A new *Craspedorrhynchus* species (Phthiraptera, Ischnocera) from Australia, with an annotated checklist of this chewing louse genus[1]

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With 31 figures and 1 table

Abstract

Craspedorrhynchus reichelti sp. n. ex *Aquila a. audax* (Latham) from Victoria (Australia) is described. In this context, research history and present status of taxonomic knowledge of the genus *Craspedorrhynchus* Kéler (Philopteridae sensu lato) are outlined and morphological characters are suggested to enable a further subdivision of the same to species groups in advance of a revision of the genus. All species are presented in a numbered annotated checklist, with type locality, hosts, previous descriptions (including synonyms), and other relevant taxonomic comments, giving the following picture: 37 species have been ± recognizably described (a fraction of the actuall expected number). They exclusively infest members of the Falconiformes, almost always one *Craspedorrhynchus* species to one host. Subspecies are not distinguished, although slight morphological differences between those on hosts of differing origins seem to offer some justification for doing so. The type host of *C. insolitus* Kéler is not *Aquila wahlbergi* but possibly an African *Accipiter* species. Type material no longer exists for 10 other species described in the 19th century. It is recommended that "*Docophorus cicatricosus* Percheron, 1835" ex "Aigle", should in future be suppressed as a *nomen oblitum*.

Key words: Phthiraptera, Ischnocera, Philopteridae *sensu lato*, Australia, *Craspedorrhynchus reichelti* sp. n., annotated checklist of *Craspedorrhynchus* species.

Zusammenfassung

Eine neue *Craspedorrhynchus*-Art (Insecta, Phthiraptera, Ischnocera) aus Australien mit einer annotierten Check-Liste von dieser Federlingsgattung.

Craspedorrhynchus reichelti sp. n. ex *Aquila a. audax* (Latham) von Victoria (Australien) wird beschrieben. In diesem Zusammenhang werden Erforschungsgeschichte und taxonomischer Kenntnisstand der Gattung *Craspedorrhynchus* Kéler (Philopteridae sensu lato) umrissen und morphologische Merkmale zu einer weiteren Gliederung derselben in Artengruppen vor einer Gattungsrevision in Vorschlag gebracht. Die in einer numerierten Checkliste zusammengestellten und mit Typuslokalität, Typenstandort(e), bisherigen Beschreibungen (incl. Synonyma) und sonstigen taxonomisch relevanten Bemerkungen annotierten Arten ergeben folgendes Bild: Bisher sind 37 Spezies ± gut wiedererkennbar beschrieben worden (ein Bruchteil der tatsächlich zu erwartenden). Sie parasitieren zumeist monohospital ausschließlich Falconiformes. Unterarten werden nicht unterschieden, obgleich geringe morphologische Unterschiede zwischen manchen Wirtsherkünften dies als gerechtfertigt erscheinen ließen. Von *C. insolitus* Kéler ist der Kennwirt nicht *Aquila wahlbergi*, sondern möglicherweise eine afrikanische *Accipiter*-Art. Von 10 anderen, im 19. Jh. beschriebenen Arten existiert definitiv kein Typenmaterial mehr. Es wird vorgeschlagen, „*Docophorus cicatricosus* Percheron, 1835" ex „Aigle" künftig als nomen oblitum zu unterdrücken.

Introduction

The ischnoceran genus *Craspedorrhynchus* Kéler, 1938 (Philopteridae *sensu lato*) parasitizes exclusively raptors (Falconiformes) worldwide, principally Accipitridae and, as far as is known, rarely Falconidae. *Craspedorrhynchus* species have yet to be found on Pandionidae, Cathartidae, and Sagittariidae. The diversity of this apparently morphologically uniform ischnoceran group is very poorly studied. Identified *Craspedorrhynchus* species have been found on fewer than 10% of all the Accipitridae (the family comprises 237 species). The state of research is even more unsatisfactory for the Falconidae (with 61 species), although several finds have been made in recent years in southern Europe (Mocci Demartis & Restivo de Miranda 1978, Gállego et al. 1987, Pérez & Martin-Mateo 1995).

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Eichler (1944) was the first to provide a survey of all the then known *Craspedorrhynchus* species (26 in total). Hopkins & Clay (1952) listed 27 valid forms, and since then a further 10 *Craspedorrhynchus* species have been described. However, a revision which would create the necessary taxonomic foundation for future descriptions in this group has yet to be carried out. Partial revisions only have been undertaken, mostly restricted to particular political-geographical areas of origin ("New World": Carriker 1956; North America and north of Mexico: Emerson 1960; Spain: Gállego et al. 1987; Finland: Merisuo 1945; Poland: Złotorzycka 1977).

Eichler & Złotorzycka (1975) give a short diagnosis of the genus, in which they defined their group as "*Craspedorrhynchus* species of the Aquilini", in which they included *C. aquilinus* (ex *Aquila chrysaetos*), *C. fraterculus* (ex *A. heliaca*), *C. insolitus* (ex *A. wahlbergi*), *C. naevius* (ex *A. pomarina*), *C. nipalensis* (ex *A. nipalensis*), and *C. triangularis* (ex *Circaetus gallicus*). This grouping, whose limits are defined by its hosts (for *C. insolitus* does not belong in it, see p. 126), would also contain the *Craspedorrhynchus* specimens collected by me in 1997 from a mounted Wedge-tailed Eagle *Aquila a. audax* in Little Desert National Park in Victoria, Australia. They proved to be so different from the members of this grouping that it seemed advisable to regard them as belonging to a hitherto undescribed species. This hypothesis was confirmed following comparison with additional species, in particular with the two single species of the genus so far identified in Australia (according to Palma & Barker 1996), namely *C. haematopus* (ex *Accipiter f. fasciatus*; type host however is *A. g. gentilis*) and *C. pachypus* (ex *Haliastur sphenurus*; though type host is *H. indus*).

A description of this new species is given here, followed by an annotated checklist of the genus *Craspedorrhynchus* which it is hoped will serve as a basis for a revision of the genus. Finally, a few remarks concerning morphology, taxonomy, and distribution by host of *Craspedorrhynchus* are presented.

***Craspedorrhynchus reichelti*, sp. n.**

Figs 1–8, 11, 21, 23

Type host: *Aquila a. audax* (Latham, 1801).

Material: 1 ♂ and 2 ♀♀ (prep. Mey 4255. a–c) from the mounted specimen of a Wedge-tailed Eagle that is fixed as decoration to a wall in "Whimpey's" Lodge in the Little Desert National Park. The eagle was an immature bird that had been found, with an injured wing, on 30. 9. 1990 near Netherby (Region 17) in the Little Desert NP (Victoria, Australia). According to R. W. Reichelt, the bird was very heavily infested with ectoparasites. However, on the mounted skin itself, apart from *Craspedorrhynchus* (from the nape plumage), only a larval *Falcolipeurus* sp. (prep. M. 4255. d) could be found.

Holotype male (M. 4255. a) and allotype (M. 4255. b) in the Museum of Victoria, Department of Entomology, Melbourne (Australia). Paratype female (M. 4255. c) in the Museum of Natural History Rudolstadt (at the Thüringen State Museum, Heidecksburg) in Germany.

Description: Male – for habitus and dorsal structures see Fig. 1. Measurements (in mm; holotype): total length 1.73, head length 0.66, head width 0.72, head index 0.92; prothorax width 0.42, mesometathorax width 0.55, abdomen width 0.91. Preantennal segment short, sides strongly converging towards centre line, head appearing squat. Clypeal signature 0.19 broad with short tongue section, length 0.27. Hypandrium with macrochaetae insertions as in Fig. 5. Genitalia (Fig. 4) 0.558 long, paramere insertion 0.153 wide.

Female: Larger than male. Measurements (in mm; allotype, paratype): total length 2.20, 2.17; head length 0.78, 0.75; head width 0.81, 0.79; head index 0.96, 0,95; prothoray width 0.48, 0.48; mesometathorax width 0.66, 0.64; abdomen width 1.00, 1.11. Ventral structures from head, prothorax and anterior part of mesometathorax as in Fig. 2. Paired mesometanotum plates with setae (see Fig. 21), anterior pair of platelets absent. Number of tergocentral abdominal setae (including postspiracular setae): ii, 13–15; iii, 14–16; iv, 11–13; v, 10–11; vi, 7–10; vii, 9–10; viii, 8–9; ix, 2. No setae insertions at anterior edge of tergopleural plate of abdominal segment viii (Fig. 23). Number of sternocentral abdominal setae: ii, 5; iii, 6; iv, 10–11; v, 10; vi, 9–12; vii, 4. Terminalia (ventral) from abdominal segment v as in Fig. 3. Abdominal segments ii–vii without lateral sternites.

