

Morphological variation of *Neopsittaconirmus gracilis* (Phthiraptera, Ischnocera) from budgerigar, *Melopsittacus undulatus*

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Abstract: Chewing lice of the species *Neopsittaconirmus gracilis* Guimarães, 1974 (Ischnocera, Philopteridae) were found on captive budgerigars *Melopsittacus undulatus* (Shaw, 1805) (Psittaciformes, Psittacidae), in the Czech Republic and in Australia. This is the first record of lice of genus *Neopsittaconirmus* in the Czech Republic. The primary host species of *N. gracilis* is the yellow-collared lovebird *Agapornis personatus* Reichenow, 1887 (Psittaciformes, Psittacidae). The finding of *N. gracilis* on budgerigars is, most likely, a result of a contamination in captivity. Morphological variation and origin of these lice is discussed.

Key words: Parrots, *Agapornis*, budgerigar, *Melopsittacus undulatus*, Phthiraptera, chewing lice, *Neopsittaconirmus gracilis*.

Introduction

The genus *Neopsittaconirmus* Conci, 1942 is one of seven ischnoceran genera of chewing lice found on members of the avian order Psittaciformes. At present, this genus comprises 31 species (PRICE et al., 2003) all of them parasitic on 40 species of parrots from the Old World, included in 21 genera belonging to the subfamilies Calyptorhynchinae, Cacatuinae, Loriinae and Psittacinae, with one exception: *N. inexpectatus* Guimarães, 1974, which was described from the African pygmy falcon *Polihierax semitorquatus* (Smith, 1836) (see GUIMARÃES, 1974). The zoogeographical distribution of the host species is given in Table 1.

The budgerigar, *Melopsittacus undulatus* (Shaw, 1805), is an abundant wild parrot in Australia (world population estimated at around 5,000,000) and at the same time it is one of the most popular bird species kept in aviaries throughout the world. It is one of few species of parrots (another are for example cockatiel *Nymphicus hollandicus* (Kerr, 1792) or several species of lovebirds *Agapornis* Selby, 1836), which have self-reproducing captive populations that no longer need to be augmented with wild living birds (JUNIPER & PARR, 1998). Despite the fact that keepers as well as veterinary surgeon have some experience with lice from budgerigars (BECK, 1999; MULLEN & DURDEN, 2002; MEY, 2003a, b; keepers from Australia, pers. com.), first lice from this parrot determined MEY (2003a) as *Neopsittaconirmus gracilis gracilis* (Guimarães, 1974)

only one year ago. Still it is surprising that no species of chewing lice has been described from wild budgerigars yet.

The budgerigar belongs to the tribus Platycercini, which comprises 14 genera of Australo-Papuan parrots. It is closely related to parrots of genera *Pezoporus*, *Geopsittacus* and *Neophema*, but only one chewing louse is known from two of these parrots: *Forficuloeccus greeni* Guimarães, 1985 from blue-winged parrot *Neophema chrysostoma* (Kuhl, 1820) and scarlet-chested parrot *N. splendida* (Gould, 1841) (GUIMARÃES, 1985).

The aim of this paper is to report about chewing lice found on captive budgerigars in the Czech Republic and in the South Perth Zoo, Western Australia, present their morphological variation and update the original Guimarães's description of *N. gracilis*.

Material and methods

Seventy-one budgerigars from private breeders, pet shops and the Brno Zoo (Czech Republic) were searched for lice from 2001 to 2003. The material examined was divided into four groups:

Group 1: 2 males, 8 females, 2 nymphs, ex *M. undulatus*, Czech Republic, Brno (five birds from a private breeder and a pet shop, but not the same as for group 2), XI.2001 (O. Sychra).

Group 2: 8 males, 15 females, 95 nymphs, ex *M. undulatus*, Czech Republic, Brno (one bird from pet shop), 25.IX.2002 (O. Sychra).

Table 1. Zoogeographical distribution of lice of genus *Neopsittaconirmus* and their host species.¹

Psittaciformes	AF (5/24)	OR (10/43)	AR (42/125)	PA (10/26)	NT (30/148)	Total (84/353)	Number of <i>Neopsitt.</i> sp.
Calyptorhynchinae (2/6)	–	–	2/3	–	–	2/3	2
Cacatuinae (3/14)	–	1/1	2/5	1/1	–	3/6	5
Loriinae (12/53)	–	0	1/1	0	–	1/1	1
Psittacinae							
Nestorini (1/2)	–	–	1/2	–	–	1/2	1
Psittichadini (1/1)	–	–	1/1	–	–	1/1	1
Platyercini (14/37)	–	–	2/3	1/2	–	3/5	2 ²
Psittaculini (12/66)	1/1	3/8	4/6	1/1	–	8/15	13
Psittacini (3/12)	3/7	–	–	–	–	3/7	5
Arini? (30/148)	–	–	–	–	(1/1) ³	(1/1)	1?
Total	4/8	4/9	13/19	3/4	(1/1)	21(22)/40(41)	29(30)
Number of <i>Neopsitt.</i> spp.	6	10	11	3	1?		29(30)

