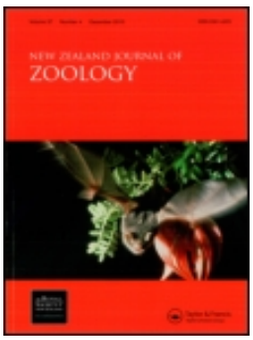

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J. M. Martens & R. L. Palma

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Species distribution of genus *Quadraceps* (Mallophaga: Philopteridae) on New Zealand endemic plovers

J. M. MARTENS

Universität Hamburg, Zoologisches Institut und Zoologisches Museum, Martin-Luther-King-Platz 3, D-2000 Hamburg 13, Federal Republic of Germany

and

R. L. PALMA

National Museum of New Zealand, Private Bag, Wellington, New Zealand

The louse genus *Quadraceps* Clay & Meinertzhagen is represented on New Zealand endemic Charadriinae by *Q. dominella* Timmermann, *Q. novaeseelandiae* Timmermann, and *Q. cedemajori* Timmermann, which are parasitic on *Charadrius obscurus* (Gmelin), *Thinornis novaeseelandiae* (Gmelin), and *Anarhynchus frontalis* Quoy & Gaimard respectively. *Charadrius bicinctus* Jardine & Selby is parasitised by both *Q. novaeseelandiae* and *Q. cedemajori*. This pattern of distribution is unusual, in that two *Quadraceps* species are sympatric on the same host individuals, and host species that are not closely related have louse species in common. It seems probable that *C. bicinctus* has been secondarily colonised by two species of *Quadraceps*. One species appears to have primarily evolved on *T. novaeseelandiae* and the other on *A. frontalis*.

Keywords: Mallophaga; *Quadraceps*; Charadriinae; host distribution; host specificity.

INTRODUCTION

On charadriiform birds most species of philopterid feather lice occupying the body and wing plumage belong to genus *Quadraceps* Clay & Meinertzhagen, 1939. Since feather lice are obligate parasites passing their entire life cycle on the host, their phylogenetic relationships are considered to often reflect those of their hosts, owing to parallel cladogenesis ("Fahrenholz's rule" sensu Eichler (1942); see Timmermann 1952, 1957, Regenfuss 1978).

However, several irregularities are found within the Mallophaga associated with Charadriiformes (see Martens 1974). Systematic relationships between several *Quadraceps* species parasitic on plovers (subfamily Charadriinae sensu Peters (1934)) are not paralleled in their hosts. Rather, these lice show host distribution patterns which are dominated by geographical factors. This seems to apply to the *Quadraceps* species from endemic plovers of New Zealand, following examination of previous records of lice and recently collected louse samples from dead and live birds in New Zealand, plus specimens found on old bird skins in German museums (Martens 1980).

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HOST DISTRIBUTION

The *Quadraceps* fauna of plovers can be divided into four species-groups, after exclusion of *hiaticulae* as type species of *Chadraceps* (Zlotorzycka 1967):

1. the *charadrii*-group, including the species *charadrii, hospes,* and *punctifer* which parasitise the grey and golden plovers (genus *Pluvialis*) and *Eudromias morinellus*, birds with Arctic breeding ranges;
2. the *fissus*-group, with species such as *fissus, ptyadis, bicuspis,* and *dressleri* on several *Charadius* species of worldwide distribution, e.g., *Quadraceps dressleri* Timmermann, 1971 living on *Charadrius melanops*, a bird of Australian origin which has recently become established in New Zealand (Ornithological Society of New Zealand 1970);
3. the cosmopolitan *assimilis*-group, with *assimilis, macrocephalus,* and *cedemajori* on many plover species (only *cedemajori* is recorded from New Zealand – see below);
4. the *novaeseelandiae*-group, of which *novaeseelandiae* and *dominella* parasitise three of the five endemic plovers of New Zealand (see below)

and *cucullatus* the Australian *Charadrius rubricollis*.

Up to now, all information about the species distribution of genus *Quadraceps* on New Zealand's endemic plovers has derived solely from the type series of the lice. Our collections are of particular interest in that only three louse species could be found. The specimens examined, and their provenance, are listed below under host species headings. All localities are within the New Zealand region as defined in the Ornithological Society of New Zealand (1970) Checklist (maps 1 and 2).