Differential diagnosis: Differs visibly from all other *Craspedorrhynchus* species by short truncated-cone-shaped preantennal segment with short clypeal signature. The head is like that of no other member of the genus, being broader than it is long, giving *Craspedorrhynchus reichelti* sp. n. a general overall squat appearance (Fig. 1). This head form is at the opposite extreme of the genus *Craspedorrhynchus* compared with *C. mellitoscopus* (see Figs 11–20), but does belong to the *aquilinus* group. *C. reichelti* sp. n. is on

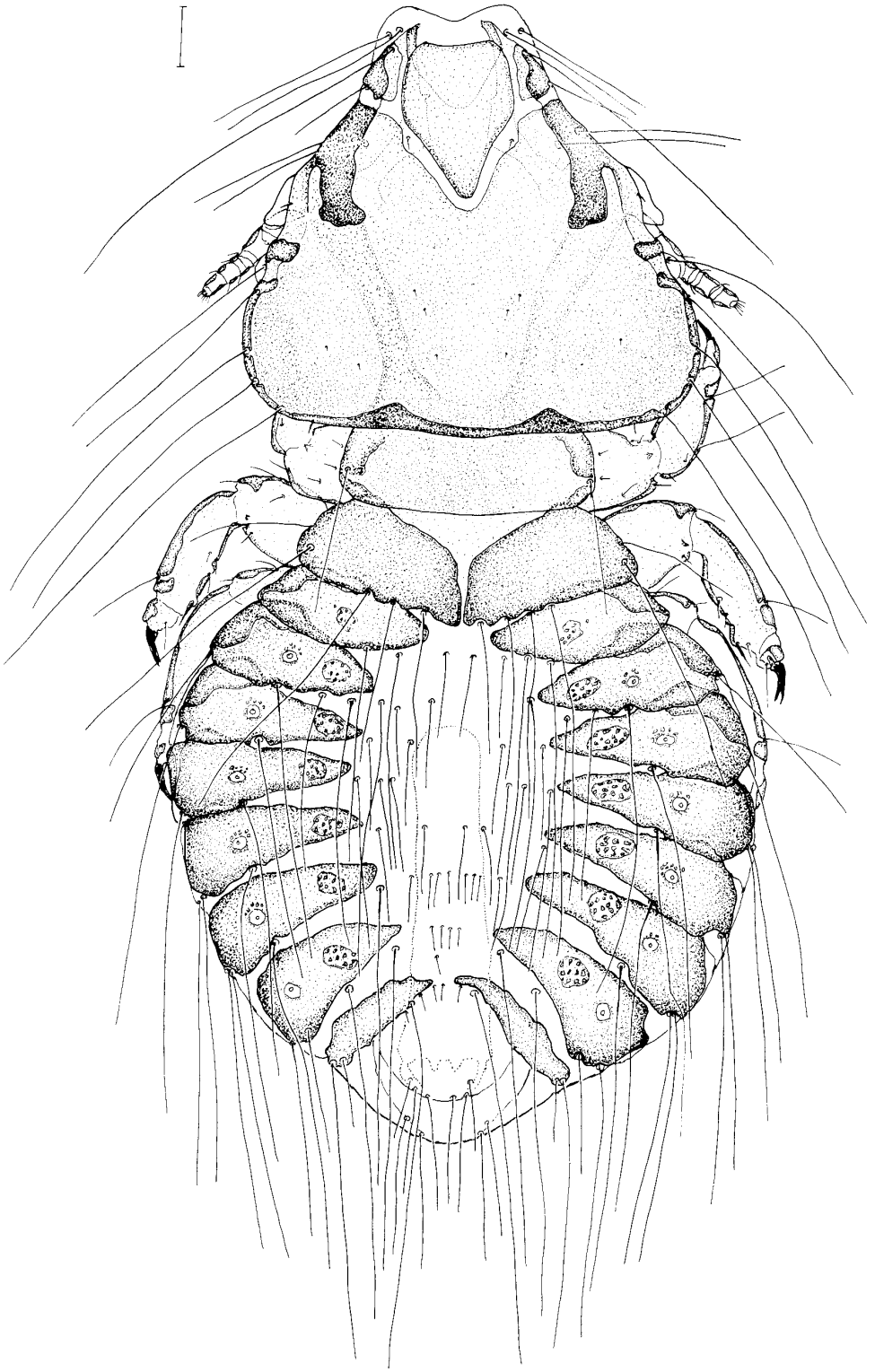


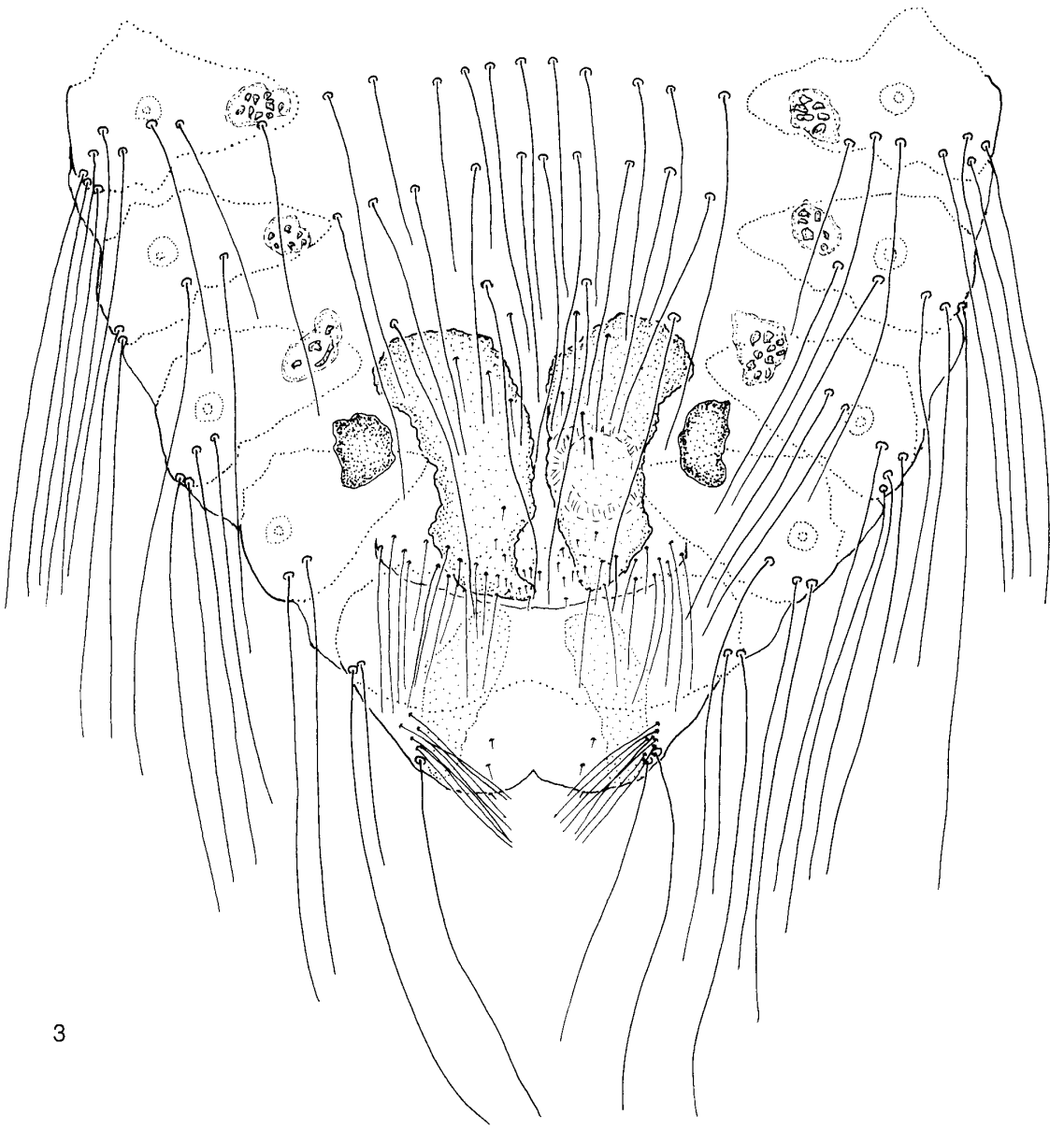
Fig. 1. *Craspedorrhynchus reichelti* sp. n., male (holotype), dorsal. Scale: 0.1 mm. – del. E. Mey.

