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A redescription of Neophilopterus tricolor (Burmeister,) (Insecta: Phthiraptera: Ischnocera: Philopteridae) from the black stork Ciconia nigra (L.) (Aves) with notes on its prevalence

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A redescription of *Neophilopterus tricolor* (Burmeister, 1838) (Insecta: Phthiraptera: Ischnocera: Philopteridae) from the black stork *Ciconia nigra* (L.) (Aves) with notes on its prevalence

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Abstract

A redescription of *Neophilopterus tricolor* (Insecta: Phthiraptera: Ischnocera: Philopteridae) is presented and its prevalence on black stork nestlings from Comunidad de Madrid (central Spain) is reported for 4 consecutive years. The presence of four long and two short temporal marginal setae, the second row of abdominal tergal setae located across the midline of the segment, and details of the male genitalia are the key differences between *N. tricolor* and *N. incompletus* (Denny, 1842). Lice were found only on birds sampled in the last 2 years of this study, infesting 11 nestlings from 19 nests. The overall prevalence for the 4 years is 22% (11 lousy hosts out of 50 nestlings examined). As far as we know, these are the first records and data on prevalence of *Neophilopterus tricolor* in the Spanish population of *Ciconia nigra* (L.).

Keywords: *Black stork nestlings, Ciconia nigra, Neophilopterus tricolor, parasites, Phthiraptera, Philopteridae, prevalence*

Introduction

Despite the wide geographical distribution of the black stork, its Phthiraptera parasites have been poorly studied. Burmeister (1838, p 424) described *Docophorus tricolor* as follows: "*capite, protorace pedibusque fuscis; signaturis trunci nigris, completis*". Denny (1842, p 105), Giebel (1874, p 96), and Piaget (1880, p 94) all cited and redescribed *Docophorus tricolor* as a parasite of black storks. Cummings (1916, p 660) included the forms characterized by the fusion of the double signature into one plate, which Piaget (1880) grouped under the heading "*setosi*", in his new genus *Neophilopterus*, with *N. tricolor* assigned as the type species, as well as four other species from parasites of Ciconiformes. Séguy (1944) published a short and concise description of *N. tricolor*, clearly inadequate for the determination of the species. In fact, it is possible that Séguy did not examine any material

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belonging to this species as no French locality for the species was given. Tendeiro (1955), describing *N. incompletus* (Denny, 1842), noted that the abdominal quetotaxia was different to that of *N. tricolor* but he did not offer more information for this latter species. Hopkins and Clay (1952) and Ledger (1980) cited *N. tricolor* in their "List of Mallophaga" but without any description. Zlotorzycka (1980) included this species in the "Keys for the identification of Polish insects", and mentioned the morphological characters that distinguished it from *N. incompletus*, namely the presence of five marginal temporal setae of approximately the same length for *N. incompletus*, and the last of the five setae several times shorter than the rest for *N. tricolor*.

Data about the morphology of *Neophilopterus tricolor* are scarce for the recognition of the species. For example, Zlotorzycka (1983) studied four males and 14 females collected from Wroclaw Zoo and two males from Lodz Zoo, both on *Ciconia nigra* but without morphological data about it. Because early descriptions are clearly inadequate, in this paper we present a redescription of *N. tricolor*, including biometrical data and illustrations of specimens collected in Spain. This is the first record of this louse species for Spain.

Material and methods

As a part of a study on black storks (*Ciconia nigra*) in Comunidad Autónoma de Madrid (Central Spain, 39°52′–41°8′N, 3°6′–4°31′W) we searched for ectoparasites on nestlings sampled between May and July from 2000 to 2003. All nestlings were examined at their nests between 10:00 and 13:00 h by the same veterinarian (M.P.L.). Each bird was handled for approximately 10 min for physical examination, blood sample collection and search for ectoparasites. Sampling of external parasites was done by visual examination of the feathers. Ages of all birds were determined using the hatching date, known with an accuracy of ±3 days. Nestlings examined ranged in age from 25 to 53 days old. All birds included in this study were clinically healthy on physical examination.

