Systematic Parasitology **52:** 171–182, 2002.

Cestodes of the family Dilepididae (Cestoda: Cyclophyllidea) from fish-eating birds in Mexico: a survey of species

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Accepted for publication 6th November, 2001

Abstract

A survey of adults of dilepidid tapeworms (Cyclophyllidea) from piscivorous birds from Mexico is presented on the basis of the taxonomic evaluation of freshly collected and voucher specimens. The following species are reported (first records from Mexico marked with an asterisk): *Cyclustera capito* (Rudolphi, 1819); **C. ibisae* (Schmidt & Bush, 1972); **Dendrouterina ardeae* Rausch, 1955; **D. herodiae* Fuhrmann, 1912; **D. papillifera* (Fuhrmann, 1908); *Glossocercus auritus* (Rudolphi, 1819); **Neogryporhynchus cheilancristrotus* (Wedl, 1855); *Paradilepis caballeroi* Rysavy & Macko, 1973; *Paradilepis* sp.; *Parvitaenia cochlearii* Coil, 1955; and *Valipora mutabilis* Linton, 1927. *Dendrouteria herodiae* is reported from America for the first time. New definitive hosts are *Phalacrocorax olivaceus* for *C. capito*, *N. cheilancristrotus* and *P. caballeroi*; *Casmerodius albus* and *Egretta thula* for *G. auritus*; and *E. thula* for *D. herodiae*. Data on the morphology of the rostellar hooks of all species, their hosts and distribution in Mexico are provided.

Introduction

Tapeworms of the family Dilepididae Railliet & Henry, 1909 (Eucestoda: Cyclophyllidea) are frequent and widely distributed parasites of birds, with many species parasitising fish-eating birds, such herons, spoonbills and cormorants (Bona, 1994). The taxonomy of the group has been treated in detail by Bona (1975, 1994), but the information on the occurrence of dilepidid cestodes, their species composition and distribution in Latin America is rather limited (see Bona, 1975, 1983a,b).

This is also valid for Mexico, from where only three records of adult dilepidids have been published. Coil (1955a) reported adults of *Cyclustera capito* (Rudolphi, 1819) from the roseate spoonbill *Platalea ajaja* L. from Oaxaca, and the same author (Coil 1955b) described *Parvitaenia cochlearii* from the boat-billed heron *Cochlearius cochlearius* (L.) from both Oaxaca and Chiapas. More recently, Lamothe-Argumedo et al. (1997) listed four species of dilepidids found in Mexico; namely, *Dendrouterina botauri* Rausch, 1948 from *Egretta thula* (Molina), *Dilepis hilli* Polk, 1941 from *Bubulcus ibis* (L.), and *Ophiovalipora minuta* (Coil, 1950) and *O. nycticoracis* (Olsen, 1936) from *Nycticorax nycticorax* (L.). However, no data on the morphology of these species have been provided.

Scholz & Salgado-Maldonado (2001) have recently found metacestodes of as many as 13 species of dilepidid tapeworms in fishes from Mexico, which indicates that cestodes of this family may be relatively frequent parasites. During studies on the helminth parasites of piscivorous birds from central and southeastern Mexico, several species of dilepidid cestodes

were found, with most tapeworms being reported as adults from Mexico for the first time.

During the evaluation of this material, all vouchers of dilepidids found in Mexico and deposited in the National Helminthological Collection of Mexico (CNHE), Instituto de Biología, Universidad Nacional Autónoma de México, Mexico City, were also examined and numerous misidentifications were found. Therefore, all available material of dilepidid tapeworms parasitising fish-eating birds in Mexico has been revised and a survey of species is presented, together with the information on the spectrum of their definitive hosts, geographical distribution and life-cycles.

