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A review of the genus *Forficuloecus* Conci (Phthiraptera: Philopteridae) from parrots (Psittaciformes: Psittacidae), with descriptions of four new species

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Abstract

Ten species, including four new species, of the chewing louse genus *Forficuloecus* Conci, 1941, are recognized from Australasian parrots, and a key is given for their identification. The new species and their type hosts are: *F. cameroni* ex the Red-winged Parrot, *Aprosmictus erythropterus* (J.F. Gmelin, 1788); *F. banksi* ex the Mulga Parrot, *Psephotus varius* Clark, 1910; *F. wilsoni* ex the Northern Rosella, *Platycercus venustus* (Kuhl, 1820); and *F. josephi* ex the Bourke's Parrot, *Neopsephotus bourkii* (Gould, 1841). Partial sequences of the mitochondrial COI gene support the genetic distinctiveness of these new species.

Key words: *Forficuloecus*, chewing lice, taxonomy, Australasia, parrots, cytochrome oxidase I, new species

Introduction

The genus *Forficuloecus* Conci, 1941, contains six species (Price *et al*. 2003), all found on parrots from Australasia. *Forficuloecus* has been thoroughly treated in two papers by Guimarães (1974, 1985). However, upon examining specimens representing those six species, together with some series of lice from hosts not previously represented, we can review all known species of this genus. Included are brief redescriptions of the six previously described species, descriptions of four new species, and additional host data where appropriate. A portion of the mitochondrial cytochrome oxidase I (COI) gene has been sequenced for some of these lice to evaluate the genetic distinctiveness of the species and their phylogenetic relationships (using methods described by Johnson *et al*. 2001).

For the following descriptions, all measurements were made with an ocular micrometer. Dimensions (in millimeters) of all the specimens available for each species are summarized in Table 1. This tabulation is especially appropriate since Guimarães (1985) erred in all of the measurements given for the four new species he described in that paper, with his values being approximately 60% of what they actually should be. Measurements are accurately given for the species described in Guimarães (1974), and we do not know how the discrepancies occurred in the 1985 paper.

The host nomenclature follows Dickinson (2003). Deposition of holotypes, paratypes, and other material is indicated by: ANIC (Australian National Insect Collection, Canberra), FMNH (Field Museum, Chicago, Illinois), INHS (Illinois Natural History Survey, Champaign, Illinois), MONZ (Museum of New Zealand Te Papa Tongarewa, Wellington), KCEM (K.C. Emerson Museum, Oklahoma State University, Stillwater, Oklahoma), NHM (The Natural History Museum, London), QVTA (Queen Victoria Museum and Art Gallery, Tasmania), UMSP (University of Minnesota, St. Paul, Minnesota), and UU (University of Utah, Salt Lake City, Utah).

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Table 1. Dimensions (mm) of ten species of *Forficuloecus*

Abbreviations for dimensions of *Forficuloecus* species are: TW, temple width; HL, head length at midline from anterior end of dorsoanterior plate; DPL, length of dorsoanterior head plate; PW, prothorax width; MW, metathorax width; AWV, abdomen width at segment V; TL, total length at midline from anterior end of dorsoanterior plate; GL, male genitalia length. Transverse lines separate the four species of the *meinertzhageni* group (upper) from the six species of the *forficula* group (lower).

MALES	TW	HL	DPL	PW	MW	AWV	TL	GL
F. cameroni **n.sp.**	0.56–0.60	0.57–0.60	0.21–0.24	0.36–0.38	0.49–0.51	0.74–0.81	1.68–1.76	0.37–0.40
F. emersoni	0.57–0.62	0.58–0.63	0.22–0.24	0.34–0.37	0.53–0.56	0.74–0.82	1.66–1.82	0.35–0.36
F. meinertzhageni	0.48–0.54	0.50–0.55	0.17–0.21	0.33–0.36	0.45–0.56	0.63–0.78	1.51–1.71	0.37–0.39
F. pilgrimi	0.46–0.53	0.47–0.53	0.17–0.20	0.27–0.33	0.40–0.46	0.59–0.70	1.33–1.53	0.24–0.30
F. banksi **n.sp.**	0.54–0.59	0.51–0.54	0.18–0.20	0.32–0.34	0.44–0.46	0.76–0.82	1.48–1.58	0.32–0.34
F. forficula	0.57–0.58	0.54–0.57	0.22–0.23	0.30–0.34	0.43–0.47	0.66–0.74	1.50–1.60	0.30–0.34
F. wilsoni **n.sp.**	0.64–0.67	0.57–0.61	0.22–0.24	0.38–0.40	0.51–0.52	0.89–0.93	1.68–1.82	0.36–0.39
F. palmai	0.66–0.69	0.61–0.63	0.24–0.25	0.38–0.43	0.51–0.56	0.86–0.91	1.73–1.81	0.37–0.39
F. josephi **n.sp**	0.48–0.54	0.47–0.51	0.18–0.21	0.27–0.33	0.37–0.47	0.64–0.71	1.33–1.48	0.28–0.33
F. greeni	0.54–0.55	0.54	0.21	0.29–0.31	0.43–0.46	0.66	1.41–1.45	0.30–0.31

FEMALES	TW	HL	DPL	PW	MW	AWV	TL
F. cameroni **n.sp.**	0.61–0.67	0.61–0.65	0.23–0.24	0.37–0.41	0.51–0.59	0.83–0.94	1.88–2.14
F. emersoni	0.62–0.66	0.63–0.68	0.24–0.27	0.38–0.41	0.58–0.62	0.86–0.96	2.03–2.19
F. meinertzhageni	0.56–0.63	0.58–0.62	0.18–0.23	0.37–0.42	0.51–0.61	0.77–0.94	1.91–2.14
F. pilgrimi	0.53–0.59	0.52–0.61	0.20–0.23	0.31–0.37	0.47–0.55	0.67–0.80	1.63–1.85
F. banksi **n.sp.**	0.63–0.66	0.57–0.60	0.20–0.22	0.34–0.39	0.49–0.56	0.83–1.02	1.83–2.04
F. forficula	0.67–0.70	0.61–0.64	0.27	0.36–0.39	0.53–0.57	0.80–0.92	1.71–1.96
F. wilsoni **n.sp.**	0.73–0.78	0.64–0.67	0.25–0.28	0.42–0.45	0.60–0.66	1.07–1.12	2.14–2.19
F. palmai	0.70–0.78	0.65–0.69	0.25–0.29	0.37–0.46	0.57–0.66	0.90–1.07	2.02–2.17
F. josephi **n.sp.**	0.58–0.60	0.55–0.56	0.21–0.23	0.31–0.37	0.42–0.49	0.71–0.84	1.72–1.84
F. greeni	0.61–0.63	0.58–0.60	0.23–0.25	0.34–0.38	0.52–0.58	0.76–0.79	1.73–1.82

Genus *Forficuloecus* Conci

Forficuloecus Conci, 1941: 126. Type species: *Philopterus forficula* (Piaget, 1871) by original designation.