Figs 2–3. *Craspedorrhynchus reichelti* sp. n., female. **2**, Head and thorax (pro parte), ventral. **3**, Terminalia up to abdominal segment v, ventral (paratergalia and lateral sclerites shown by dotted lines). Scale: 0.1 mm.

average smaller than *C. aquilinus* (see Figs 11 and 12, 21 and 22, 23 and 24).

The hypandrium of *Craspedorrhynchus reichelti* sp. n. is winged (Fig. 5). Two macrochaetae are inserted between the two wings. The species has this character in common with *C. fraterculus*. By contrast, in *C. aquilus* these wings are fragmented into several small platelets, and between the two groups there are 4–5 macrochaetae. The number of macrochaetae in the centre of the posterior margin of the mesometanotum of 15 *C. aquilinus* females from a single host varied between 5 and 9, and in place of the lateral pair of macrochaetae there is sometimes only a single long seta on one side of the body. Accordingly, *C. aquilinus* cannot be sharply separated from the two *C. reichelti* individuals (see Figs 21, 22). The pair of small sclerites on the head side of the large paired mesometanotum plate of *C. aquilinus* are variable in form and size and can have multiple subdivisions. This is completely absent in *C. reichelti* sp. n.

Derivatio nominis: I name this species for Raymond "Whimpey" Reichelt, and also include in this expression of gratitude his wife Maureen. They extended the most generous hospitality to me in their lodge in the Little Desert National Park, near Nhill (Victoria), during my researches in November/December 1997 and supplied me with helpful logistical support. For many years, and with great personal commitment, they have dedicated them-



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selves not only to the development of tourism in this ornithologically valuable reserve but also, and with great success, to the popularization of nature conservation in Victoria. They have in particular devoted many years to the study and protection of the Malleefowl.

Annotated checklist of *Craspedorrhynchus* species

Craspedorrhynchus Kéler, Aug. 1938
syn. *Falcoecus* Clay & Meinertzhagen, Dec. 1938 (Entomologist **71**, 275)

Type species: "*Docophorus platystomus* Burmeister, 1838" ex *Buteo b. buteo* (L.). See No. 27 below.

The starting point for this synopsis is the checklist by Hopkins & Clay (1952). Synonyms mentioned there are not referred to here. The name of the type locality of the holotype follows that of the type host (inside square brackets if it has been extrapolated by me from the distribution of the type host), and then the place of deposition of the type material. Type material of *Craspedorrhynchus* species is deposited in the following institutions (in brackets after the name the number

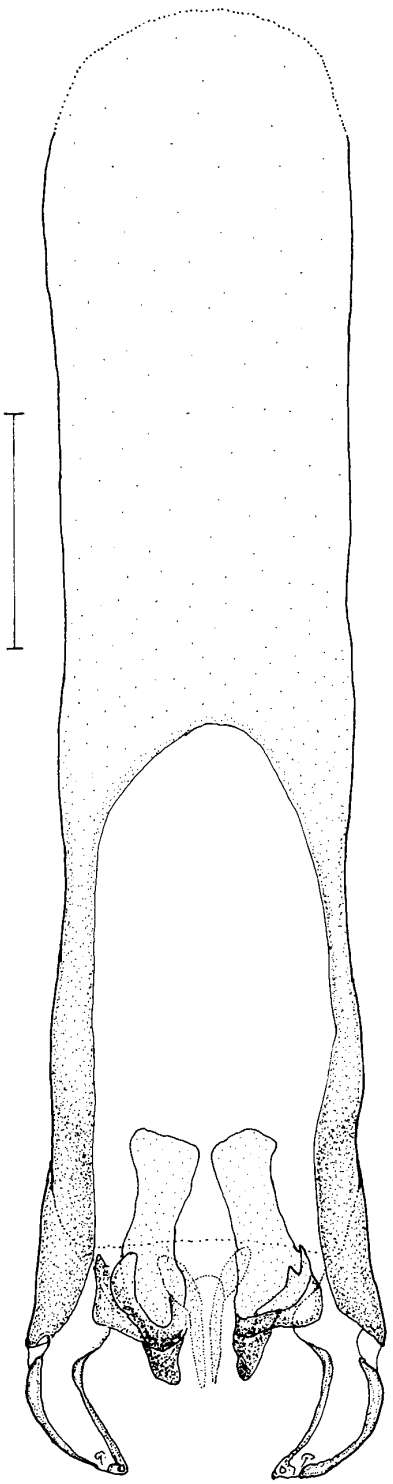


Fig. 4. *Craspedorrhynchus reichelti* (holotype), male genitalia. Scale: 0.1 mm.

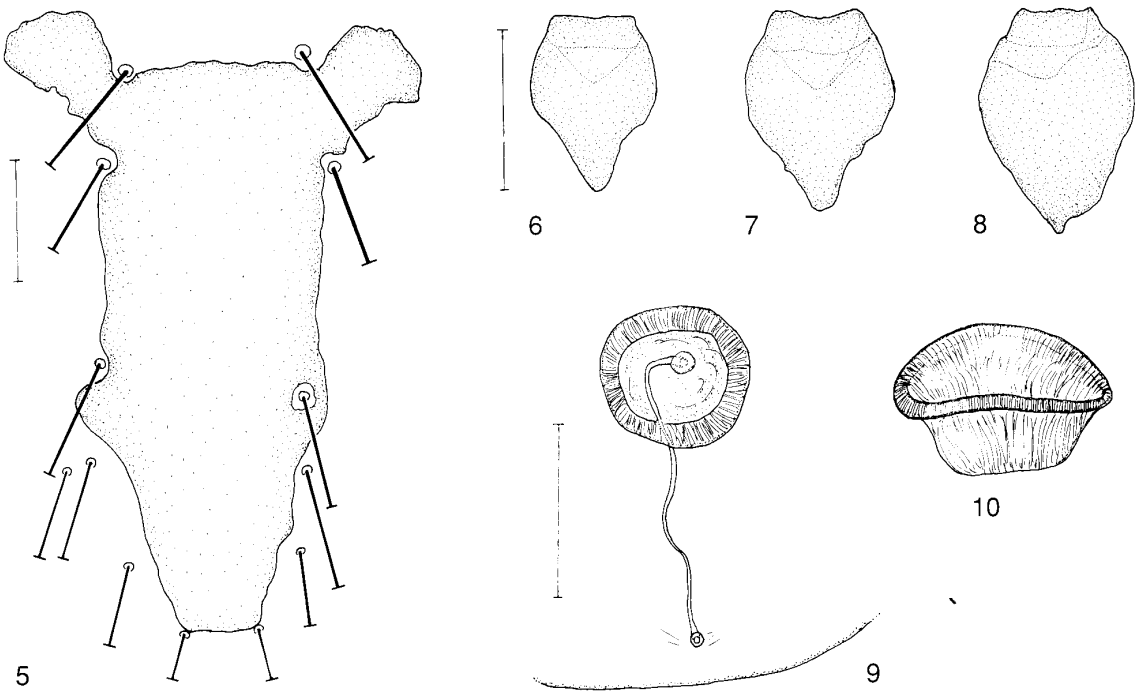
of species whose type material has been deposited). The details mostly refer to (cited) publications. Verification of the references was not undertaken, therefore it is not certain in every case that the type material still exists today in the given institution.