The chewing lice were stored in tubes containing 70% alcohol until they were mounted as permanent slides. This process included the following steps: (1) clearance by immersion in a 30% potassium hydroxide hot solution; (2) neutralization by acetic acid; (3) dehydration by passing the material thorough 40%, 70%, and 90% ethanol; mounting in Hoyer's liquid; and (5) drying the slides at 50–55°C for several weeks.

A morphometric study of several parameters in each species was carried out by means of a Wild MMS-235 digital micrometer.

All specimens are deposited in the Collection of the Museo Nacional de Ciencias Naturales, Madrid, Spain. We used the term prevalence following the terminology proposed by Bush et al. (1997). Setae nomenclature was taken from Clay (1951).

Results

A total of 50 nestlings from 19 nests were sampled for ectoparasites. Although the study was conducted in 4 consecutive years, only in the last two (2002 and 2003) did we find nestlings infested. In 2002, 13 nestlings from five nests were found without lice, and three siblings from another nest were infested. In addition, in another nest only one of three nestlings was infested. Therefore, four out of 19 nestlings (21.05%) were infested by lice in 2002. In 2003 only one nest, with four nestlings, was free of lice, while all the nestlings of the other three nests were infested. Therefore, eight out of 12 nestlings (66.67%) were infested in 2003. The overall prevalence of *Neophilopterus tricolor* was 22% (11 out of 50 nestlings from 19 nests examined). A total of 26 lice, including three males, eight females and 15 nymphs, were collected. Lice were the only ectoparasites detected.

Neophilopterus tricolor (Burmeister, 1838)
(Figures 1–3)

