (*P. axillaris*) (Pilgrim & Palma 1982) and the Bonin petrel (*P. hypoleuca*) (Timmermann 1969), as well as the taiko. Other hosts of this louse are found in the North Atlantic Ocean (Zonfrillo 1993). The Chatham and Bonin petrels are closely related (Falla 1942), and probably share common ancestry (Imber 1985). Thus *H. theresae* is likely to have been inherited by the Chatham petrel from its ancestors.

Whereas the Chatham petrel appears to be a primitive gadfly petrel (Imber 1985), the taiko belongs to a more highly evolved group of gadfly petrels (Imber 1985) and its ancestors were likely to have been later colonists of main Chatham Island than were the ancestors of the Chatham petrel. There is so far no evidence that taiko colonised the lesser islands of the archipelago (A. J. D. Tennyson pers. comm. 1999). Thus, the occurrence of *Halipeurus theresae* on taiko is apparently due to a successful secondary infestation (host-switch), with the Chatham petrel being the donor.

That *H. theresae* co-habits with *H. procellariae* on taiko is evidence that Chatham petrels bred in inter-mixed colonies with taiko on Chatham Island in the past. Such colonies have not been recorded in historic times, but there is ample sub-fossil evidence of Chatham petrel, as well as the widespread taiko, breeding on Chatham Island (Sutton & Marshall 1977; Atkinson & Millener 1991; P. R. Millener pers. comm. 1993). This association has probably been broken for most of the twentieth century or longer, since the demise of all Chatham petrel colonies on Chatham Island caused by human-induced habitat alteration and predation. The fact that *H. theresae* is still living on taiko, in the absence of presumed reinforcing colonisations from Chatham petrels, suggests a partly stable host-parasite relationship, though this may be quite brief in geological time. The ecological niches of *H. procellariae* and *H. theresae* are likely to be very similar and compe-

titution may eventually drive one to extinction on taiko.

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