CZIICT – Centro de Zoologia do Instituto de Investigação Cientifica Tropical, Lisboa (2)
DEI – Deutsches Entomologisches Institut, Eberswalde (1)
DEUM – Department of Entomology, University of Minnesota, St. Paul (1)
MNCN – Museo Nacional de Ciencias Naturales, U.E.I. Entomologia de Madrid (2)
MNHU – Museum für Naturkunde der Humboldt-Universität Berlin (1)
MV – Museum of Victoria, Melbourne (1)
MZLSU – Museum of Zoology, Louisiana State University, Baton Rouge (4)
NHM – Natural History Museum, London (6)
NM – Naturhistorisches Museum im Thüringer Landesmuseum Heidecksburg, Rudolstadt (2)
OSU – Ohio State University, Columbus (1)
USNM – United States National Museum of Natural History, Washington D.C. (5)
UT – University of Turku (Finland) (1)
ZSD – Zoological Survey Department Karachi (Pakistan) (1)

Names of the host species are arranged as in del Hoyo et al. (1994). In the case of *Aquila vindhiana*, I follow Sibley & Monroe (1990). Synonyms, *nomina nuda* and other invalid names are printed in smaller type.

1. *americanus* Emerson, 1960 a (40, Figs 9, 13 and 17) ex ***Buteo jamaicensis*** (Gmelin). North America (Mississippi, Wisconsin, Utah, Pennsylvania, New Hampshire, New York, New Jersey). Type material in USNM (Cat.-No. 64,939).

2. *aquilinus* (Denny, 1842) (*Docophorus*) (43, 81, pl. 2 Fig. 7) ex ***Aquila chrysaetos*** (L.). England. Type material in NHM.
Redescriptions are given by Merisuo (1945: 109, Figs 2–3 E, e), Eichler & Złotorzycka (1974: 157, Figs 3a–c) and Gállego et al. (1987: 34, Figs 1–8). Ledger (1980: 125) stated: "... that populations from all Ethiopian *Aquila* (other than *wahlbergi*) should for the meantime be regarded as *aquilinus* sens. lat., the earliest name for a species from *Aquila*, since it seems likely (Dr. Clay, in litt.) that the larger eagles will probably be found to share the same species of *Craspedorrhynchus*. The named populations come from *A. pomarina* (*C. naevius*), *A. nipalensis* (*C. nipalensis*) and *A. pennata* (*C. ranj-*



Figs 5–10. *Craspedorrhynchus* spp. **5**, Hypandrium of *C. reichelti*. **6–8**, Clypeal signature of *C. reichelti* (6, male, holotype; 7, female, allotype; 8 female, paratype). **9**, View from above of capsule (calynx) on spermatheca (receptaculum seminis) of *C. melittoscopus*, with ductus spermathecae leading into genital chamber (ventral posterior margin illustrated). **10**, Side view of capsule (calynx) on spermatheca of *C. macrocephalus*. Scales: 0.1 mm.

hae), while other material has been seen from *A. rapax*."

3. *brevicapitis* Carriker, 1956 (26, Figs 13–15) ex ***Buteo magnirostris griseocauda*** (Ridgway). Mexico. Type material in MZLSU.

4. *buteonis* (Packard, 1870) (*Docophorus*). (93, pl. I, Fig. 3) ex ***Buteo lineatus*** (Gmelin). North America. Whereabouts of type material is unknown.

5. *candidus* (Rudow, 1870) (*Docophorus*) (457) ex "Buteo Ghisbrechtii" = ***Leucopternis albicollis ghiesbreghti*** (Du Bus de Gisignies). [Mexico]. Carriker (1956: 22, Figs 7–8) redescribed this species with material from the type host from Mexico and designated a pair as "neotypes" and others from the same series as "neoparatypes", deposited in MZLSU.

chicquerae Ansari, 1955 (48) ex ***Falco c. chicquera*** Daudin. Pakistan. Short redescription under the same name but as "sp. nov." by Ansari (1956a: 398), and again, using the same first illustration, as "*Craspidorrhynchus chiquerae*, sp. nov." ex "*Fulco c. chiquera*" by Ansari (1959: 97, Figs 211–212)!

The repeated descriptions in words are based on a female (= holotype) (not a male as Ansari 1959: 97 states) which, judging from his first illustrations (according to habitus, head and abdominal structures, as well as chaetotaxy), in my opinion cannot possibly belong to the genus *Craspedorrhynchus*, if the classification is based on the details of Ansari's two drawings alone. The holotype is not in the NHM (P. Brown *in Lit.*) and its whereabouts are unknown.

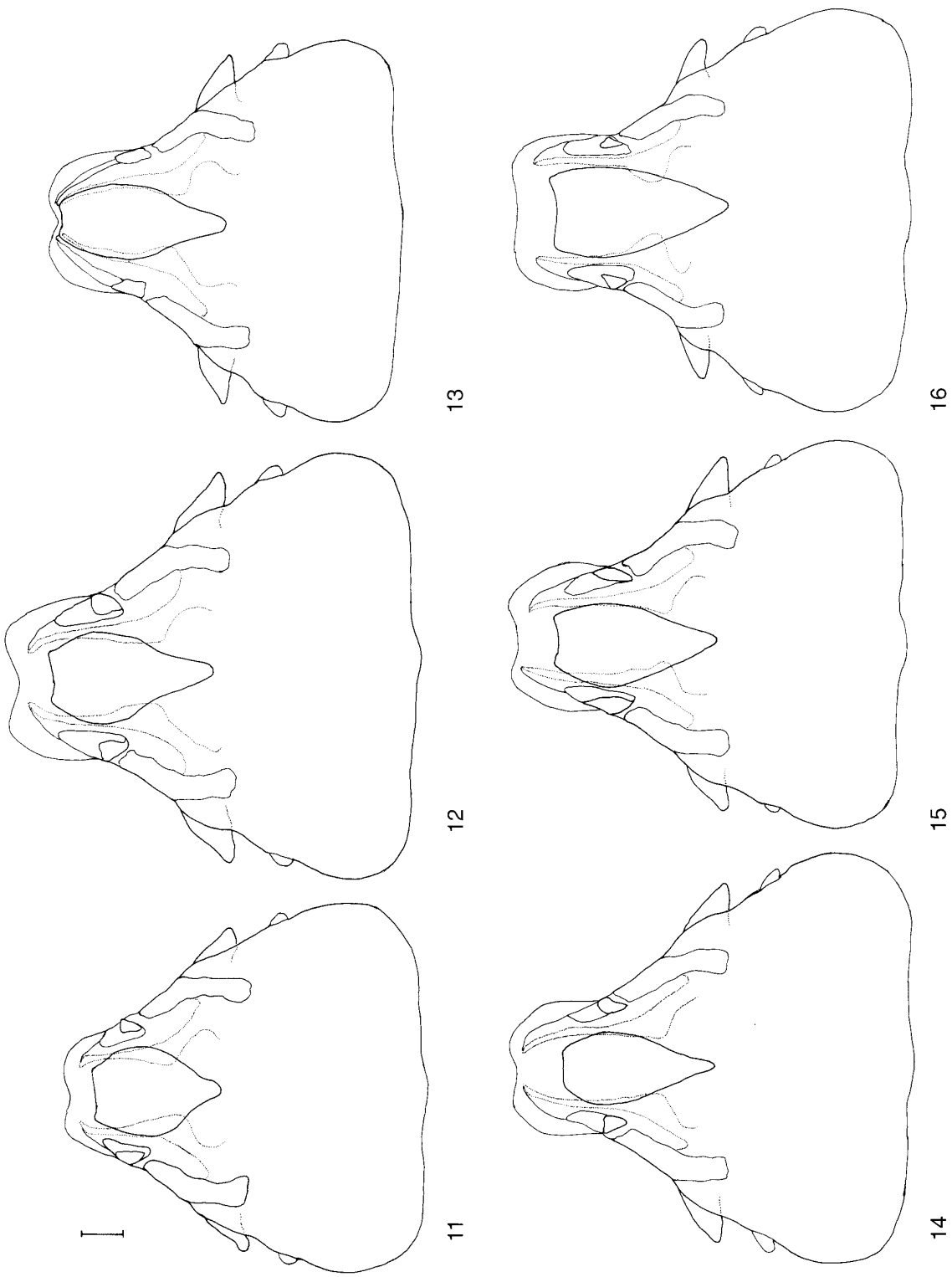
cicatricosus (Percheron, 1837) (*Docophorus*) (pl. I) ex "**Aigle**". Europe (France). Type material lost.