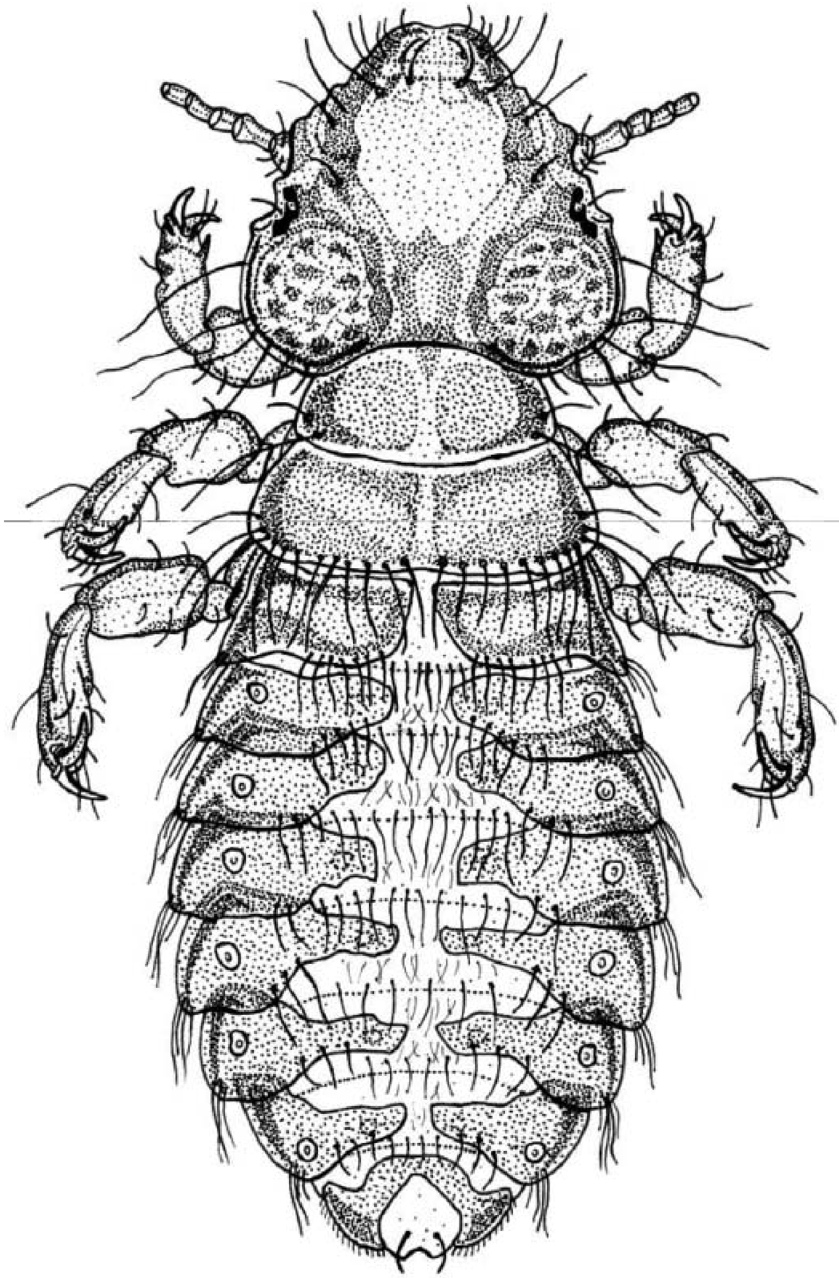

Figure 1. Female dorsal view of *Neophilopterus tricolor*.