A brief characterization of this genus as it pertains to the features shared by the lice in this study is as follows. Head as in Fig. 1; broadest at temples, elongated and narrowed anteriorly, terminating in a relatively transparent forceps-like structure; with prominent dorsoanterior plate; without sexually dimorphic antennae. Thorax (Fig. 1) with pronotum having a single lateroposterior seta. Metanotum without central setae and with 18–22 setae distributed across posterior margin. Metasternal plate small, with two setae.

Abdomen (Figs. 1, 4) with divided tergites on II–VIII, variable on IX of male, prominent and complete on IX of female. Counts for tergal setae include all setae on line mediad of spiracles. Sternites weakly developed, with sparse setae; anterior sterna lacking numerous short spiniform setae. Male genitalia (e.g., Figs. 2, 12) with prominent pair of parameres, conspicuous mesosomal complex, and medioposterior unpaired "penis" structure of characteristic shape. Female with large medioposterior subgenital plate (e.g., Figs. 4, 10). For brevity, neither these characters nor those of the species groups will be repeated in the species descriptions.

meinertzhageni species group

The four species of this group are recognized from those of the other group by having both sexes with two long setae on each lateral temple margin (Figs. 1, 3), male genitalia with a short heavily pigmented penis (Figs. 2, 5, 6, 8), and females with setae posterior to subgenital plate aligned as in Fig. 4, with two transverse rows of short setae and few setae interspersed between these rows.

Forficuloecus cameroni Price, Johnson, and Palma, new species
(Figs. 1–4)

Type host. *Aprosmictus erythropterus* (J.F. Gmelin, 1788), the Red-winged Parrot.

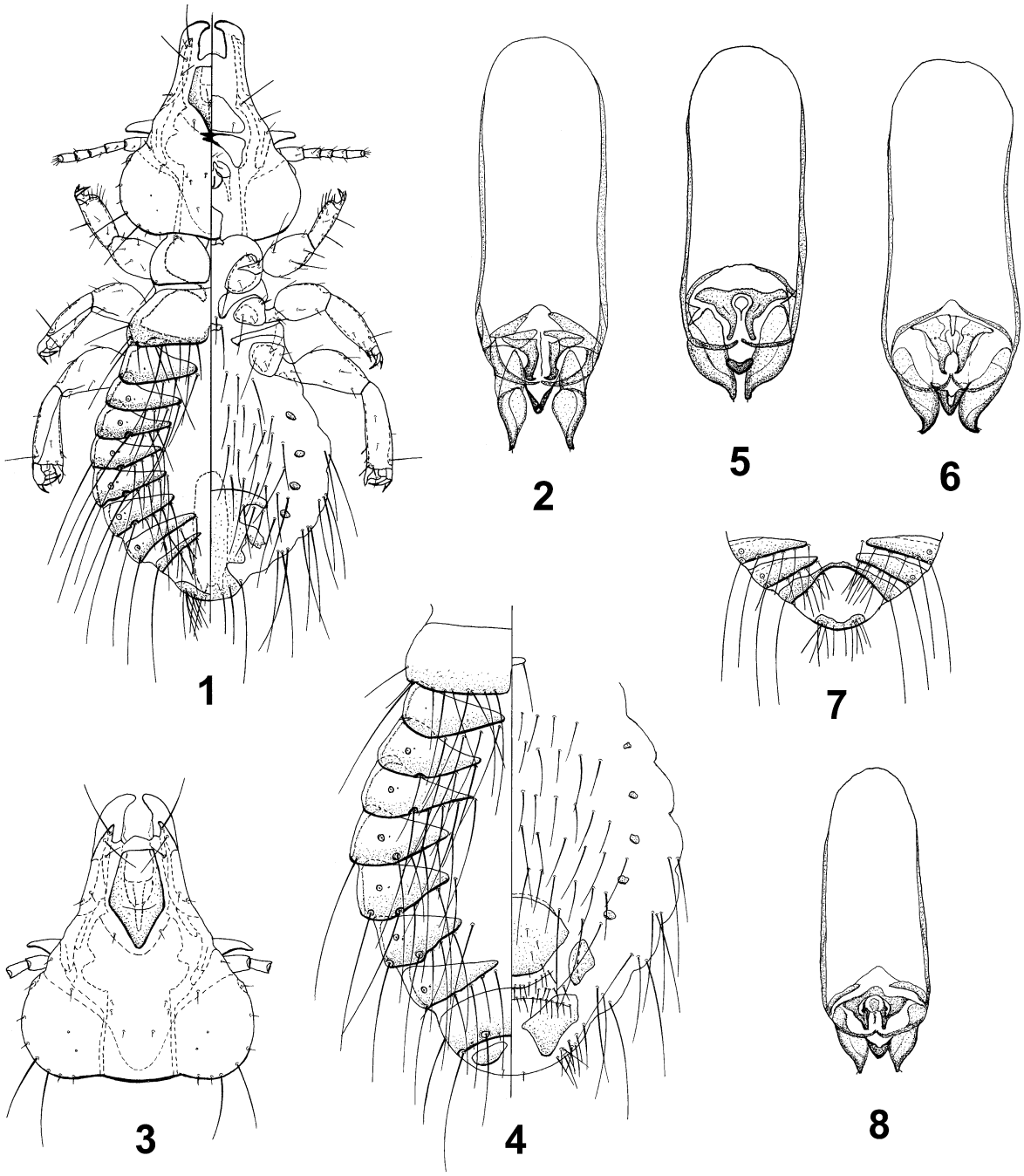
Male. As in Fig. 1. Tergal setae: II–III, usually 8–9, less often 10; IV–VII, 10–11, less often 12; VIII, 6–8. Tergite IX with well developed lateral plates, distinct median gap between them. Sternal setae: II, 4–8; III–VI, 8–13; VII, 5–8. Genitalia with parameres and penis shaped as shown (Fig. 2).

Female. Head as in Fig. 3, shaped as for male; metanotum and abdomen as in Fig. 4. Tergal setae: II–III, 8–11; IV–VII, 9–11; VIII, 7–8. Sternal setae: II, 5–8; III, 9–12; IV–VI, 10–14; VII, 6–7.