The type host is probably *Aquila chrysaetos* (L.). Species incertae sedis. Whereabouts of type material is unknown. The best course is presumably to suppress this name altogether since it is not possible to assign it to a definite *Craspedorrhynchus* population with any certainty. I suggest treating *cicatricosus* as a *nomen oblitum*.

6. *cornutus* (Piaget, 1880) (*Docophorus*) (21) ex ***Harpagus bidentatus*** (Latham). [South America]. Type material in NHM.

7. *dilatatus* (Rudow, 1869) (*Docophorus*) (14) ex ***Buteo l. lagopus*** (Pontoppidan). Europe. Original type material lost.

Merisuo (1945: 104, Figs 1, 2–3 C c) described this species under the synonym "*Craspedorrhynchus buteolagopi*" ex *Buteo l. lagopus* from Fennica. Hopkins (1949: 3f.) selected as neotype the male type of *C. buteolagopi* Merisuo, and as neallotype the female type of Merisuo's species. Both types are in the collection of UT. Carriker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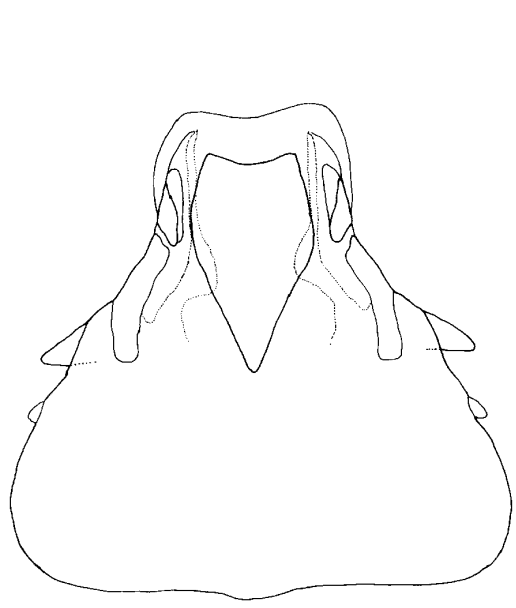

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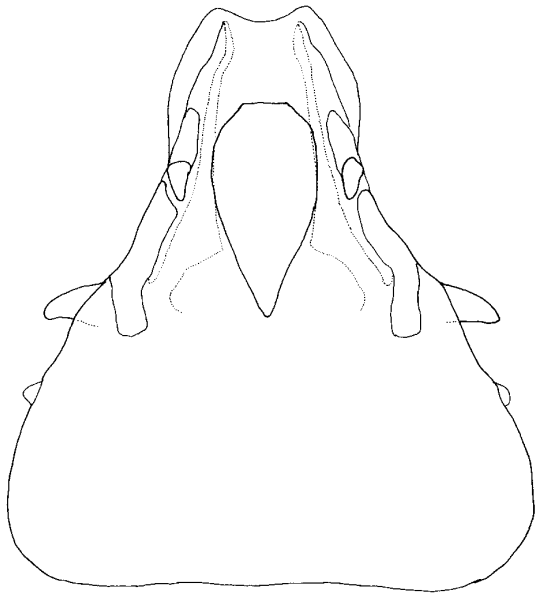

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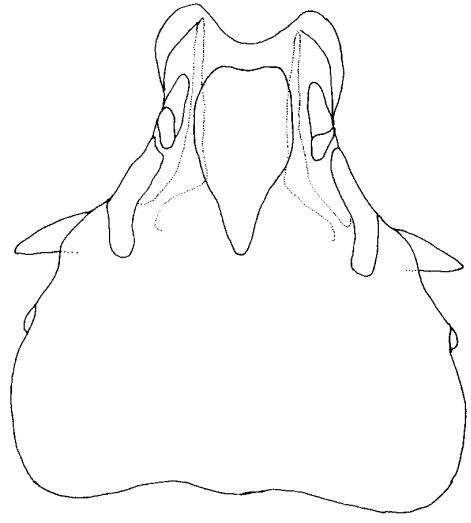

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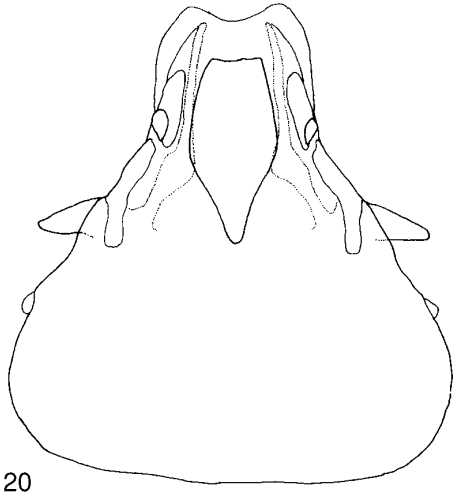

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Figs 11–20. *Craspedorrhynchus* spp., females. Head (dorsal) with following details: outline, ommatidium, conus, clypeal signature, clypeal marginal carina (without clypeal suture), hyaline margin (alation of clypeus) and ventral carina (dotted line). **11**, *C. reichelti* sp. n. **12**, *C. aquilinus* (Denny) ex *Aquila c. chrysaetos*. **13**, *C. nipalensis* Eichler (paratype 1507/10) ex *Aquila vindhiana*. **14**, *Craspedorrhynchus* sp. 1 (prep. M. 367. h) ex *Aquila wahlbergi*. **15**, *C. platystomus* (Burmeister) ex *Buteo buteo*. **16**, *C. pachypus* (Giebel) ex *Haliastur indus*. **17**, *C. spathulatus* (Giebel) ex *Milvus migrans lineatus*. **18**, *C. melittoscopus* (Nitzsch in Giebel) ex *Pernis apivorus*. **19**, *C. isolitus* Kéler (lectotype). **20**, *C. nisi* (Denny) ex *Accipiter nisus*. Scale: 0.1 mm.

(1956: 23, Figs 9–10) redescribed *dilatatus* ex *Buteo lagopus sanctijohannis* (Gmelin) from Texas, Nebraska and Labrador.

8. *fasciati* Gállego, Martin-Mateo & Aguirre, 1987 (52, Figs 65–72) ex ***Hieraaetus fasciatus*** (Vieillot). Spain. Type material in MNCN.

9. *femoralis* (Giebel, 1874) (*Docophorus*) (71) ex ***Polihierax semitorquatus*** (A. Smith). [Africa]. Type material lost.

Fraterculus [sic!] Eichler, 1944 (74) = *nomen nudum.*

10. *fraterculus* Eichler & Złotorzycka, 1975 (Angew. Parasitol. **16**, 155, Figs 1a–h, 2a–c) ex ***Aquila heliaca*** Savigni. Type locality unknown. Deposition of holotype unknown; 11 paratypes in MNHU.

Martin-Mateo & Rivas (1982: 198, Fgs 9–12) and Gállego et al. (1987: 36, Figs 9–16) recorded and described *fraterculus* ex *Aquila adelberti* C. L. Brehm (see Tab. 1).

11. *genitalis* Carriker, 1956 (29, Figs 19–20) ex ***Geranospiza caerulescens nigra*** (Du Bus de Gisignies). Mexico. Type material in MZLSU.

12. *gypohieracis* Tendeiro, 1955 (803, Figs 5–7, microfot. 3) ex ***Gypohierax angolensis*** (Gmelin). Guinea-Bissau. Holotype male in CZIICT (Mendes 1993). Further descriptions and records from Angola and Congo are given by Tendeiro (1960, 1964).

13. *haematopus* (Scopoli, 1763) (*Pediculus*) (381) ex ***Accipiter g. gentilis*** (L.). Type host by original designation is *A. g. marginatus* Piller & Mitterspacher, which is a synonym of the nominate form. Europe (Italy). Type material lost.

Clay & Hopkins (1951) designated a male as neotype and a neallotype both ex *Accipiter g. gentilis* from Estonia. Types in NHM. A detailed illustration and discussion of the male genitalia is given by Cummings (1916).

14. *halieti* (Osborn, 1896) (*Docophorus*) (218) ex ***Haliaeetus leucocephalus*** (L.). North America (Florida). Type material (1 ♂ , 2 ♀♀) in OSU.