Materials and methods

The specimens studied were found in fish-eating birds from several localities in central and southeastern Mexico (see 'Survey of species'). Freshly collected specimens were fixed with 4% formaldehyde solution, either under pressure or with hot (almost boiling) fixative. Scoleces of some specimens were squashed to place the rostellar hooks into one layer and then fixed with glycerine-ammonium picrate, using the methodology outlined by Ergens (1969). The following voucher specimens from the National Helminthological Collection of Mexico have been examined: *Dendrouterina botauri* Rausch, 1948 (CNHE Collection No. 1314); *Dilepis hilli* Polk, 1941 (CNHE 393); *Ophiovalipora minuta* Coil, 1950 (CNHE 392); and *O. nycticoracis* (Olsen, 1937) (CNHE 1315). The types (holotype and paratypes) of *Glossocercus caribaensis* (Rysavy & Macko, 1973) from the helminthological collection of the Parasitological Institute, Slovak Academy of Sciences, Košice (PISAS 9673a,b,c,e), 9 type-specimens (8 specimens labelled as 'syntypes' and one as 'paratype') of *Paradilepis brevis* Burt, 1940 and vouchers of *Paradilepis scolecina* (Rudolphi, 1819) from The Natural History Museum, London, UK (BMNH 1983.7.19.13-17 and 1946.5.6.41-55, respectively), and vouchers of *P. scolecina* from the helminthological collection of the Institute of Parasitology, Academy of Sciences of the Czech Republic, České Budějovice (IPCAS C-168) were also studied.

As most species were redescribed by Bona (1975), morphological descriptions of the Mexican material are largely limited to data on the rostellar hooks. Measurements in descriptions are in micrometres (μm) unless otherwise stated. The specimens are deposited in the National Helminthological Collection of Mexico (CNHE); US National Parasite Collection (USNPC), Beltsville, Maryland, USA; Institute of Parasitology, Academy of Sciences of the Czech Republic, České Budějovice (IPCAS); and The Natural History Museum, London, UK (BMNH). The classification proposed by Bona (1975, 1994) is followed in this paper and the nomenclature of bird species follows that of del Hoyo et al. (1992). Species being reported from Mexico for the first time are marked with an asterisk.

Survey of species

Cyclustera capito (Rudolphi, 1819) Fuhrmann, 1901 (Figure 1A)

Host and locality: *Phalacrocorax olivaceus* (Humboldt) – State of Yucatán: Chelém lagoon at Chuburná (January, 1994).
Site: Intestine.
Specimens deposited: IPCAS C-278.
Comments: The specimens found were in bad condition, which made it impossible to obtain detailed data on their strobilar morphology. However, the shape and size of the hooks (Table 1; compare Figure 1A with plate 67, figure Aa in Bona, 1975) and the internal morphology, such as the regularly alternating genital pores, the distribution (surrounding the seminal receptacle) and number (about 50) of testes, the dilation of the vagina in premature proglottids, the shape of thick-walled cirrus-sac, and the presence of cyclusteroid rostellar apparatus with a very large pouch, are identical to those typical of *Cyclustera capito* (see Bona, 1975, 1994).

This species was redescribed by Coil (1955a) and Bona (1975). The former author found adults of *C. capito* in the roseate spoonbill *Platalea ajaja* from Tututepec, Oaxaca, Mexico, and reported the hooks being 213–250 (distal) and 147–169 (proximal) in length. The tapeworms from Yucatán have distal hooks of a similar size (length 218–234; Table 1) to those redescribed by Coil (1955a), but the proximal hooks are longer (173–186). Bona (1975) found the hooks to be 218–227 (distal) and 169–178 (proximal) long, whilst Rysavy & Macko (1973) recorded them as 224–233 and 167–180 long; both of these correspond more closely to the present material.

Adults of *C. capito* have been found in *P. ajaja* and *Eudocimus albus* (L.) from South America and North America, including Mexico and Cuba (Coil, 1955a;