Key: Numbers of genera/numbers of species of parrots are in the parentheses (according to ROWLEY, 1997 and COLLAR, 1997): AF – African region; OR – Oriental region; AU – Australian region; PA – Pacific region; NT – Neotropical region. ¹ The African pygmy falcon *Polihierax semitorquatus* (Falconiformes) is not included: ² *N. circumfasciatus* (Piaget, 1880) found on platycercines was originally described from a psittaculine; ³ According to GUIMARÃES (1974), the louse described as *Nirmus trimotus* (Piaget, 1890) and currently placed in *Neopsittaconirmus*, does not belong to this genus; also, its recorded host *Ara macao* (L., 1758) is most likely not the true host of this louse.

Other samples of chewing lice from budgerigars collected in the South Perth Zoo (Western Australia) in 1967 and 1968 were located in the collection of the Natural History Museum in London (NHML). It is **group 3**: 2 males, 3 females, ex two *Melopsittacus undulatus*, Western Australia, South Perth Zoo, IX.1967 and 7.IV.1968 (R.H. Stranger) 680407, BM 1968-293 (NHML).

Another samples of lice were collected from captive budgerigar in Germany. It is **group 4**: 1 male and 1 female, ex one *Melopsittacus undulatus*, Saxonie, East Germany, 12.X.2001 (R. Schmäsckhe).

Additional material examined was one male and two females of *Neopsittaconirmus gracilis* Guimarães, 1974 held in the NHML, from a wild live lovebird collected in Dodoma, Tanganyika, Africa. The holotypes, allotypes and paratypes of *N. gracilis gracilis* (NHML slides no. 20594) and *N. gracilis inexpectatus* Guimarães, 1974* (NHML slides no. 18547) were also examined.

None of the examined budgerigars had been kept together with *A. personatus*. For example, the South Perth Zoo had only rosy-faced lovebirds, *A. roseicollis* (Vieillot, 1818), in 1968, but specimens of *A. personatus* were not kept until 1970 (fide R.P. Hobbs – South Perth Zoo Annual Reports). Also, Czech private breeders (group 1) have kept only budgerigars in captivity. The birds of group 2 were kept close to a small flock of lovebirds (*A. roseicollis*, *A. personatus* and Fischer's lovebird *A. fischeri* Reichenow, 1887) for a few weeks, but not inside the same cage. None of these lovebirds had any chewing lice.

Results

All the lice collected from budgerigars belong to the species *Neopsittaconirmus gracilis* Guimarães, 1974,

* PRICE et al. (2003) regarded these two subspecies as separate species: *Neopsittaconirmus gracilis* and *N. inexpectatus*.

originally described from the yellow-collared lovebird, *Agapornis personatus* Reichenow, 1887, its type host.

Order Phthiraptera
Suborder Ischnocera
Family Philopteridae
Genus *Neopsittaconirmus* Conci, 1942