Type material. Holotype male (ANIC), ex *A. erythropterus,* **AUSTRALIA:** 45 km E Darwin, 22 Oct. 2002, D.H. Clayton, ANWC 50026. Paratypes all ex *A. erythropterus* (UMSP, UU, FMNH, ANIC): 1 male, same data as holotype except ANWC 50044; 1 female same except Queensland, Weipa, 25 Oct. 2001, T. Chesser, ANWC 29802. **SE NEW GUINEA:** 2 males, 3 females, Papua, Weam, 1 June 1964, H. Clissold, BBM-NG 50872; 3 males, 4 females, same except 29 May 1964, BBM-NG 50765; 2 females, same except 9 June 1964, BBM-NG 50817.

Remarks. This new species is recognized by the combination of the large dimensions of both sexes, the male with tergites on IX having a distinct median gap between them and with a unique shape of the genitalic parameres and penis, and the female with more numerous setae on sterna II–VII. While in a number of features it is close to *F. emersoni* Guimarães, the differences of the male in the structure of tergite IX (Fig. 1 vs Fig. 7) and the shape of the parameres and penis (Fig. 2 vs Fig. 5) afford good separation. The female is tenuously recognized from *F. emersoni* by having a total of 35–37 setae on sterna IV–VI.

Etymology. This species is named for Stephen Cameron, Australian National Insect Collection, CSIRO, Canberra, Australia, in recognition of his work on the systematics and genomics of lice.



FIGURES 1–8. 1–4, *Forficuloecus cameroni*. 1, Entire dorsoventral male. 2, Male genitalia. 3, Dorsal female head. 4, Female metanotum and dorsoventral abdomen. 5, *F. emersoni*, male genitalia. 6, *F. meinertzhageni*, male genitalia. **7**–8, *F. pilgrimi*. 7, Dorsal male terminalia. 8, Male genitalia.

Forficuloecus emersoni **Guimarães**
(Fig. 5)

Forficuloecus emersoni Guimarães, 1985: 42. Type host: *Alisterus chloropterus* (E.P. Ramsay, 1879), the Papuan King Parrot.

Male. Tergal setae: II–III, 7–8; IV–VII, 9–11; VIII, 6–8. Tergite IX with median bridge connecting lateral portions, as in Fig. 7. Sternal setae: II, 5–12; III–VI, 6–15; VII, 4–6. Genitalia (Fig. 5) with parameres shaped as shown and isolated darkly pigmented medioposterior structure of kidney-bean shape.

Female. Tergal setae: II, 8; III, 8–9; IV–VII, 8–11; VIII, 6–8. Sternal setae: II, 8–10; III, 8–14; IV–VI, 7–12; VII, 4–8.

Material. Ex *A. chloropterus*, **NEW GUINEA:** Holotype male, allotype female of *F. emersoni* (KCEM), Bulolo, 3 Mar. 1962, H. Clissold; 1 male, 2 females (UMSP), Bulolo River, BBM-NG 27880, P. Shanahan; 1 male (UMSP), Wau, 27 Feb. 1963, BBM-NG 20349, H. Clissold.

Remarks. While very similar to *F. cameroni*, the male of *F. emersoni* differs in the shape of the parameres, the characteristic kidney-bean shape of the penis, and the presence of a bridge connecting the lateral portions of tergite IX. Females of these two species are very close, with *F. emersoni* having a total of 23–33 setae on sterna IV–VI.

***Forficuloecus meinertzhageni* Guimarães**
(Fig. 6)

Forficuloecus meinertzhageni Guimarães, 1974: 177. Type host: *Nestor meridionalis* (J.F. Gmelin, 1788), the Kaka.

Male. Tergal setae: II–III, 7–8; IV–VII, 9–11; VIII, 8–10. Tergite IX with median bridge connecting lateral portions of tergite IX, as in Fig. 7. Sternal setae: II, 3–4; III–VI, 5–8; VII, 3–6. Genitalia (Fig. 6) with parameres and penis shaped as shown.

Female. Tergal setae: II, 7–8; III, 8–11; IV–VII, 9–12; VIII, 8–11. Sternal setae: II, 5–6; III–VI, 6–8; VII, 4–6.

Material. Ex *N. meridionalis*, **NEW ZEALAND:** 1 male, 1 female [paratypes of *F. meinertzhageni*] (MONZ), JG.150. Ex *N. m. meridionalis*, **NEW ZEALAND:** 1 male, 1 female (MONZ), E.F. Stead; 2 males, 2 females (MONZ), Canterbury, Patersons Creek, 23 Oct. 1974, D.S. Horning. Ex *N. m. septentrionalis* Lorenz, 1896, **NEW ZEALAND:** 1 male, 1 female (MONZ), North Island, Dannevirke, 27 June 1976, E. Brown; 1 male (MONZ), Kapiti Island, 25 Aug. 1981, P. McKenzie; 1 male, 1 female (MONZ), Kapiti Island, P. Daniel. Ex *N. notabilis* Gould, 1856, **NEW ZEALAND:** 1 male, 1 female (MONZ), South Island, 5 Sept. 1965; 2 females (MONZ), Kokatahi, Oct. 1973, C. Howatt; 4 males, 3 females (MONZ), South Island, near Discovery Stream, Hawdon Hut, 2 Sept. 1978, J.R. Jackson.

Remarks. The combination of the small dimensions of both sexes and the male tergite IX with a median connecting bridge ally *F. meinertzhageni* with *F. pilgrimi* Guimarães and distinguish it from the other two species. Males of *F. meinertzhageni* are separated from those of *F. pilgrimi* by their longer and wider male genitalia (Fig. 6 vs Fig. 8). Females of *F. meinertzhageni* are tenuously separable by their greater total length.

***Forficuloecus pilgrimi* Guimarães**
(Figs. 7–8)

Forficuloecus pilgrimi Guimarães, 1985: 43. Type host: *Cyanoramphus novaezelandiae chathamensis* Oliver, 1930, the Chatham Island Red-fronted Parakeet.

Male. Tergal setae: II–III, 8–9; IV–VII, 8–11; VIII, 6–9. Tergite IX with well developed lateral plates and narrow median bridge connecting them (Fig. 7). Sternal setae: II, 3–5; III, 4–6; IV–VI, 5–8; VII, 4–6. Genitalia (Fig. 8) with parameres and penis shaped as shown.

Female. Tergal setae: II, 7–9; III, 8–10; IV–VII, 9–11; VIII, 7–10. Sternal setae: II, 2–6; III, 4–7; IV, 6–8; V–VI, 6–7; VII, 4–5.