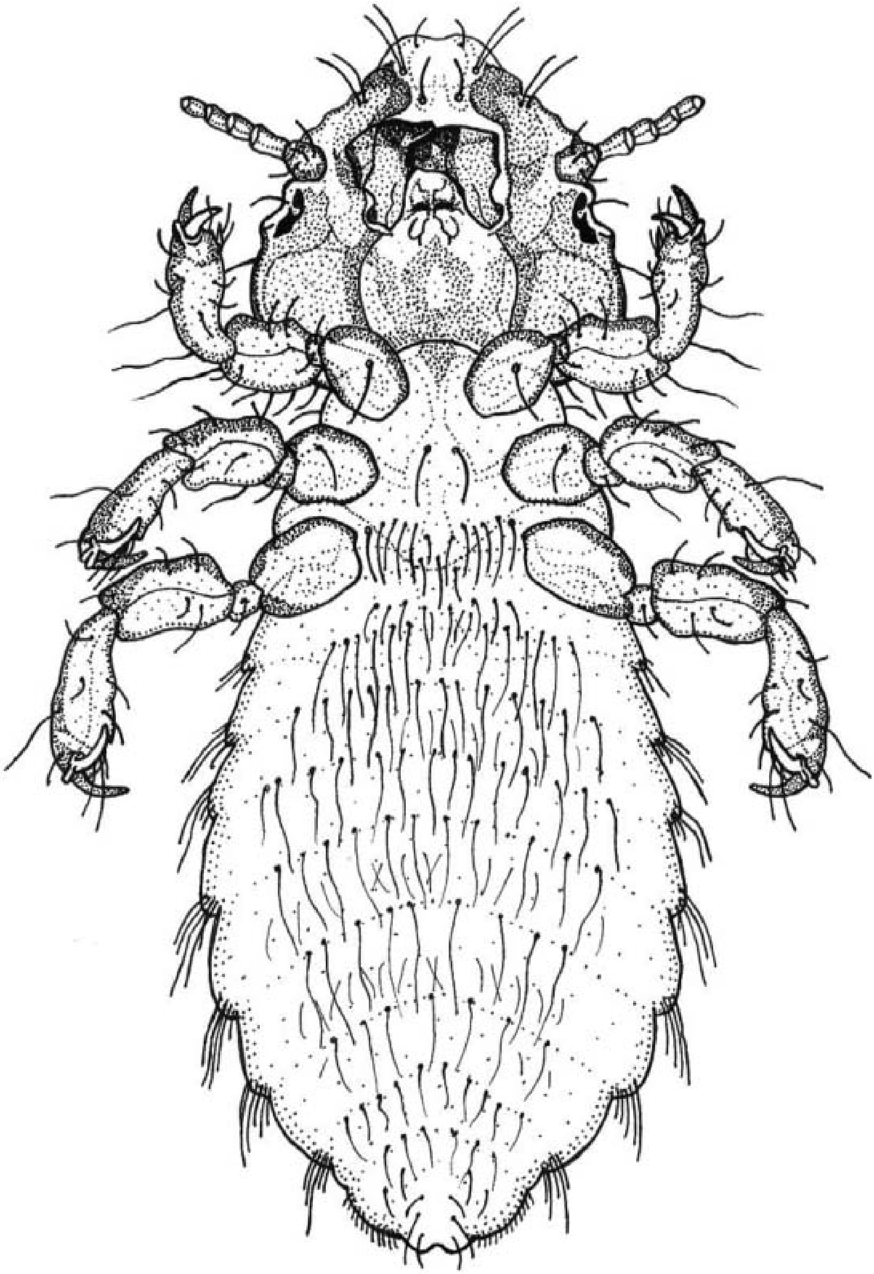

Figure 2. Female ventral view of *Neophilopterus tricolor*.

Docophorus tricolor Burmeister 1838, p 424.
Philopterus tricolor (Burmeister): Harrison 1916, p 106.
Neophilopterus tricolor (Burmeister): Cummings 1916, p 660.

Type host. Ciconia nigra (Linnaeus).

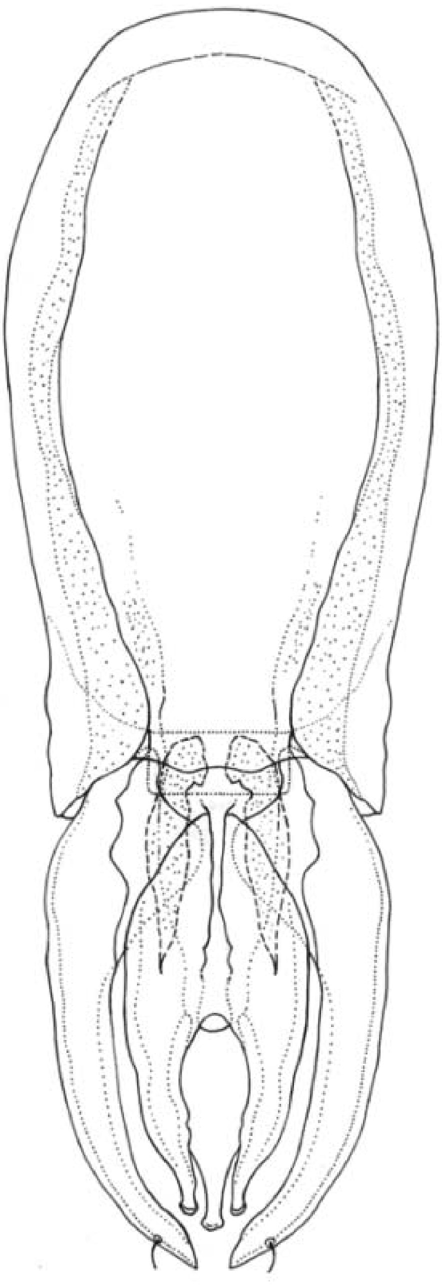

Figure 3. Copulatory apparatus of male *Neophilopterus tricolor*.

Redescription

Head large, wider than long (Table I), with maximum width at the level of the temples; preantennal region shorter than the postantennal region. Frontal zone showing a straight hyaline margin whilst the cephalic anterior edge is lightly concave as an ''osculum'' (median indentation of the anterior margin of the head: Symmons 1952; Lyal 1985).