Abbreviations used for repositories are as follows:

AMNZ – Auckland Institute and Museum, Private Bag, Auckland, N.Z.;
BMNH – British Museum (Natural History), Cromwell Road, London, England;
BPBM – Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.;
NMNZ – National Museum of New Zealand, Private Bag, Wellington, N.Z.;
RLCP – R.L.C. Pilgrim collection, Christchurch, N.Z.;
SMFG – Natur-Museum Senckenberg, Frankfurt am Main, West Germany (B.R.D.);
ZMHG – Zoologisches Institut und Zoologisches Museum, Martin-Luther-King-Platz 3, Hamburg, West Germany (B.R.D.)

Charadrius (Pluviorhynchus) obscurus (Gmelin, 1789) **New Zealand dotterel**

Quadraceps dominella Timmermann, 1953: Stewart I., holotype ♀ (BMNH, Harrison Collection); New Zealand, 1880, 4 ♂♂, 4 ♀♀ (SMFG); Manukau, 1882, 1 ♂, 1 ♀ (ZMHG), 1 ♂ (SMFG); Waipu, 6 Jan 1971, 2 ♂♂, 2 ♀♀ (RLCP); Kaiaua, 21 Jan 1978, 7 ♂♂, 5 ♀♀ (NMNZ): Mangawhai, 1 Dec 1979, 8 ♂♂, 8 ♀♀ (NMNZ), 1 ♂, 1 ♀ (AMNZ); Browns I., 18 Dec 1979, 4 ♂♂, 4 ♀♀ (NMNZ); Miretahi, 1 Jan 1980, 5 ♂♂, 5 ♀♀ (NMNZ), 1 ♂, 1 ♀ (AMNZ).

Charadrius (Nesoceryx) bicinctus bicinctus Jardine & Selby, 1827 **Banded dotterel**

Quadraceps cedemajori Timmermann, 1969: Wanaka, 25 Nov 1969, 1 ♂, 1 ♀ (RLCP); Tutaekuri R., 11 Dec 1971, 1 ♂, 1 ♀ (NMNZ); Palliser Bay, 8 Sep 1980, 4 ♂♂, 1 ♀ (NMNZ).

Charadrius (Nesoceryx) bicinctus exilis Falla, 1978 . **Auckland Island banded dotterel**

[Letters in common between records of *cedemajori* and *novaeseelandiae* denote joint occurrence on the one host specimen.]

Q. cedemajori: (A) Enderby I., Auckland Is, 17 Jan 1963, holotype ♂, 22 paratypes (BPBM); (B) Adams I., Auckland Is, 12 Oct 1943, D.M. 17307, 2 ♂♂ (NMNZ); (C) Adams I., Auckland Is, 12 Oct 1943, D.M. 17308, 2 ♂♂, 1 ♀ (NMNZ); (D) Auckland Is, 19 Apr 1944, D.M. 13071–5, 2 ♂♂, 1♀ (NMNZ); (E) Enderby I., Auckland Is, 25 Feb 1973, 1 ♂, 4 ♀♀ (RLCP); (F) Enderby I., Auckland Is, 8 Dec 1976, 4 ♂♂, 4 ♀♀ (NMNZ).

Quadraceps novaeseelandiae Timmermann, 1953: (B) 14 ♂♂, 3 ♀♀; (C) 3 ♂♂, 5 ♀♀; (E) 3 ♂♂, 6 ♀♀; (F) 4 ♂♂, 4 ♀♀.

Thinornis novaeseelandiae (Gmelin, 1789) **New Zealand shore plover**

Q. novaeseelandiae: no data, holotype ♂, 3 ♂ and 2 ♀ paratypes (BMNH, Harrison Collection); Chatham Is, 1890, 4 ♂♂, 1 ♀ (SMFG); South East I., Chatham Is, 8 Jan 1899, D.M. 2341, 2 ♂♂, 6 ♀♀ (NMNZ); Rangatira I., Chatham Is, 15 Mar 1926, D.M. 1826–7, 5 ♂♂, 7 ♀♀ (NMNZ), 1 ♂, 1 ♀ (ZMHG); Chatham Is, Sep 1950, D.M. 2356, 4 ♂♂, 4♀♀ (NMNZ); South East I., Chatham Is, 29 Aug 1968, 2 ♂♂ (RLCP); South East I., Chatham Is, 18 Oct 1977, 6 ♂♂, 6♀♀ (NMNZ); South East I., Chatham Is, 2 Mar 1979, 8 ♂♂, 8 ♀♀ (NMNZ); South East I., Chatham Is, 8–11 Feb 1980, 8 ♂♂, 8 ♀♀ (NMNZ), 2 ♂♂, 2 ♀♀ (ZMHG), 1 ♂, 1♀ (AMNZ).