Emerson (1960b) designated the male as lectotype. Perhaps conspecific with *macrocephalus*? Emerson (1960a) compared *halieti* only with species from North America.

15. *hirsutus* Carriker, 1956 (27, Figs 18) ex ***Buteo regalis*** (G. R. Gray). North America (Kansas ?). Type material in MZLSU.

Description based on two females. Emerson (1960: 41, Figs 12, 16) gave some features of the male and included *hirsutus* in a key to species of North American *Craspedorrhynchus.*

hiyodori Uchida, 1949 (*Philopterus*) (546, Fig. 14) ex ***Microscelis a. amaurotis*** (Temminck). Hopkins & Clay (1952: 91) placed this species, with some reservations, in *Craspedorrhynchus.* Uchida's description clearly shows that *hiyodori* belongs to *Tritrabeculus*, which is in my opinion not synonymous with *Philopterus sensu lato.*

16. *hopkinsi* Tendeiro, 1955 (796, Figs 1, 5, Microfot. 1) ex ***Elanus c. caeruleus*** (Desfontaines). Mozambique. Holotype in CZIICT (Mendes 1993). Description based on one female.

17. *insolitus* Kéler, 1938 (240, Fig. 7) ex "einem **Raubvogel** aus Ekona, Kamerun" [ex "a raptor from Ekona, Cameroon"] (October 1935, leg. Fr. Zumpt). Cameroon. 11 ♂♂, 14 ♀♀ syntypes by original designation. Gaedike (1970: 468) designated lectotype female and 5 (not 15, misprint) paralectotypes[3] deposited in DEI (at present on permanent loan in NM).

Clay (1940: 432) stated: "In the collection of Colonel Meinertzhagen there are 2 ♂♂, 1 ♀ paratypes of *C. insolitus*, received through the kindness of the late Dr. Horn of Berlin-Dahlem. These have been compared with specimens of *Craspedorrhynchus* from all Accipitrines which are likely to occur in the Cameroons, and appear to be conspecific with specimens from *Aquila wahlbergi* Sund., which occurs commonly in that region." Following this statement, Hopkins & Clay (1952), and subsequent authors, registered *Aquila wahlbergi* Sundevall as the type host of *C. insolitus.* In my opinion this is an error. After examination of the type material (lectotype and paralectotypes 3 ♂♂, 2 ♀♀), I have concluded that *C. isolitus* cannot come from an *Aquila* species because: 1.) head form, structure and setae of tergopleurites ix and x, and presence of small lateral sternites on abdominal segments iii–viii (only), deviate

[3] These are individually mounted as unusual Canada balsam permanent specimens. They are placed between two round cover slips inserted into a card label. All of these so-called Kélerian 'window slides' (described in Eichler 1952: 186) are mounted on an insect pin and measure 0.7 × 1.6 mm.

clearly from all known *Craspedorrhynchus* from *Aquila* spp.; and 2.) it is not conspecific with a series of 3 ♂♂ und 4 ♀♀ of *Craspedorrhynchus* sp. I taken by me from an *Aquila wahlbergi* from Ethiopia (skin in the Museum für Naturkunde, Berlin). It appears that only this still unnamed species, which is similar to *C. aquilinus*, infests Wahlberg's Eagle, while *C. insolitus* perhaps comes from a species of *Accipiter*.

18. *intermedius* (Piaget, 1880) (*Docophorus*) (20, pl. I, Fig. 2) ex ***Haliaeetus vociferoides*** Des Murs. Madagascar. Type material in NHM.

19. *leucogaster* (Giebel, 1874) (*Docophorus*) (300) ex ***Buteo rufofuscus*** (J. R. Forster). [South Africa]. Type material lost.

20. *macrocephalus* (Nitzsch in Giebel 1874) (*Docophorus*) (73) ex ***Haliaeetus albicilla*** (L.). Europe (Germany). Type material lost.

Redescriptions are given by Merisuo (1945: 110, Figs 2–3 F, f) and Eichler & Złotorzycka (1975: 157, Figs 5 a–c).

* ***maruhashi*** (Uchida, 1949) (*Philopterus*) (545, Fig. 13) ex ***Pomatorhinus ruficollis musicus*** Swinhoe [error]. Hopkins & Clay (1952: 91) provisionally assigned this species to *Craspedorrhynchus*. After examination of a paratype, Clay (1961: 58) put *maruhashi* into the genus *Cuculoecus*. This proves that the true host species of *maruhashi* is unknown.

21. *melittoscopus* (Nitzsch in Giebel, 1874) (*Docophorus*) (71) ex ***Pernis apivorus***. Europe (Germany). Type material lost.

Hopkins (1947: 40) designated both neotype male and neallotype from the type host from Italy. These types in NHM. Redescriptions by Gállego et al. (1987) and Merisuo (1945, under the synonym *C. cornutus* Piaget).

22. *naevius* (Giebel, 1861) (*Docophorus*) (523) ex "*Aquila naevia* Naum." = ***Aquila p. pomarina*** C. L. Brehm. [Germany]. Type material lost.

See notes to No. 1.

23. *nipalensis* Eichler, 1944 (73) ex "***Aquila nipalensis*** [*nipalensis* Hodgson]" (by original designation). But slides with holotype and two paratypes are labelled with ***"Aquila nipalensis orientalis"*** [Cabanis]. From a captive bird in Berlin Zoo (Germany). Type material (male, holotype; one male and one female, paratypes; all WdE 1507/10) in poor condition in NM.

See notes to No. 1. "*Aquila orientalis* Cabanis, 1854" is a synonym of ***Aquila vindhiana*** Franklin, 1831 (= type host of *C. nipalensis* Eichler here by subsequent designation). *Aquila vindhiana* (from south Eurasia) forms a superspecies with *A. rapax* Temminck (from Africa) und *A. nipalensis* Hodgson (from central Asia) (Sibley & Monroe 1990: 286).

24. *nisi* (Denny, 1842) (48, 109, pl. 3, Fig. 11) ex ***Accipiter n. nisus*** (L.). England. Type material in NHM.

Redescription by Gállego et al. (1987).

25. *obscurus* (Giebel, 1874) (72) ex ***Rost[rh]amus hamatus*** (Temminck) by original designation. Type material lost.

However, type host uncertain; according to Guimarães (1943: 430) probably *Rostrhamus sociabilis* (Vieillot), according to Hopkins & Clay (1952: 92) perhaps *Helicolestes hamatus* (Temminck); but this name is synonymous with *Rostrhamus hamatus* (Temminck). Carriker (1956: 22, Figs 5–6) and Emerson (1960: 43) used *Rostrhamus sociabilis* as type host of *obscurus*.

26. *pachypus* (Giebel, 1874) (*Docophorus*) (71) ex ***Haliastur indus*** (Boddaert). Type material lost.

For discussion on the use of "*pachypus*" by Piaget (1880) and Séguy (1944), see Hopkins (1949: 41) and Tendeiro (1955: 807f.).

pennati Gállego, Martin-Mateo & Aguirre, 1987 (55, Figs 73–80) ex ***Hieraaetus pennatus*** (Gmelin). Spain. Type material in MNCN.

Price et al. (1997) examined the holotype male and the allotype of *C. ranjhae* Ansari, 1955 and compared them with the description of *C. pennati* by Gállego et al. (1987), and concluded that *C. pennati* is a synonym of *C. ranjhae*.

27. *platystomus* (Burmeister, 1838) (426) ex ***Buteo b. buteo*** (L.). [Germany]. Type material lost.

Redescriptions by Martin-Mateo & González-Andújar (1983), Gállego et al. (1987), and Pérez-Jiménez et al. (1988).

28. *ranjhae* Ansari, 1955 (49) ex ***Hieraaetus pennatus*** (Gmelin). Pakistan. Holotype male and allotype in ZSD.

Ansari (1956a: 398) mentions *ranjhae* again as "sp. nov." with a brief, very superficial differential diagnosis, adequately describing and illustrating the species only in a later paper (Ansari 1956b: 14, Figs 17–22).

29. *reichelti* n. sp. ex ***Aquila a. audax*** (Latham). Australia (Victoria). Holotype und allotype in MV, the paratype in NM.