Table I. Measurements (in mm) of *Neophilopterus tricolor*.

	Males (n=3)			Females (n=8)		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
CL	0.58	0.70	0.65	0.70	0.78	0.75
CW	0.74	0.85	0.79	0.78	0.92	0.88
CI	1.16	1.25	1.21	1.12	1.23	1.17
TL	0.41	0.44	0.43	0.48	0.55	0.52
TW	0.55	0.67	0.60	0.70	0.85	0.80
AL	1.07	1.52	1.34	1.55	2.11	1.95
AW	0.78	1.07	0.92	0.93	1.33	1.27
ToL	2.07	2.66	2.42	2.74	3.41	3.23

CL, cephalic length; CW, cephalic width; CI, cephalic index (CW/CL); TL, thoracic length; TW, thoracic width; AL, abdominal length; AW, abdominal width; ToL, total length.

Scarcely defined clipeal plate; anterior region to dorsal preantennal sutura not medially divided, with two acute angles presents posteriorly, suggesting the fusion of an originally double plate (Cummings 1916, p 660). Marginal ventral carinae curved, extending from the mandibular framework to support the pulvinus (Symmons 1952). Large and very sclerotized mandibles. Antennae filiform in both sexes with five antennomeres: scape, pedicel, and three terminal flagellomeres; the scape slightly broader than the remaining ones with two mediate setae; the two terminal flagellomeres showing clearly the sensilar complex (Soler Cruz and Martín Mateo 1996, 1998; Smith 2001). Temples show a characteristic sculpture of small, more or less circular sclerotizations. Temporal carinas narrow and occiput straight.

Cephalic chaetotaxy: in addition to the five pairs of setae always present throughout the Philopteridae (Clay 1951), there is a single submarginal setae lying to each side of the midline (dorsal submarginal setae) on the dorsal surface of the preantenal region. The temporal margins have four long and two short setae, some arising dorsally and some ventrally (all called marginal temporal setae); one small postemporal setae near the midline on each side above the occipital margin. On the ventral surface there are four marginal anterior setae on the marginal carina and two ventral submarginal setae just lateral to the ventral anterior plate; lateral and posterior to the ventral submarginal setae there are two ventral setae on each side (anterior ventral setae).

Thorax wider than long (Table I). Prothorax with posterolateral corners rounded; 2+2 minute setae near the anterior edge; 2+2 longer setae on the posterolateral corners. Pterothorax laterally divergent; posterior margin indented in the midline with 12+12 long setae; ventrally there are 2+2 minute anterior setae and 5+5 medium setae on the central zone.

Abdomen oval in both sexes; the visible segment I is interpreted as the II, although it is probably I and II fused following interpretation by Wilson (1936) and Smith (2001); also segment IX is the result of IX, X, and XI fused together (Smith 2001). Segments II–VIII bear the spiracles. Tergopleurites well chitinized; tergites II–VII subtriangular, long and blunt, without reaching the midline, separate by a median gap; pleurites III–VII more sclerotized, each one reaching beyond the anterior segment.

Abdominal chaetotaxy: two rows of tergal setae on each segment, one distal with 10–15 setae arising regularly across the posterior margin of each segment, and another with 8–10 setae on the central surface of each segment. The number of setae in both rows is lower in the terminal segments. There is sexual dimorphism in the terminal segments and in their chaetotaxy. In the male tergites VIII–IX are narrow and continuous across the segment covering almost the entire tergum; tergite VIII with 2+2 lateral setae and 2 central setae; tergite IX with a continuous row of long setae on in the anterior margin; abdominal end rounded with 4+4 very long marginal setae and 1+1 anterior setae; the genital plate is a narrow central plate curved and enlarged (Figure 4). In the female only tergite IX is continuous but narrow in the middle with lateral groups or clusters of medium long setae (7–8); posterior margin with a fairly deep median notch and many marginal setae (17 on each side); 2+2 central and variably long setae.