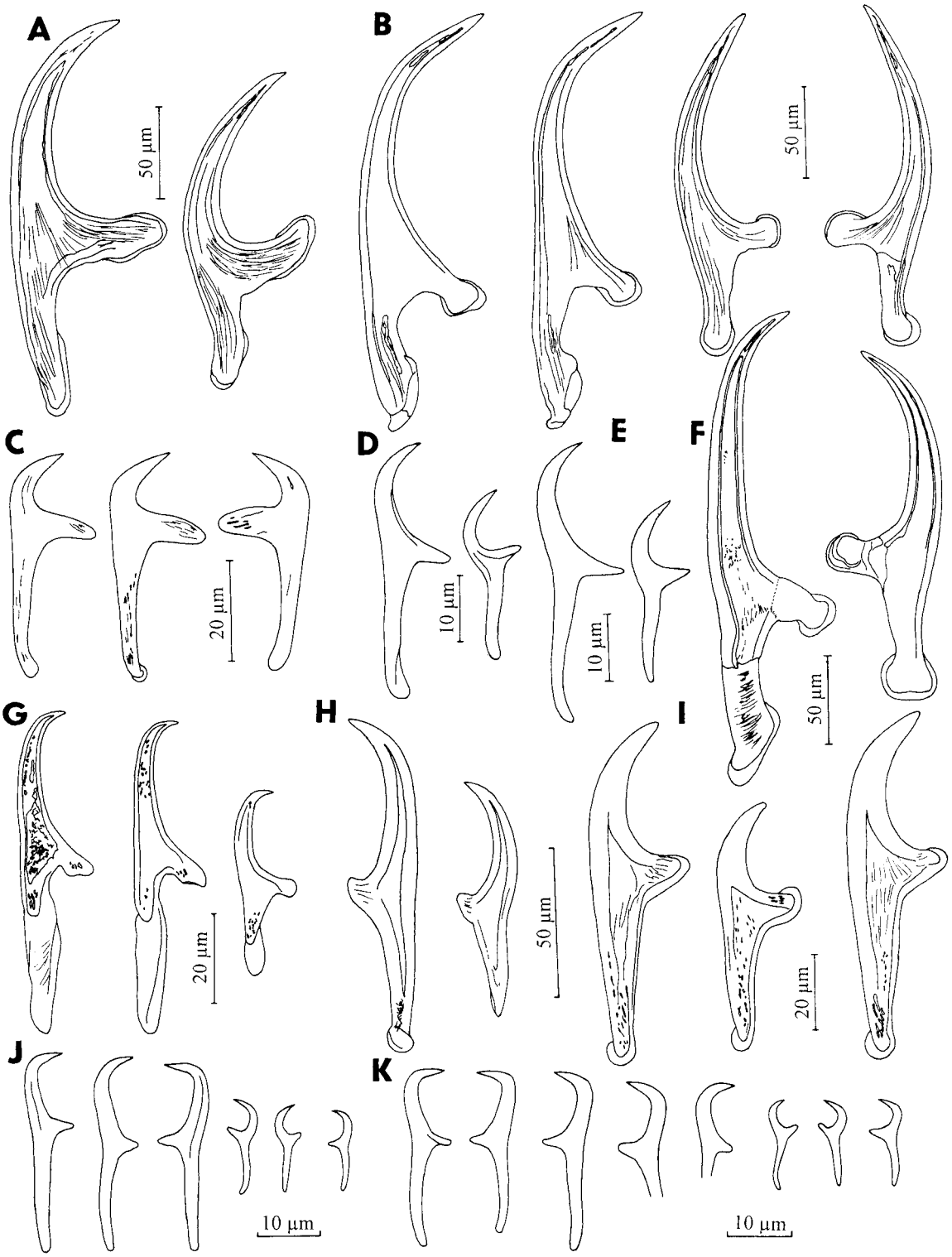

Figure 1. Rostellar hooks of adults of dilepidid cestodes from Mexico (distal hooks on the left). A. *Cyclustera capito* (Rudolphi, 1819); B. *C. ibisae* (Schmidt & Bush, 1972); C. *Dendrouterina ardeae* (Rausch, 1955) (two distal hooks on the left); D. *Dendrouterina herodiae* Fuhrmann, 1912 (CNHE 1314); E. *Dendrouterina papillifera* (Fuhrmann, 1908) (CNHE 393); F. *Glossocercus auritus* (Rudolphi, 1819); G. *Neogryporhynchus cheilancristrotus* (Wedl, 1855); H. *Paradilepis caballeroi* Rysavy & Macko, 1973; I. *Paradilepis* sp. (proximal hook in the middle); J, K. *Valipora mutabilis* Linton, 1927 (J, CNHE 392; K, CNHE 1315).

Table 1. Measurements of rostellar hooks of species of the Dilepididae from fish-eating birds in Mexico (range with mean ± standard deviation).