Material. Ex *C. n. novaezelandiae* (Sparrman, 1787), **NEW ZEALAND:** 1 male, 1 female [paratypes of *F. pilgrimi*] (MONZ), Whitianga, 10 Jan. 1974, J. Smuts-Kennedy. Ex *C. n. chathamensis*, **NEW**

ZEALAND: 4 males, 4 females [paratypes of *F. pilgrimi*] (MONZ), Chatham Islands, Little Mangere Island, Oct. 1976, N.Z. Wildlife Service; 2 males, 2 females (MONZ), Chatham Islands, South East Island, 10 Feb. 1980, A. Nixon. Ex *C. n. hochstetteri* (Reischek, 1889), **NEW ZEALAND:** 1 male [paratype of *F. pilgrimi*] (MONZ), Antipodes Islands, 31 Oct. 1970, N.Z. Wildlife Service; 2 males, 2 females [paratypes of *F. pilgrimi*] (MONZ), Antipodes Islands, 4 Dec. 1978, D.S. Horning. Ex *C. auriceps* (Kuhl, 1820), **NEW ZEALAND:** 2 males, 3 females (MONZ), Fiordland, Eglinton Valley, 10 Mar. 1980, B. Harcourt. Ex *C. forbesi* Rothschild, 1893, **NEW ZEALAND:** 1 male, 1 female (MONZ), Chatham Islands, D. Merton; 1 male, 1 female (MONZ), Chatham Islands, Mangere Island, 6 Dec. 2001, Dept. of Conservation. Ex *C. unicolor* (Lear, 1831), **NEW ZEALAND:** 1 male, 1 female [paratypes of *F. pilgrimi*] (MONZ), Antipodes Islands, 28 Feb. 1969, R.T. & B.D. Bell; 2 males, 2 females [paratypes of *F. pilgrimi*] (MONZ), Antipodes Islands, Hut Cove, 27 Nov. 1978, D.S. Horning; 1 male, 1 female (MONZ), Antipodes Islands, 8 Mar. 1985, B.D. Bell. Ex *C. malherbi* Souancé, 1857, **NEW ZEALAND:** 2 males, 2 females (MONZ), Lake Sumner Forest Park, Mar. 1981, N.Z. Wildlife Service.

Remarks. The males and females of *F. pilgrimi* are similar to those of *F. meinertzhageni*, but are separable by features discussed under the latter species.

forficula species group

The six species of this group are recognized from those of the *meinertzhageni* group by having both sexes with only one long seta on each lateral temple margin (Figs. 11, 24), male genitalia with a conspicuous elongate tapered penis (Figs. 12, 14, 17, 20, 22), and females with setae posterior to subgenital plate as in Figs. 10, 18, or 23, with few setae grouped around pair of inwardly pointing sclerites.

Forficuloecus banksi Price, Johnson, and Palma, new species
(Figs. 9–13)

Type host. *Psephotus varius* Clark, 1910, the Mulga Parrot.

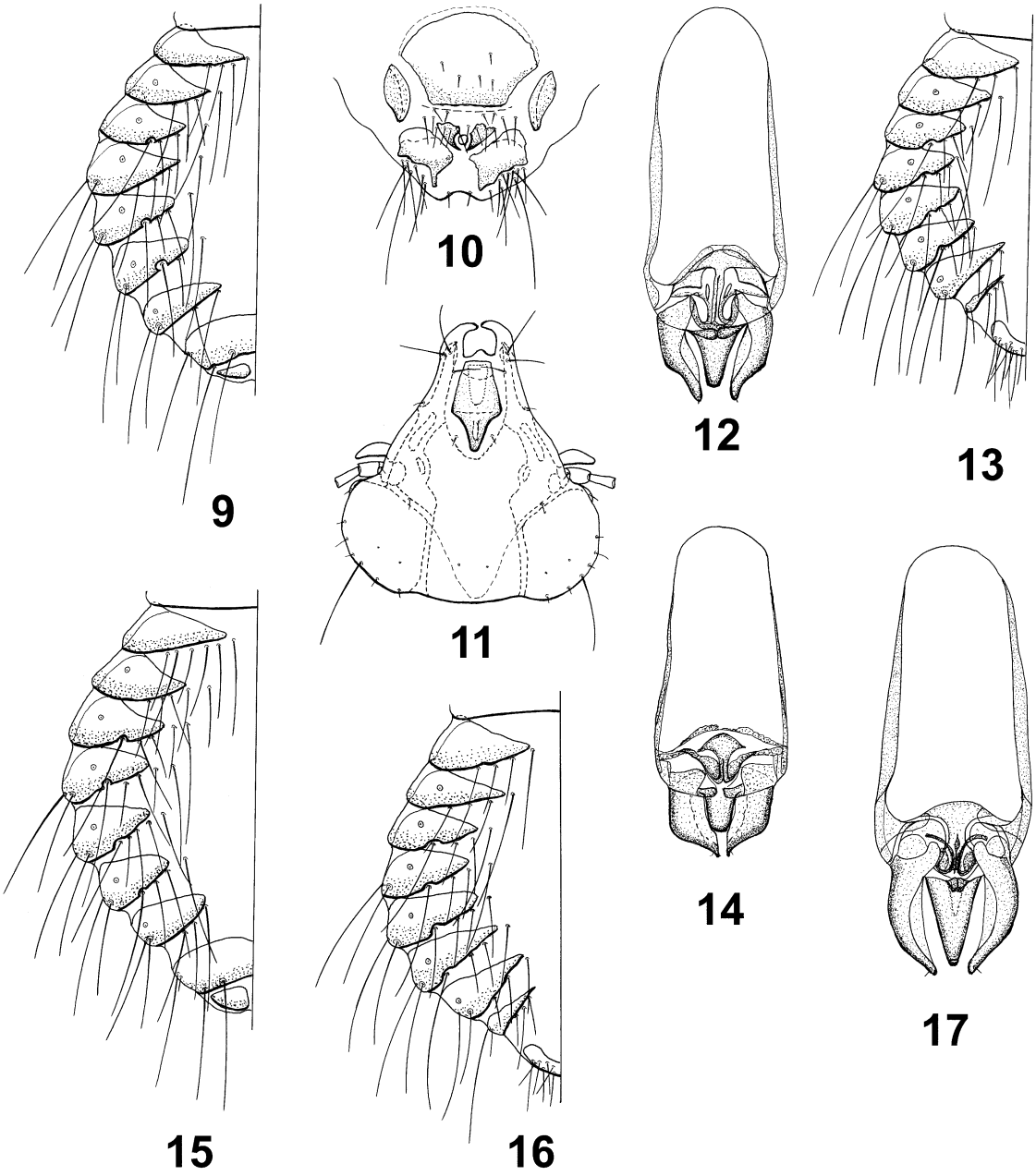
Male. Dorsal abdomen as in Fig. 13. Tergal setae: II–VII, 5–8; VIII, 3–6. Tergite IX with well developed lateral plates, distinct median gap between them (Fig. 13). Sternal setae: II, 2; III, 3–6; IV–V, 4–8; VI, 6; VII, 4. Genitalia (Fig. 12) with long slender curved parameres and elongate "V"-shaped penis.