The male genitalia (Figure 3; Table II) comprise a flattened basal plate or apodema longer than the parameres, with the posterior margin convex and undulated; each lateral margin has a broad band; between these lateral bands the median area of the apodema is trough-shaped; just behind the mesosoma there is a small median plate, with a branch on

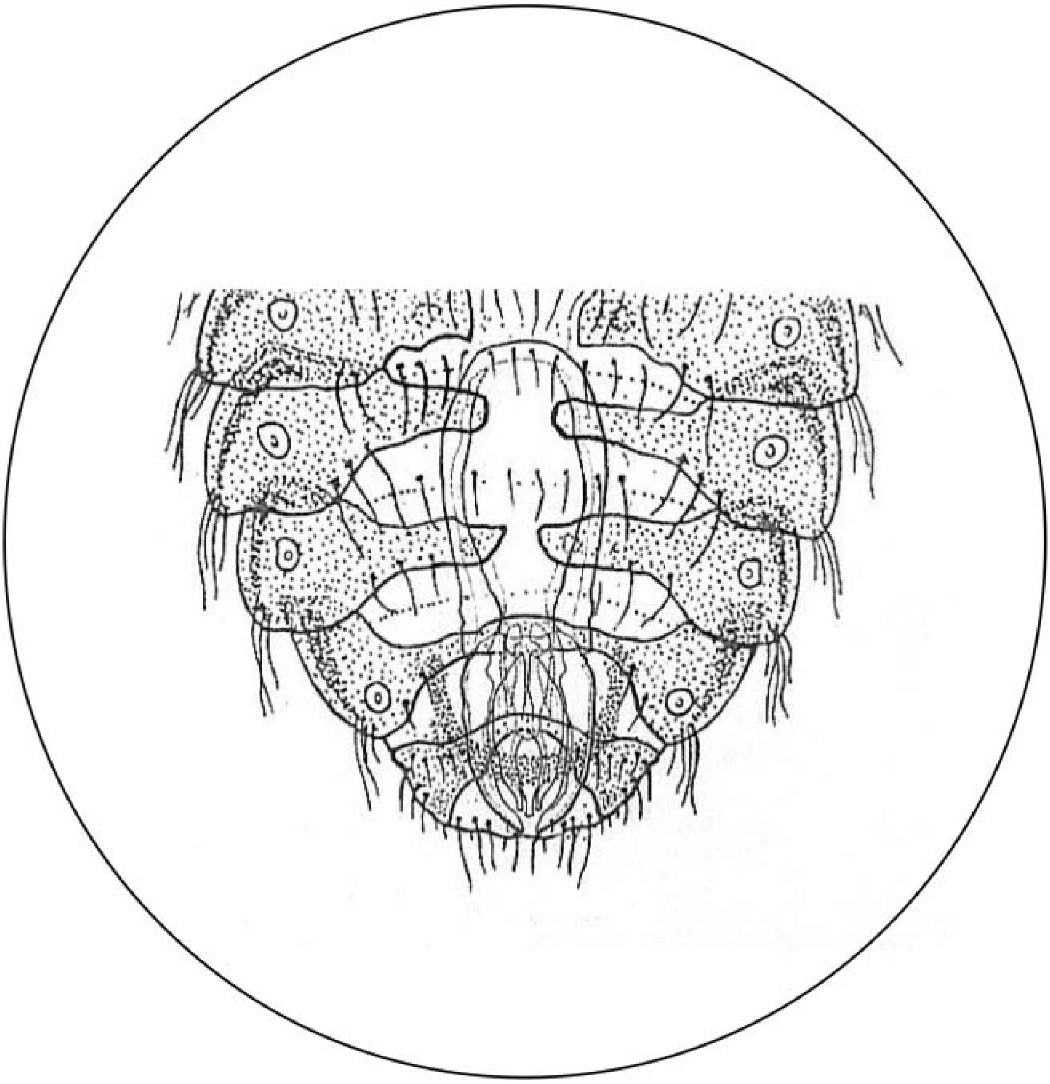

Figure 4. Terminal segments of the male *Neophilopterus tricolor*.