Anarhynchus frontalis Quoy & Gaimard, 1830 **Wrybill**

Q. cedemajori: Plimmerton, 21 Feb 1945, CM:Av 4572, 4 ♂♂, 4 ♀♀ (RLCP); Auckland, 27 May 1959, D.M. 9336, 9 ♂♂, 11 ♀♀ (NMNZ); Miranda, 8 Feb 1970, 2 ♂♂, 8 ♀♀ (NMNZ), 2 ♂♂, 11 ♀♀ (AMNZ); Waiongana R., 6 Feb 1972, D.M. 16669, 3 ♀♀ (NMNZ); Miranda, 25 Mar 1979, 8 ♂♂, 8 ♀♀ (NMNZ); Miranda, 28 Apr 1979, 10 ♂♂, 10 ♀♀ (NMNZ), 2 ♂♂, 2 ♀♀ (AMNZ), 3 ♂♂, 3 ♀♀ (ZMHG).

DISCUSSION

These records suggest that on *Charadrius obscurus* only *Quadraceps dominella* occurs, on *Thinornis novaeseelandiae* only *Q. novaeseelandiae*, and on *Anarhynchus frontalis* only *Q. cedemajori*. Both *cedemajori* and *novaeseelandiae* were found on four out of six specimens of *Charadrius bicinctus exilis*, indicating that they are established parasites of this bird.

Q. cedemajori individuals from *C. bicinctus* sspp. and from *A. frontalis* do not differ morphologically; also, *Q. novaeseelandiae* specimens from *C. bicinctus exilis* and from *T. novaeseelandiae* are identical. Therefore it seems highly probable that *C. bicinctus* sspp. originally obtained their lice by secondary infestation, on the one hand from *Anarhynchus* and on the other from *Thinornis*. The reciprocal route is far less likely.

C. b. bicinctus breeds on the North and South Islands, Stewart Island, and the Chatham Islands, partially migrating even as far as Australia. (The *C. bicinctus* population on the Auckland Islands has

only recently been proposed as a distinct subspecies, *C. b. exilis* Falla, 1978). *C. b. bicinctus* could have had close contact with *A. frontalis*, which is restricted to the New Zealand mainland; and with *T. novaeseelandiae*, which is now limited to the Chatham Islands but which was formerly present on the mainland also (Ornithological Society of New Zealand 1970). *Q. novaeseelandiae* has not yet been found on *C. b. bicinctus*, but records of lice from this host are very scarce.

Q. cedemajori on *C. b. exilis* is presumably derived from mainland sources, since it is present there on both *A. frontalis* and *C. b. bicinctus*.

There are at least two possible origins for *Q. novaeseelandiae* on *C. b. exilis*. One is from mainland sources, should this louse prove to occur on *C. b. bicinctus*. The other is from specimens of *T. novaeseelandiae* on the Auckland Islands—there is an unconfirmed record of *Thinornis* from Auckland Island (described as *T. rossii* by Gray in Gray & Sharpe (1846–1875)).

Within the Charadriiformes the occurrence of two *Quadraceps* species on the same host is quite unusual (Timmermann 1971). The well known example from *Charadrius hiaticula*, which is host to two ecologically and morphologically quite different species, is no longer valid if the removal of *Q. hiaticulae* to *Chadraceps* (Zlotorzycka 1967) is accepted. On some gull species (Laridae) from the transitional zones of both hemispheres the *Quadraceps* species *punctatus* and *ornatus* occur on the same host species but never on the same individual. The variable oystercatcher, *Haematopus unicolor*, harbours *Quadraceps auratus* and *Q. ridgwayi* sympatrically (Baker 1974).

The inference reported here of a 'recent' invasion of two congeneric Mallophaga from alien host species is of great interest. It should be observed whether competition between these species may perhaps favour one of them.

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