Female. Head as in Fig. 11, dorsal abdomen as in Fig. 9. Tergal setae: II, 7–8; III, 5–8; IV, 8–9; V–VII, 6–8; VIII, 4–6. Sternal setae: II, 2–4; III, 4–7; IV–V, 5–8; VI, 5–6; VII, 4. Ventral terminalia as in Fig. 10.

Type material. Holotype male (ANIC), ex *P. varius*, **AUSTRALIA:** Northwest Territory, 2 May 2002, T. Chesser, ANWC 32856. Paratypes (INHS, UU): 4 males, 5 females, same data as holotype; 2 males, 1 female, same except ANWC 32871; 1 female, same except with only ANWC 32737.

Remarks. The dimensions of the male of *F. banksi* place it closest to that of *F. forficula* (Piaget). However, the shape of the genitalic parameres and penis along with the smaller number of abdominal tergal setae afford separation. The female of *F. banksi* also appears similar to *F. forficula*, but the differences in dimensions and the number of tergal setae support separation.

Etymology. This species is named for Jonathan Banks, University of Waikato, Hamilton, New Zealand, in recognition of his work on louse systematics.



FIGURES 9–17. 9–13, *Forficuloecus banksi*. 9, Dorsal female abdomen. 10, Ventral female terminalia. 11, Dorsal female head. 12, Male genitalia. 13, Dorsal male abdomen. 14, *F. forficula*, male genitalia. 15–17, *F. wilsoni*. 15, Dorsal female abdomen. 16, Dorsal male abdomen. 17, Male genitalia.

***Forficuloecus forficula* (Piaget)**
(Fig. 14)

Docophorus forficula Piaget, 1871: 117. Type host: *Platycercus eximius* (Shaw, 1792), the Eastern Rosella.

Male. Tergal setae: II–III, 9–11; IV, 10–11; V–VII, 7–10; VIII, 8. Tergite IX with well developed lateral plates, distinct median gap between them. Sternal setae: II, 2; III–VI, 5–8; VII, 3–4. Genitalia (Fig. 14) with broad inwardly projecting parameres and penis "U"-shaped.

Female. Tergal setae: II–VI, 11–14; VII, 10–12; VIII, 6–9. Sternal setae: II, 2; III–V, 7–9; VI, 6–7; VII, 4–5.

Material. Ex *P. caledonicus* (J.F. Gmelin, 1788), **AUSTRALIA:** 2 males, 2 females (MONZ), N. Tasmania, Oct.-Nov. 1986, N. Rice & R.H. Green. Ex *P. adscitus* (Latham, 1790), **AUSTRALIA:** 1 male, 1 female (MONZ), Victoria, 561/81. Ex *P. elegans* (J.F. Gmelin, 1788), **AUSTRALIA:** 1 male (INHS), N.S.W., Navra region, ANWC 29246, 19 Jul. 2002, R. Palmer. Ex *Lathamus discolor* (Shaw, 1790), **AUSTRALIA:** 1 female (MONZ), Tasmania, Glengarry, 18 Nov. 1984, S. Holland.

Remarks. This species is similar to *F. banksi*, but is separable by features discussed under the latter species.

Forficuloecus wilsoni Price, Johnson, and Palma, new species

(Figs. 15–17)

Type host. *Platycercus venustus* (Kuhl, 1820), the Northern Rosella.

Male. Dorsal abdomen as in Fig. 16. Tergal setae: II–VII, 6–10; VIII, 6–7. Tergite IX with well developed lateral plates, distinct median gap between them. Sternal setae: II, 2–3; III–VI, 6–11; VII, 3–6. Genitalia (Fig. 17) with evenly curved parameres and very long penis shaped as shown.

Female. Dorsal abdomen as in Fig. 15. Tergal setae: II, 12–13; III, 9–13; IV, 12; V–VI, 8–11; VII, 8; VIII, 6–7. Sternal setae: II, 2; III–V, 8–10; VI, 7–8; VII, 4–6.

Type material. Holotype male (ANIC), ex *P. venustus*, **AUSTRALIA:** Northwest Territory, Pine Creek, 24 Oct. 2002, D.H. Clayton, ANWC 33998 & 99. Paratypes (UU, INHS): 2 males, 4 females, same data holotype.

Remarks. Both sexes of *F. wilsoni* and *F. palmai* Guimarães represent the largest members of this species group. However, both sexes of *F. wilsoni* have consistently fewer tergal setae on most abdominal segments and males are distinctive by their strongly defined tergite IX and details of the genitalia (Fig. 17 vs Fig. 20).

Etymology. This species is named for Robert Wilson, University of Alaska, Fairbanks, Alaska, in recognition of his assistance in collecting lice from a wide range of avian hosts.

Forficuloecus palmai Guimarães

(Figs. 18–20)