Table II. Measurements (in mm) of the male genitalia of *Neophilopterus tricolor*.

	Minimum	Maximum	Mean
BpL	0.35	0.42	0.38
BpW	0.18	0.26	0.22
PaL	0.24	0.32	0.28
PaW	0.17	0.20	0.18

BpL, basal plate length; BpW, basal plate width; PaL, paramere length; PaW, width of parameral area (parameres, endomeres, and penis).

each side, reaching the lateral regions of the apodema. Parameres are broad, evenly rounded rods, tapering towards the distal end curving slightly inwards; in the base of the mesosoma there is a small process or plate as an upper endomeral chitinization, the "lower endomere" in Cummings (1916); at the end of endomeres is the penis, apparently telomeral, more or less membranous, held by the basal endomeral portion shaped like a pair of pincers.

Discussion

N. tricolor is close to *Neophilopterus incompletus* (Denny, 1842), parasite of *Ciconia ciconia* (L). Cummings (1916) described the new genus *Neophilopterus* with *N. tricolor* as type genus, stating the differences between this species and *N. incompletus*. Differences in the genitalia can be found in features of the mesosoma, and in the presence of a small process or plate at the base of the mesosoma, as an upper endomeral chitinization. Moreover, there are other differences between both species: while the lyriform organ and basal pieces of the mouthparts of *N. incompletus* are normal, in *N. tricolor* the same parts are greatly modified. Also, the presence of six temporal marginal setae (four long and two short), and not five setae as previously reported by Zlotorzycka (1980), distinguishes these two species. Another difference is the second row of abdominal tergal setae located across the midline of the segment in *N. tricolor* (Table III).

The fact that in most of the cases infestation by lice was found in all siblings from the same nest is probably due to the transmission mode of these parasites. Because of the strict dependence of the environment provided by the host plumage for survival, chewing lice are, with some exceptions, transmitted vertically between parents and offspring in the nest, with a varying degree of horizontal transmission between nestlings and between adult birds as well (Miller et al. 1997; Darolova et al. 2001). There are many opportunities for louse transmission between parents and offspring among black storks, as both parents invest in offspring care and nestling period is rather long (63–71 days; Cramp and Simmons 1977).

Table III. Morphological differences between *Neophilopterus tricolor* and *N. incompletus* (after Martín-Mateo 1988).

N. tricolor	N. incompletus
Six temporal marginal setae: four long and two short	Five temporal marginal setae, all long and of similar length
Two rows of abdominal tergal setae: one apical and one across the midline of the segment	Two rows of abdominal tergal setae: one apical and one basal
Abdominal tergal plates strongly sclerotized	Abdominal tergal plates slightly sclerotized
Mesosoma with a small process or plate as an upper endomeral chitinization ("lower endomere")	Mesosoma without such a process

Species of the Ischnocera live and feed on epidermal scales, skin secretions, and feathers (Martín Mateo 1999). They may affect host thermoregulation and feather breakage (Barbosa et al. 2002) and reduce host fitness (Clayton et al. 1992) through the energetic consequences of feather damage (Clayton and Tompkins 1995; Miller et al. 1997). In addition, some indirect effects like stress to hosts (Martín Mateo 1999) must be considered. The study of variation in prevalence during consecutive years allows the evaluation of the existence of problems associated with parasitosis and its consequences in a monitored population (Spalding et al. 1993; Coyner et al. 2002). Our results shows that black stork is a species with a relatively low prevalence (22%) of *Neophilopterus tricolor* and low diversity of external parasites in the studied area. The causes of the apparent increase in prevalence of these parasites during the course of this study are unknown and deserve future investigation.

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