Green & Palma (1991: 30) mentioned *Craspedorrhynchus* sp. ex *Aquila audax* from Tasmania, Stranger & Palma (1998: 174) the same from Western Australia.

rhacophorus Eichler, 1944 (74) = *nomen nudum.*

30. *robustisetosus* Tuff, 1970 (216–220 Figs 1–6) ex ***Terathopius ecaudatus*** (Daudin). From a captive bird (from Africa). Type material in USNM and DEUM.

31. *rotundatus* (Piaget, 1880) (*Docophorus*) (21) ex ***Circus aeruginosus*** (L.). [Europe]. Type material in NHM.

Redescribed by Gállego et al. (1987: 45, Figs 41–48).

32. *spathulatus* (Giebel, 1874) (*Docophorus*) (73) ex ***Milvus m. migrans*** (Boddaert). [Germany]. Type material lost (see Hopkins 1949: 44).

Redescriptions and new records summarized by Tendeiro (1955) and Gállego et al. (1987).

33. *subbuteonis* Gállego, Martin-Mateo & Aguirre, 1987 (59, Figs 81–84) ex ***Falco subbuteo*** (L.). Spain. Type material (only females) in MNCN.

Further description (including male) is given by Pérez & Martin-Mateo (1995).

34. *subhaematopus* Emerson, 1960 (39–44, Figs 5–8) ex ***Accipiter cooperii*** (Bonaparte). North America (Maryland, Florida, Oregon). Type material in USNM (Cat.-No. 64,938).

transversifrons (Carriker, 1903) (*Docophorus*) (127, pl. I, Fig. 1) ex ***Micrastur ruficollis interestes*** Bangs. Hopkins & Clay (1952: 93) placed this species in *Craspedorrhynchus*, but Carriker (1956: 24) stated that it actually belonged in *Philopterus*. Emerson (1981) examined the holotype male and allotype, both on U. S. Nat. Mus. type slide 68262, and stated that *transversifrons* belongs to the genus *Strigiphilus* and that the true type host is *Lophostrix cristata stricklandi* Sclater & Salvin. But according to Clayton & Price (1984) the true host is still in question.

35. *triangularis* (Rudow, 1869) (*Docophorus*) (10) ex ***Circaetus gallicus*** (Gmelin). Type material lost.

Redescribed by Gállego et al. (1987: 50, 52, Figs 57–64).

36. *tubulus* Carriker, 1956 (26, Figs 16–17) ex ***Busarellus n. nigricollis*** (Latham). Mexico. Type material in USNM (Cat. No. 65431).

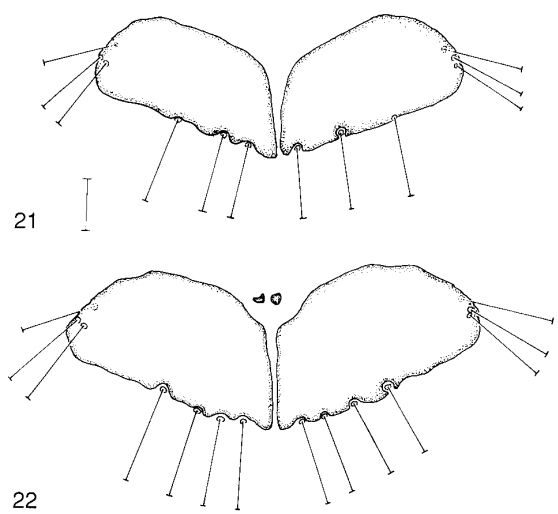
37. *platystoma* [sic !] *umbrosus* (Carriker, 1903) (*Docophorus*) (126) ex ***Leucopternis semiplumbea*** Lawrence. Costa Rica. Type in USNM (Cat. No. 68261).

Carriker (1956: 24, Figs 11–12) redescribed the male (female unknown) and gave *umbrosus* species status, which had already been done by Hopkins & Clay (1952: 93).

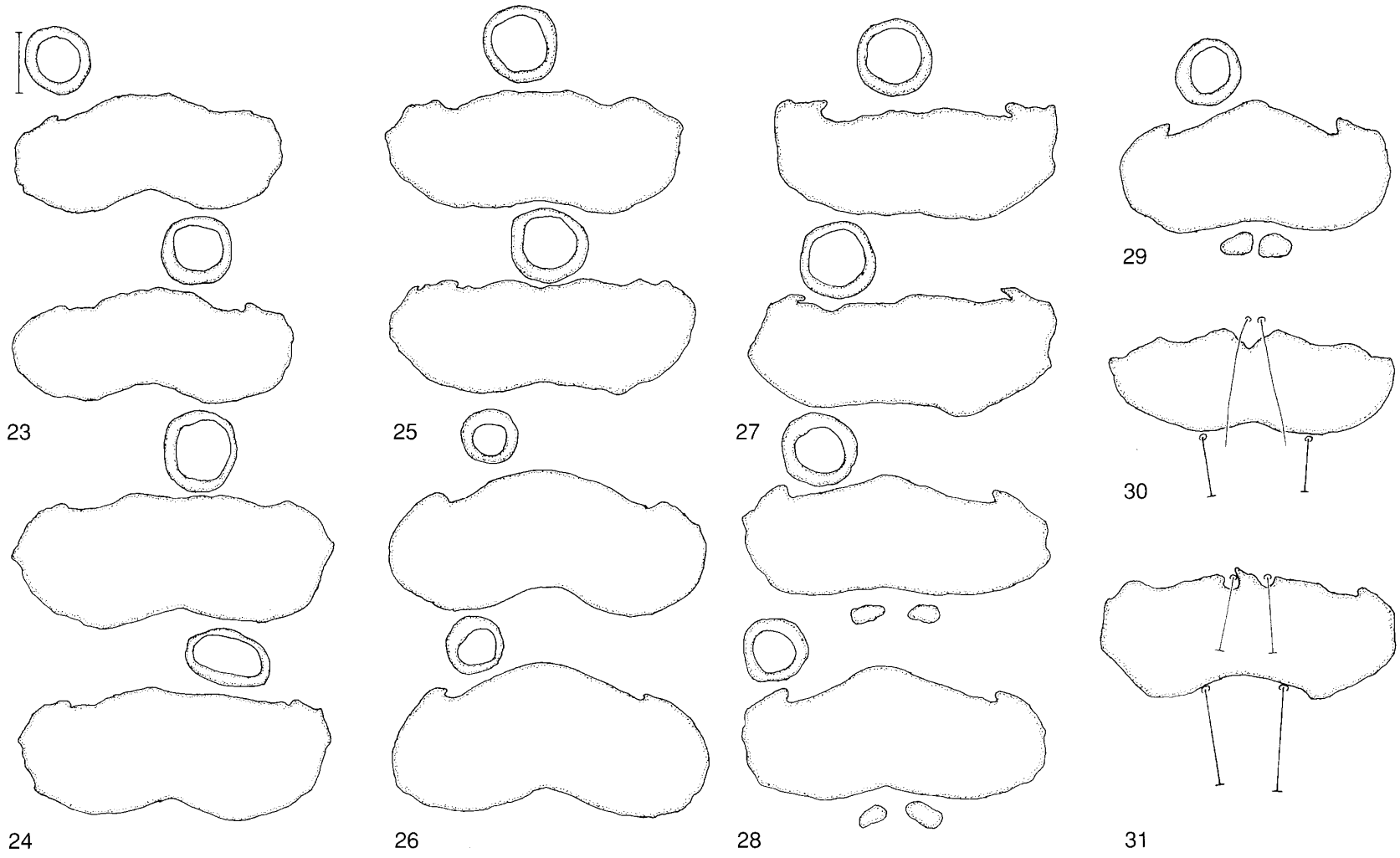
Remarks on morphology, taxonomy and distribution by host of *Craspedorrhynchus*

A diagnostic character of *Craspedorrhynchus* is provided by the marginal postantennal setae. Instead of 7 (as in most philopterids) there are only 6 setae on each side; the seventh (mts 5), usually a microchaeta, is absent. Therefore present in *Craspedorrhynchus* are: ocular seta, postocular seta, and temporal setae mts 1–3 as macrochaetae and mts 4 as microchaeta (Fig. 1). In addition, the absence of true trabeculae, but presence of strongly pronounced coni, place *Craspedorrhynchus* in a genus group that cannot be closely related to *Philopterus sensu lato*. The strong resemblances in habitus and numerous morphological details between *Craspedorrhynchus* and *Philopterus sensu lato* may be a result of convergent evolution, presumably accounted for by their common occupation of the niche area "head plumage".