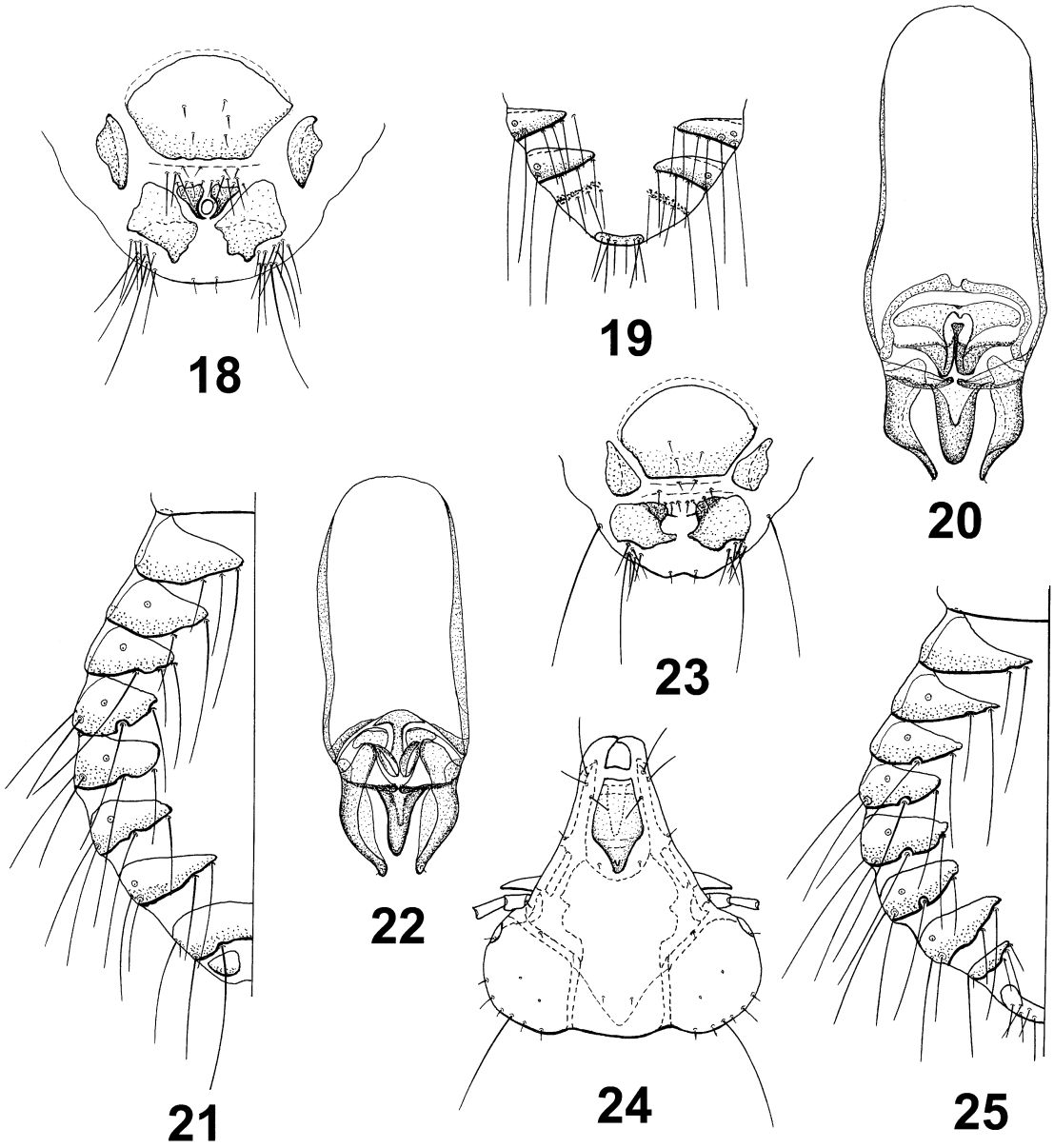
Forficuloecus palmai Guimarães, 1985: 46. Type host: *Barnardius zonarius* (Shaw, 1805), the Australian Ringneck.

Male. Tergal setae: II–V, 11–14; VI, 10–13; VII, 9–11; VIII, 6–7. Tergite IX with only poorly developed lateral plates, distinct median gap between them (Fig. 19). Sternal setae: II, 2; III–VI, 6–8; VII, 5–6. Genitalia (Fig. 20) with long pointed flexed parameres and elongate "U"-shaped penis.

Female. Tergal setae: II, 10–15; III, 14–18; IV, 15–21; V–VI, 12–16;VII, 10–12; VIII, 7–9. Sternal setae: II, 2; III–VI, 6–9; VII, 4. Ventral terminalia as in Fig. 18.

Material. Ex *B. zonarius*, **AUSTRALIA:** 1 male, 1 female (INHS), Shaw/DeGrey River Jct., 11 May 2002, T. Chesser, ANWC 33127; 1 male, 1 female (INHS), Burkett Rd to Exmouth, 61 km NW of NW Central Hwy., 18 May 2002, T. Chesser, ANWC 33296; 1 male, 1 female (INHS), N.S.W., Round Hill, 24 July 2001, K.P. Johnson, ANWC 29267.

Remarks. The differences between *F. palmai* and *F. wilsoni* have been discussed under the latter species.



FIGURES 18–25. 18–20, *Forficuloecus palmai*. 18, Ventral female terminalia. 19, Dorsal male terminalia. 20, Male genitalia. 21–25, *F. josephi*. 21, Dorsal female abdomen. 22, Male genitalia. 23, Ventral female terminalia. 24, Dorsal female head. 25, Dorsal male abdomen.

***Forficuloecus josephi* Price, Johnson, and Palma, new species**
(Figs. 21–25)

Type host. *Neopsephotus bourkii* (Gould, 1841), the Bourke's Parrot.

Male. Dorsal abdomen as in Fig. 25. Tergal setae: II, 4–6; III–VII, 4; VIII, 2–4. Tergite IX with small but well-defined lateral plates, distinct median gap between them. Sternal setae: II, 2; III, 2–4; IV–V, 4; VI–VII, 4–6. Genitalia (Fig. 22) with long gently curved parameres and elongate slender penis shaped as shown.

Female. Head as in Fig. 24, dorsal abdomen as in Fig. 21. Tergal setae: II, 5–6; III, 4–5; IV, 4–6; V–VIII, 4. Sternal setae: II, 2–3; III, 2–5; IV–V, 4–7; VI, 5–7; VII, 4. Ventral terminalia as in Fig. 23

Type material. Holotype male (ANIC), ex *N. bourkii*, **AUSTRALIA:** Western Australia, 22 May 2002, T. Chesser, ANWC 33375. Paratypes (INHS): 1 male, 3 females, same data as holotype; 1 male, 1 female, same except South Australia, 1 May 2002, ANWC 32776.

Other material. Ex *Neophema splendida* (Gould, 1841) [captive], **AUSTRALIA:** 1 male, 1 female (MONZ), South Australia, Adelaide, June 1986, P. Needham.

Remarks. Both sexes of *F. josephi* are the smallest of the species in this group, and they are further distinctive by having the fewest abdominal tergal setae. This small size and reduced number of tergal setae are most similar to *F. greeni* Guimarães. However, the consistently smaller number of tergal setae for *F. josephi* will separate these two species. Palma and Barker (1996: 178) listed *Neophema splendida* as a host for *F. greeni*, based on the same specimens that we have identified as *F. josephi* in this review.

Etymology. This species is named for Leo Joseph, Australian National Wildlife Collection, CSIRO, Canberra, in recognition of his work on the systematics of parrots and his assistance in collecting bird lice.

Forficuloecus greeni Guimarães

Forficuloecus greeni Guimarães, 1985: 44. Type host: *Neophema chrysostoma* (Kuhl, 1820), the Blue-winged Parrot.