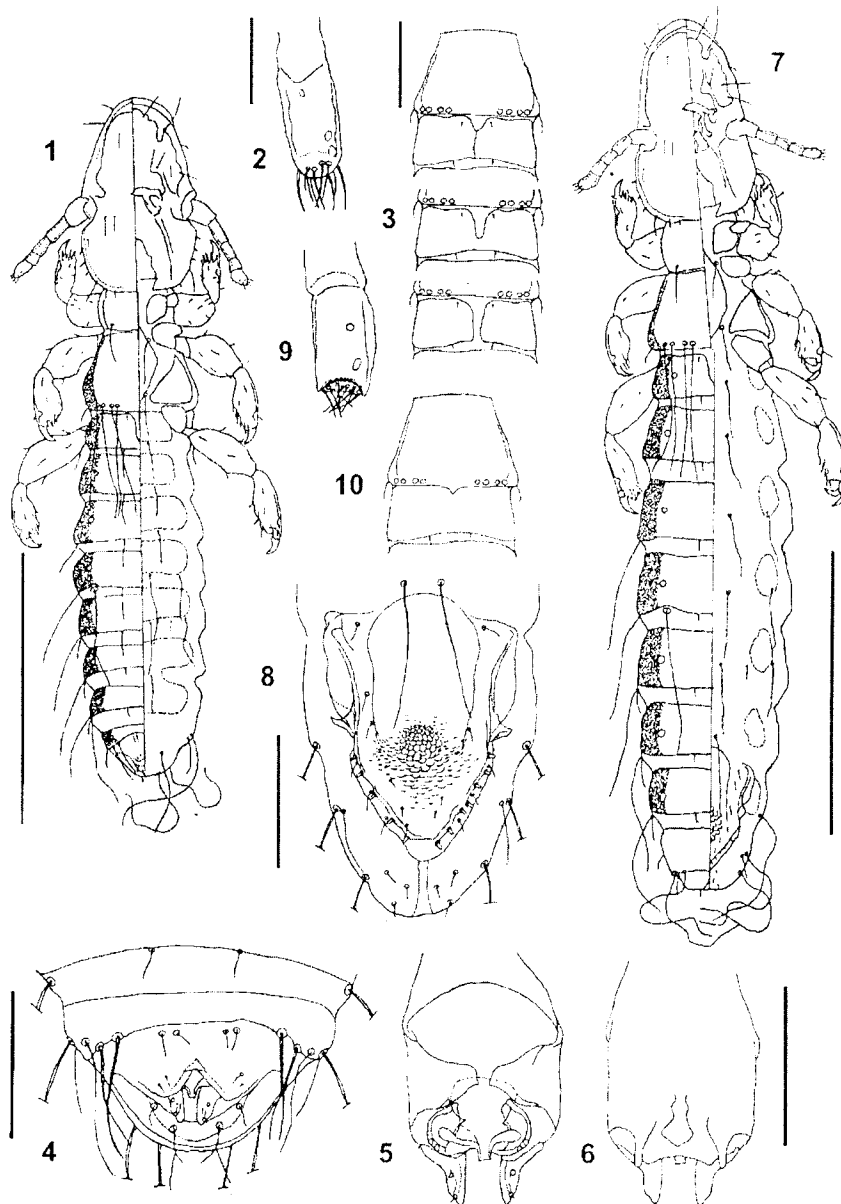
Neopsittaconirmus gracilis Guimarães, 1974 (Figs 1A–J)

Neopsittaconirmus gracilis gracilis Guimarães, 1974a: 168, Figs 84, 86, 88–90, 94, 96–97. Type host: *Agapornis personatus* Reichenow, 1887. Holotype male on slide 20594a (NHML).

Neopsittaconirmus gracilis Guimarães, 1974; Price et al., 2003: 200

Description. Male (Fig. 1). Antenna filiform, tip of terminal segment rounded (Fig. 2). Pteronotum with 4 very long setae grouped two by two on each side of the posterior margin. The first abdominal tergal plate is almost completely split along the midline (in some specimens it is only slightly split, and in four louse is entirely divided into two parts, as in Fig. 3). Only tergite V (fourth visible tergite) with a long tergo-lateral seta on either side. Posterior margin of subgenital plate is deeply split (in dorsal view, Fig. 4).

Male genitalia as in Figs 5, 6. Basal apodeme short, a little longer than wide, with a tooth-like backward projection on each of the latero-posterior corners; parameres short and stout, each with a very short subapical seta and a conspicuous circular spot on the lateral margin. Lateral margin of mesosomal complex rounded, with another two circular spots.



Figs 1-10. *Neopsittaconirmus gracilis* from budgerigars: 1 - male; 2 - terminal segment of antenna; 3 - variability of first abdominal tergal plate; 4 - male dorsal terminalia; 5-6 male genitalia, ventral view (5), dorsal view (6); 7 - female; 8 - female ventral terminalia; 9 - terminal segment of antenna of *N. gracilis* from group 3; 10 - first abdominal tergal plate of *N. gracilis* from group 3. (Figs 1, 5, 6 and 7 are taken according to the specimens of lice from NHML - R.H. Stranger 680407, BM 1968-293). Scales 0.05 mm (Figs 2, 9), 0.10 mm (Figs 4-6, 8), 0.15 mm (Figs 3, 10), 0.50 mm (Figs 1, 7).

Female (Fig. 7). Mostly as for male. Subgenital plate (vulva) distally angular (Fig. 8), with about 10 spine-like setae interspersed with short thinner setae on the lateral margin, and with a conspicuous median reticulated structure in the genital chamber.

Measurements of *N. gracilis* from budgerigar as in Table 2.