For further classification within the genus *Craspedorrhynchus*, I have found the following features helpful in my preliminary studies:



Figs 21–22. *Craspedorrhynchus* spp., females. Mesometanotum plates with posterior marginal setae (ventral insertions shown by dotted line). **21**, *C. reichelti* sp. n. **22**, *C. aquilinus* (Denny) ex *Aquila chrysaetos*. Scale: 0.1 mm.



Figs 23–31. *Craspedorrhynchus* spp., females; somatic tergopleurite viii (fused abdominal segments ix and x, dorsal) and capsule (calynx) of spermatheca (except in 30 and 31). In all species two macrochaetae are inserted medianly at the posterior margin of the tergopleurite (shown only in 30 and 31). Species illustrations (except 29 – 31) are of two individuals in each case. **23**, *C. reichelti* sp. n. (allotype, paratype). **24**, *C. aquilinus* (Denny) ex *Aquila chrysaetos*. **25**, *C. naevius* (Giebel) ex *Aquila pomarina*. **26**, *Craspedorrhynchus* sp. I (prep. M. 367. c, h) ex *Aquila wahlbergi*. **27**, *C. platystomus* (Burmeister) ex *Buteo buteo*. **28**, *C. macrocephalus* (Nitzsch in Giebel) ex *Haliaeetus albicilla*. **29**, *C. melittoscopus* (Nitzsch in Giebel) ex *Pernis apivorus*. **30**, *C. nisus* (Denny) ex *Accipiter nisus*. **31**, *C. insolitus* Kéler (paralectotype). Scale: 0.1 mm.

1. Hypandrium: anterior corners with wing-like extensions, fragmented into small platelets or both completely absent; with setae.

It should be tested whether a consistent correlation exists between the form and the presence of setae: a winged hypandrium has, as a rule, fewer anterior setae than an unwinged.

2. Male genitalia: endomeral structures in particular.

Because of their complex structure these are difficult to describe in words from light microscope slides, and can best be understood through direct comparison of specimens. To compare species using drawings can be problematic.

3. The size of the heavily chitinized calynx on the receptaculum seminis. In permanently prepared specimens this always appears as a strongly coloured brown ring.

Even where there is hardly any difference in body size between some species, the diameter of the calynx can be clearly different. For example, in *Craspedorrhynchus* sp. I ex *Aquila wahlbergi* the calynx is visibly smaller and thicker walled than in, e.g., the similarly sized *C. aquilinus* and *C. macrocephalus* (see Figs 23–31; the somatic tergopleurite viii is the point of reference here).

4. Form and median-anterior setae of tergopleurites ix and x (fused together to a plate) of the female.

Although there is clear intraspecific variation in the outline of this tergopleurite, relatively constant forms among species or species groups have emerged (see Figs 23–31). In some species (*C. insolitus*, *C. nisus*, *C. haematopus*) a pair of macrochaetae is inserted at the posterior-median margin of somatic tergopleurite viii, which is absent in all *Craspedorrhynchus* species known from members of *Aquila*, *Haliaeetus* and *Buteo*.

5. The presence of a rudimentary median sclerite pair dorsally on the final segment (xi) of the female.

This character is species-constant. This sclerite pair is present in *C. macrocephalus* (Fig. 28), *C. melittoscopus* (Fig. 29), *C. nisus*, *C. insolitus* (not shown for the last two species in Figs 30 and 31), *C. pachypus*, *C. spathulatus*, *C. triangulatus*, and *C. rotundatus*. It appears to be absent on *Craspedorrhynchus* species from hosts belonging to the genera *Aquila*, *Hieraaetus*, and *Buteo*.

Table 1
The type hosts of *Craspedorrhynchus* species in alphabetical order. Multi-host occurrence (= one *Craspedorrhynchus* species on two host species) has been noted for four species (marked by an asterisk *).

Type host	*Craspedorrhynchus* sp.	with checklist no.
Accipiter sp. ?	*insolitus*	17.
Accipiter cooperii	*subhaematopus*	34.
A. g. gentilis	**haematopus*[1]	13.
A. n. nisus	*nisi*	24.
Aquila a. audax	*reichelti* sp. n.	29.
A. chrysaetos	*aquilinus*	2.
A. heliaca	**fraterculus*[2]	10.
A. vindhiana	*nipalensis*	23.
A. p. pomarina	*naevius*	22.
A. wahlbergi	unnamed spec.	see 17.
Busarellus n. nigricollis	*tubulus*	36.
Buteo buteo	*platystomus*	27.
B. lagopus	*dilatatus*	7.
B. lineatus	*buteonis*	4.
B. magnirostris griseocauda	*brevicapitis*	3.
B. jamaicensis	*americanus*	1.
B. regalis	*hirsutus*	15.
B. rufofuscus	*leucogaster*	19.
Circaetus gallicus	*triangularis*	35.
Circus aeruginosus	*rotundatus*	31.
Elanus c. caeruleus	*hopkinsi*	16.
Falco subbuteo	*subbuteonis*	33.
Geranospiza caerulescens nigra	*genitalis*	11.
Gypohierax angolensis	*gypohieracis*	12.
Haliaeetus albicilla	*macrocephalus*	20.
H. leucocephalus	*halieti*	14.
H. vociferoides	*intermedius*	18.
Haliastur indus	**pachypus*[3]	26.
Harpagus bidentatus	*cornutus*	6.
Hieraaetus fasciatus	*fasciati*	8.
H. pennatus	*ranjhae*	28.
Leucopternis albicollis ghiesbreghti	*candidus*	5.
L. semiplumbea	*umbrosus*	37.
Milvus m. migrans	**spathulatus*[4]	32.
Pernis apivorus	*melittoscopus*	21.
Polihierax semitorquatus	*femoralis*	9.
Rostrhamus hamatus	*obscurus*	25.
Terathopius ecaudatus	*robustisetosus*	30.

[1] According to Palma & Barker (1990) also on *Accipiter f. fasciatus* in Australia.

[2] Gállego et al. (1987) report *C. fraterculus* from Spanish Imperial Eagle, regarded by them, as by many, as a subspecies of *Aquila heliaca*, but which is now treated as a full species, *Aquila adalberti* C. L. Brehm, and forms a superspecies with *A. heliaca*.

[3] According to Palma & Barker (1990) also on *Haliastur sphenurum* in Australia.

[4] Regular on *Milvus milvus* in Europa according to own findings.

6. Presence of lateral sternites on abdominal segments iii–viii of female.

These lateral sternites are absent on all known *Craspedorrhynchus* species infesting the genus *Aquila*, but present on those with *Accipiter* spp., *Milvus* spp., *Haliastur indus*, and *Circus* spp. as hosts. What is however noteworthy is that according to Gállego et al. (1987) these lateral sternites are absent on *C. fasciati* ex *Hieraaetus fasciatus* but present and well developed on *C. ranjhae* ex *Hieraaetus pennatus*.

The number of setae on the lateral and posterior margins of the mesometanotum are apparently intraspecifically very variable (Figs 21 and 22). Therefore this character, which Emerson (1960a) employed in his argument, has only limited value in differential diagnosis.

Thirty-seven species are known as of December 1999. Apart from *C. umbrosus* (Carriker 1903), none of these forms occurs in the corresponding literature as a subspecies. Besides *C. insolitus* (see 17), the type host of all *Craspedorrhynchus* species is known. Type material no longer exists for 10 species (4, 9, 19, 20, 22, 25, 26, 27, 31, and 34). In the event of a revision of the genus, it is unavoidable that a neotype for each of them will have to be designated.

No case has been recorded to date of a raptor being host to more than one species of *Craspedorrhynchus* (see Table 1). Most *Craspedorrhynchus* species appear to parasitize only one host. What the actual proportion of species is infesting more than one host is unknown, and doubtless depends on the particlar species concept employed. At any rate, four *Craspedorrhynchus* species have been found on birds other than, though as a rule closely related to, the type host.

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