Male. Whole illustration as in Guimarães (1985: Fig. 18). Tergal setae: II, 6–7; III, 5; IV–VII, 6–7; VIII, 4–6. Sternal setae: II, 2; III, 4; IV, 4–6; V, 5–6; VI–VII, 0–2. Genitalia as in Guimarães (1985: Fig. 8).

Female. Whole illustration as in Guimarães (1985: Fig. 19). Tergal setae: II, 4–7; III, 5–6; IV, 5–9; V, 5–8; VI–VII, 7–10; VIII, 4–6. Sternal setae: II, 2; III, 4–6; IV, 5–6; V–VI, 6; VII, 4. Ventral terminalia as in Guimarães (1985: Fig. 16).

Material. Ex *N. chrysostoma*, **AUSTRALIA:** Holotype male, allotype female (NMH) of *F. greeni*, Tasmania, Exeter, 11 Aug. 1968, R.H. Green (QVTA. Reg. No. 437); 1 male, 1 female [paratypes of *F. greeni*], same data as holotype. Guimarães (1985: 45) wrote that these paratypes were "to be deposited in the Queen Victoria Museum and Art Gallery, Launceston, Tasmania;". However, as they were not sent to Tasmania, it has been agreed by officers from both institutions that they will be permanently kept in NHM.

Remarks. As discussed earlier under *F. josephi*, these species are quite similar morphologically. Both are small and have a reduced abdominal tergal chaetotaxy. However, *F. josephi* consistently has only a total of four setae (rarely two) on each male abdominal tergite and the female has only a total of four on the majority of its tergites. With minor differences in dimensions and in details of the male genitalia and female ventral terminalia, it is clear that these series represent two distinct species.

Discussion

With the exception of two *Forficuloecus* species, each taken from more than one host genus, it would appear that each louse species may be limited to a single genus or even single species of parrot host. Considering the relatively high degree of host specificity shown by the ten species of *Forficuloecus* recognized in this paper, all collected from parrots found in Australasia, it is highly likely that more undescribed species of this louse genus will be found on hosts not yet examined for lice.

Sequences of a 379 base pair portion of the mitochondrial cytochrome oxidase I (COI) gene (GenBank Accession numbers EU669825-31) indicate substantial genetic differentiation between species that were available for sequencing. Uncorrected percent sequence divergences ranged from 11.2% between the closely related *F. forficula* and *F. wilsoni* to 22.4% between *F. cameroni* and *F. josephi*. A phylogenetic tree derived from parsimony analysis of these sequences (Fig. 26) generally supports the species groups identified on the basis of morphology. *Forficuloecus cameroni*, the only representative we had available of the *meinertzhageni* species group, fell outside a clade containing the five representatives of the *forficula* species group for which we had DNA sequences, and *F. cameroni* was also the most divergent sequence. Within the *forficula* species group, there is bootstrap support for a grouping of *F. banksi*, *F. wilsoni*, and *F. forficula*.

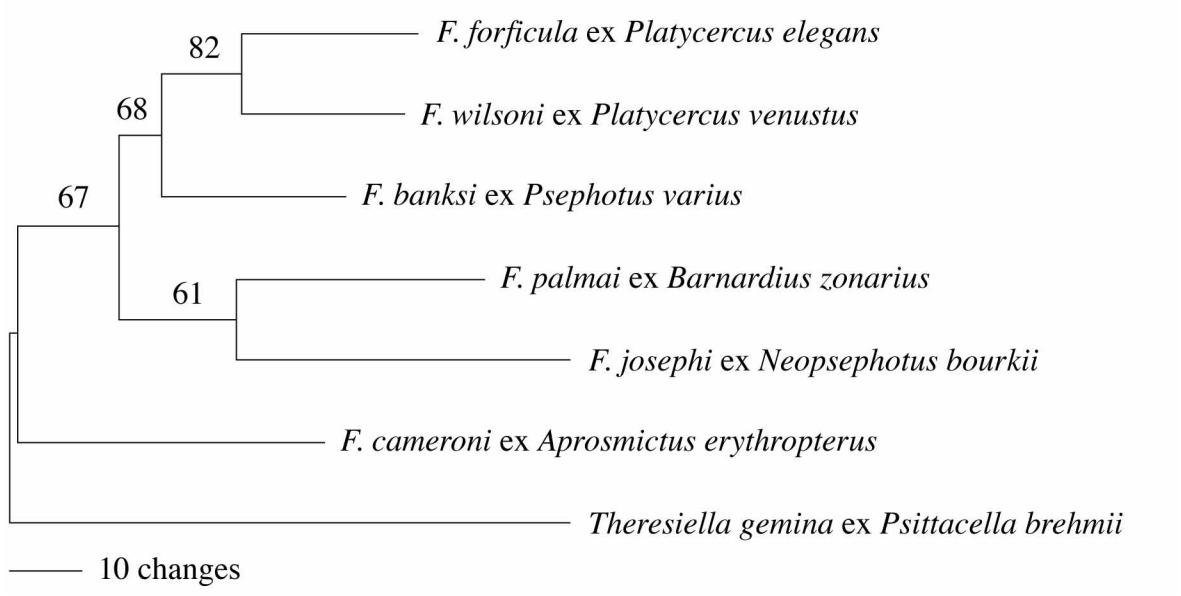


FIGURE 26. Phylogenetic tree based on parsimony analysis of a 379 base pair portion of the mitochondrial COI gene. Searches involved 10 random addition replicates and numbers above branches are support from 1000 parsimony bootstrap replicates. Branches proportional to reconstructed changes (scale indicated). *F.= Forficuloecus.*

Our material for this study consisted of lice from 19 parrot species in 10 genera as listed in Dickinson (2003). However, there are as many as 98 species in 27 genera in Australasia (Dickinson 2003) for which there are not yet records of *Forficuloecus*. More extensive collecting from Australasian parrots is needed to determine whether some of the louse species now known from a range of host taxa (e.g., *F. pilgrimi* and *F. forficula*) prove to represent a species complex. More collecting is also needed to determine if lice from as yet uncollected hosts will be new species or only an expansion of the host range for known louse species.