Remarks. The above description, although almost identical to that of GUIMARÃES (1974) for the subspecies *N. g. gracilis*, shows some slight differences in the following characters: 1 - the group of four long se-

tae on either side of the posterior margin of pterothorax grouped two by two, while in Guimarães's *N. g. gracilis* these setae are equidistant; 2 - the male of Guimarães's *N. g. gracilis* has no circular spots on the parameres and the mesosoma; 3 - the posterior margin of the male subgenital plate is deeply split (in dorsal view). These three characters are similar to those in the species *N. g. inexpectatus*. Although characters 2 and 3 are different from the original description of *N. g. gracilis*, both these characters are present in the holotype male of this subspecies. 4 - Almost all measurements of the speci-

Table 2. Mean measurements of males and females of *N. gracilis* from budgerigars and lovebirds.

	Male				Female			
	Australia <i>n</i> = 2	Czech R. <i>n</i> = 10	Germany <i>n</i> = 1	Africa ¹ <i>n</i> = 1	Australia <i>n</i> = 3	Czech R. <i>n</i> = 23	Germany <i>n</i> = 1	Africa ¹ <i>n</i> = 2
Total length	1.22	1.20	1.33	1.40	1.53	1.54	1.72	1.66
Head	0.34/0.21	0.33/0.21	0.37/0.23	0.38/0.24	0.37/0.22	0.35/0.23	0.40/0.25	0.40/0.25
Prothorax	0.07/0.15	0.08/0.15	0.09/0.17	0.10/0.18	0.08/0.15	0.09/0.16	0.10/0.17	0.09/0.18
Mesoetathorax	0.15/0.22	0.15/0.22	0.17/0.24	0.16/0.26	0.16/0.25	0.16/0.24	0.18/0.27	0.17/0.27
Abdomen	0.65/0.25	0.64/0.23	0.72/0.27	0.76/0.30	0.93/0.29	0.93/0.28	1.05/0.31	1.00/0.30
Head ratio ²	1.04	1.07	1.17	1.08	1.12	1.18	1.22	1.22

Key: Measurements are in mm; length/width: ¹ *N. gracilis* from lovebirds *Agapornis personatus*; ² preantennal/postantennal ratio.

mens examined are smaller than those of the types of *N. g. gracilis* (except lice of group 4). This means that the budgerigar lice are the smallest among all *Neopsittaconirmus* species. The four characters listed above are valid for lice of all four groups (see material examined). However, lice of group 1 are different from the other two groups, as well as from the types of *N. g. gracilis*, by other two characters: 5 – tip of terminal segment of antennae of all specimens is truncated (Fig. 9). However, this character appears to be variable, because some specimens of groups 1, 2 and also one female paratype of *N. g. gracilis* have it rounded, while one male from group 2, as well as the holotype male of *N. g. gracilis*, have the tip of one antenna rounded and the other truncated. 6 – The first (visible) abdominal tergal plate is not split along the midline, but there is a conspicuous triangle on the midline of the posterior margin of the prothorax (Fig. 10).

Discussion

The finding of chewing lice of the genus *Neopsittaconirmus* on budgerigars is fairly interesting, although the birds examined were not wild. This is the first record of chewing lice from this parrot species in the Czech Republic.

In 1998, BECK (1999, 2000) found six lice on one male budgerigar from Munich, Germany, but he was unable to identify them, because they were lost after he mailed them to a specialist. BECK published some photos of these lice and, although they are not of very good quality, I believe they may belong to the genus *Neopsittaconirmus*. However, determination of these lice to the species level is not possible. Probably first determination of lice from budgerigar, also from birds captive in Germany, made MEY (2003a) only one year ago. He found lice on three infected birds from three different places in the central Germany. He determined these lice also as *Neopsittaconirmus gracilis gracilis*.

The first budgerigars arrived in Europe in 1840, and in the Czech Republic they were kept in captivity since 1880 (VAŠÍČEK, 1978). Some ectoparasites, especially chewing lice and feather mites, may have arrived here together with their hosts. The conditions required for keeping exotic birds do not need to be optimal for

the lice to survive. However, I believe that viable populations of chewing lice can survive and breed more easily on birds that are kept in larger flocks. These flocks often consist of several species of parrots. Lice can transfer from one host species to another relatively easily in such mixed communities (PRICE et al., 2003). Most chewing lice are quite host specific, but many species can occur on more than one species, genus or family of hosts. If accidental stragglers can survive, reproduce and spread over the population of new host species, their long-term survival may be assured. The finding of *N. gracilis* on budgerigars, which appear not to have been in direct contact with other parrot species, in particular lovebirds, may be a good example of such scenario.