Key to the Species of *Forficuloecus*

1 Each temple margin with 2 long setae (Fig. 3) (*meinertzhageni* species group).....2
Each temple margin with only 1 long seta (Fig. 11) (*forficula* species group).....9
2 Male 3
Female 6
3 Temple width <0.55; head length <0.56 4
Temple width >0.55; head length >0.56 5
4 Genitalia (Fig. 6) >0.35 long .....*meinertzhageni* Guimarães
Genitalia (Fig. 8) <0.32 long ..... *pilgrimi* Guimarães
5 Abdominal tergite IX with median bridge (Fig. 7); genitalia with kidney-bean shaped penis (Fig. 5).....
.....*emersoni* Guimarães
Abdominal tergite IX without such bridge (Fig. 1); genitalia with "V"-shaped penis (Fig. 2) .....
.....*cameroni* **n. sp.**
6 Total length <1.86..... *pilgrimi* Guimarães
Total length >1.87 7
7 Total setae on sterna III–VI not >30 .....*meinertzhageni* Guimarães
Total setae on sterna III–VI >30 8

8 Total setae on sterna IV–VI <34 ..... *emersoni* Guimarães
Total setae on sterna IV–VI >34 ..... *cameroni* **n. sp.**
9 Tergites V–VIII each with total of not >4 setae ..... *josephi* **n. sp.**
Tergites V–VIII each with total of >4 setae 10
10 Male 11
Female 15
11 Total length not >1.45 ..... .*greeni* Guimarães
Total length >1.45 12
12 Temple width <0.60 13
Temple width >0.63 14
13 Majority of tergites II–V each with total of at least 9 setae; genitalia as in Fig. 14 ..... *forficula* (Piaget)
None of tergites II–V each with total of >8 setae; genitalia as in Fig. 12 ..... *banksi* **n. sp.**
14 Tergites II–V each with at least 11 setae ..... *palmai* Guimarães
Tergites II–V each with not >10 setae ..... *wilsoni* **n. sp.**
15 Temple width not >0.66; head length not >0.60 16
Temple width at least 0.67; head length at least 0.61 17
16 Ventral terminalia as in Fig. 10; total length at least 1.83 ..... *banksi* **n. sp.**
Ventral terminalia similar to Fig. 23, as in Guimarães (1985: Fig. 16); total length not >1.82 ..... *greeni* Guimarães
17 Total length <2.00 ..... *forficula* (Piaget)
Total length >2.00 18
18 Tergites III–IV each with total of at least 14 setae ..... *palmai* Guimarães
Tergites III–IV each with total of not >13 setae ..... *wilsoni* **n. sp.**

Host-louse list
(host sequence follows Dickinson 2003)

Family PSITTACIDAE

Subfamily NESTORINAE
***Nestor notabilis* Gould, 1856**
Forficuloecus meinertzhageni Guimarães
***Nestor meridionalis* (J.F. Gmelin, 1788)**
Forficuloecus meinertzhageni Guimarães

Subfamily PSITTACINAE
***Cyanoramphus forbesi* Rothschild, 1893**
Forficuloecus pilgrimi Guimarães
***Cyanoramphus unicolor* (Lear, 1831)**
Forficuloecus pilgrimi Guimarães
***Cyanoramphus auriceps* (Kuhl, 1820)**
Forficuloecus pilgrimi Guimarães
***Cyanoramphus malherbi* Souancé, 1857**
Forficuloecus pilgrimi Guimarães
***Cyanoramphus novaezelandiae novaezelandiae* (Sparrman, 1787)**

Forficuloecus pilgrimi Guimarães

***Cyanoramphus novaezelandiae chathamensis* Oliver, 1930**

Forficuloecus pilgrimi Guimarães

***Cyanoramphus novaezelandiae hochstetteri* (Reischek, 1889)**

Forficuloecus pilgrimi Guimarães

***Barnardius zonarius* (Shaw, 1805)**

Forficuloecus palmai Guimarães

***Platycercus caledonicus* (J.F. Gmelin, 1788)**

Forficuloecus forficula (Piaget)

***Platycercus elegans* (J.F. Gmelin, 1788)**

Forficuloecus forficula (Piaget)

***Platycercus venustus* (Kuhl, 1820)**

Forficuloecus wilsoni Price, Johnson, and Palma

***Platycercus adscitus* (Latham, 1790)**

Forficuloecus forficula (Piaget)

***Platycercus eximius* (Shaw, 1792)**

Forficuloecus forficula (Piaget)

***Psephotus varius* Clark, 1910**

Forficuloecus banksi Price, Johnson, and Palma

***Neopsephotus bourkii* (Gould, 1841)**

Forficuloecus josephi Price, Johnson, and Palma

***Neophema chrysostoma* (Kuhl, 1820)**

Forficuloecus greeni Guimarães

***Neophema splendida* (Gould, 1841)**

Forficuloecus josephi Price, Johnson, and Palma

***Lathamus discolor* (Shaw, 1790)**

Forficuloecus forficula (Piaget)

***Alisterus chloropterus* (E.P. Ramsay, 1879)**

Forficuloecus emersoni Guimarães

***Aprosmictus erythropterus* (J.F. Gmelin, 1788)**

Forficuloecus cameroni Price, Johnson, and Palma

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References

Conci, C. (1941) Nuovi generi di Mallofagi (Nota preliminare). *Bolletino della Societá Entomologica Italiana*, 73, 126–127.

Dickinson, E.C. (2003) *The Howard and Moore Complete Checklist of the Birds of the World. 3rd edition*. Princeton University Press, Princeton, New Jersey, 1,039 pp.

Guimarães, L.R. (1974) Ischnocera (Mallophaga) infesting parrots (Psittaciformes). II. Genera *Psittoecus* Conci, 1942, and *Forficuloecus* Conci, 1941. *Papéis Avulsos de Zoologia*, 28, 163–180.

Guimarães, L.R. (1985) Ischnocera (Mallophaga) infesting parrots (Psittaciformes). V. Four new species of *Forficuloecus* Conci, 1941 (Philopteridae) from the South Pacific. *Papéis Avulsos de Zoologia*, 36, 41–49.

Johnson, K.P., Adams, R.J., & Clayton, D.H. (2001) Molecular systematics of Goniodidae (Insecta: Phthiraptera). *Journal of Parasitology*, 87, 862–869.

Palma, R.L. & Barker, S.C. (1996) Phthiraptera. Pp 81-247, 333-361 (App. I-IV), 373–396 (index) *in* Wells, A. (*Ed.*) *Zoological Catalogue of Australia*. Vol. 26. Psocoptera, Phthiraptera, and Thysanoptera. Melbourne: CSIRO Publishing, Australia.

Piaget, E. (1871) Description de quelques parasites du genre *Docophorus*. *Tijdschrift voor Entomologie*, 14, 113–137, 2 pl.

Price, R.D., Hellenthal, R.A., & Palma, R.L. (2003) World checklist of chewing lice with host associations and keys to families and genera. *In*: Price, R.D., Hellenthal, R.A., Palma, R.L., Johnson, K.P., and Clayton, D.H. *The Chewing Lice: World Checklist and Biological Overview*. Illinois Natural History Survey Special Publication 24, x + 501 pp.