Lovebirds of the species *Agapornis personatus* are likely to be the primary hosts of *N. gracilis*. Species of the genus *Agapornis* occur in the African Region and belong to the tribe Psittaculini, comprising 12 genera of parrots. The majority of these parrots also occur in the Oriental Region and some genera are, in fact, sister groups to the platycercines. However, the genus *Agapornis* shows no links to the Australo-Papuan parrots (COLLAR, 1997).

Species of the genus *Neopsittaconirmus* occur mostly on parrots of the tribe Psittaculini (23% of species infested) as well as African Psittacini (58% of species infested; see Tab. 1). Moreover, the presence of long tergo-lateral setae on the fifth abdominal segment only is characteristic of African *Neopsittaconirmus*. There is a group of several species of *Neopsittaconirmus* [*N. albidus* (Piaget, 1880), *N. piageti* (Eichler, 1943), *N. abnormis* Guimarães, 1974, *N. strepsiceros* (Nitzsch, 1866) and *N. africanus* Guimarães, 1974], which were described from Afrotropical parrots of the tribe Psittacini (genera *Psittacus* and *Poicephalus*, also including *Coracopsis* from the Malagasy subregion).

The lack of close relationship between *Agapornis* and *Melopsittacus*, and the similarity of the lice found on budgerigars to the African species of *Neopsittaconirmus*, especially *N. gracilis* from wild lovebird suggest that budgerigars are secondary hosts to *N. gracilis*.

Parrots of the genus *Agapornis*, as well as budgerigars, are very popular cage birds. The first two species to arrive in Europe in 1860 were the grey-headed lovebird, *A. canus* (Gmelin, 1788), and the rosy-faced love-

bird, *A. roseicollis*. Yellow-collared lovebirds, *A. personatus*, only arrived after 1925. In the Czech Republic, *A. canus* were already kept in 1879, but other species became numerous since 1936. In Australia, *A. personatus* was first reported in the 1928 (VAŠÍČEK, 1981). Therefore, both budgerigars and lovebirds have been kept in captivity for a relatively long time. There are even some reports about hybrids between budgerigars and *A. canus* (FORSHAW & COOPER, 1989). Thus, the exchange of chewing lice between these birds must have been quite likely. The logical conclusion is that the lice from budgerigars reported here originated as stragglers from lovebirds, which then transferred onto, reproduced and spread over the population of captive budgerigars. The finding of nymphs shows that it has, without any doubt, successfully bred on budgerigars, despite the fact that contact with other louse populations is very limited.

The infestation reported here shows that *N. gracilis* is well adapted to switch hosts, to survive and to reproduce on new host species. That host switch probably took place independently on several sites around the world. The lice from captive birds must have originated from limited host populations, which were randomly selected from natural populations, and then bred and transported by cage-bird breeders. This scenario is comparable to the phenomenon commonly known in evolutionary biology as "founder effect". However, *N. gracilis* has been living on budgerigars for a relatively very short time, certainly from 1967 in Australia, probably from as early as 1925 in the Czech Republic and Germany, when the first *A. personatus* arrived. From the evidence available, the most likely primary host species of *N. gracilis* is *A. personatus*, so far the only species of *Agapornis* known to harbour a species of *Neopsittaconirmus*. However, considering that there are only a few specimens of *N. gracilis* from this parrot, we do not know its range of morphological variability (there are only three type specimens deposited in the NHML). The differences between the type specimens of *N. gracilis* and the lice found on budgerigars (see above) may well lie within the range of variability of this louse species. Smaller measurements of lice from budgerigars could be caused by "founder effect" or different body proportions of budgerigar, which is more slender than lovebirds (COLLAR, 1997). This pattern is known as Harrison's Rule (PRICE et al., 2003). GUIMARÃES (1980) found the same pattern of body proportions at lice of species *Echinophlopterus chapini* Ewing, 1927. He found, that lice occupying parrots of the genus *Tanygnathus* were bigger, than lice off parrots of the genus *Psittacula* (parrots of this genus are more slender than parrots of the first one). KRÍŠTOFÍK (unpubl.) also found that lice occupying bee-eaters *Merops apiaster* L., 1758 in very good condition are bigger than lice on birds in poor condition. Furthermore, it is not possible to absolutely eliminate the possibility that there could be another, yet unknown, primary host for *N. gracilis*, e.g. *A. ro-*

seicollis, the lovebird kept in captivity for the longest time, as well as the most numerous. This is relevant to the fact that none of the budgerigars examined and found with lice had been kept directly in contact with *A. personatus*. In any case, the only way to clarify this very interesting case of louse host-switching will be to collect and study the chewing lice occurring on wild budgerigars and on other species of *Agapornis* both from the wild and in captivity.

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