	Cyclustera capito (n=17)	*Cyclustera ibisae* (n=15)	*Dendrouterina ardeae* (n=4)	*Dendrouterina herodiae* (n=6)	*Dendrouterina papillifera* (n =2)
Distal hooks	218–234 228 ± 4.7	227–243 233 ± 5.5	45–48 47	38–40 39	41–42
Blade	128–134 131 ± 2.8	160–176 168 ± 6.4	19–21.5 20	15–21.5 17	21–22
Handle	122–141 128 ± 5.1	77–96 88 ± 6.3	34–37 35	21.5–28 26	24–25
Ratio	0.9–1.1	1.7–2.2	0.5–0.6	0.5–1.0	0.9
Proximal hooks	173–186 179 ± 4.3	179–198 190 ± 6.4	44–45 44	25–30 27	26–27
Blade	83–106 95 ± 5.9	128–141 135 ± 5.2	18–21.5 19.5	9–11 10	12
Handle	99–112 105 ± 3.9	70–86 80 ± 4.6	32–33 32	15–18 16.5	17
Ratio	0.8–1.0	1.6–1.8	0.6–0.7	0.5–0.7	0.7

	Glossocercus auritus (n=34)	*Neogryporhynchus cheilancristrotus* (n=7)	*Paradilepis caballeroi* (n=42)	*Paradilepis* sp. (n=12)	*Valipora mutabilis* (n=10)
Distal hooks	237–285 260 ± 11	65–75 71.5	98–119 113 ± 5	95–101 98 ± 1.8	27–31 29
Blade	160–195 182 ± 9.5	38–44 41	52–59 55.5 ± 2	36–39 38 ± 1.2	11–15 13
Handle	102–160 118 ± 12.5	35–38 37	43–67 58 ± 5	59–67 63 ± 2.5	15–19 17
Ratio	0.6–0.9	0.9–1.0	0.85–1.2	0.6	0.6–0.8
Proximal hooks	160–224 193 ± 15	39–44 41	75–88 82 ± 3	65–71 69 ± 2	11–14 11.5
Blade	115–138 125 ± 6	21.5–24 23	35–41 39 ± 1.3	25–26 26 ± 0.4	4–6 5.5
Handle	74–120 93 ± 5	20–24 22	37–52 44 ± 3.1	46–52 47 ± 1.9	6.5–11 9
Ratio	0.5–0.8	0.95–1.00	0.75–1.05	0.5–0.6	0.5–0.8

Rysavy & Macko, 1973; Bona, 1975; Sepúlveda et al., 1994). Records from other hosts, such as *Mycteria ibis* (L.), *Plegadis falcinellus* (L.) and *P. leucorodia* L. from northern Africa and the former USSR were considered doubtful by Bona (1975).

Phalacrocorax olivaceus represents a new definitive host of *C. capito* and the first record from a phalacrocoracid bird. However, it needs to be confirmed whether this host represents a suitable definitive rather than accidental host of *C. capito*. The metacestodes of *C. capito* have been recorded recently from the cyprinodontid fish *Floridichthys polyommus* Hubbs in Mexico (Scholz & Salgado-Maldonado, 2001).

******Cyclustera ibisae* **(Schmidt & Bush, 1972) Bona, 1975** (Figure 1B)

Syns *Parvitaenia ibisae* Schmidt & Bush, 1972; *Parvitaenia eudocimi* Rysavy & Macko, 1973
Host and locality: *Phalacrocorax olivaceus* – Yucatán: Chelém lagoon at Chuburná (January, 1994).
Site: Intestine.
Specimens deposited: IPCAS C-280.
Comments: The tapeworms from Yucatán correspond in their morphology to *Cyclustera ibisae*, described by Schmidt & Bush (1972) from the intestine of the white ibis *Eudocimus albus* from Florida. Rysavy & Macko

(1973) found apparently conspecific tapeworms in *E. albus*, *Casmerodius albus* (L.), *Phalacrocorax auritus* (Lesson) and *P. mexicanus* (= *P. olivaceus mexicanus* (Brandt)) from Cuba (see Bona, 1975).

The hooks of specimens from Mexico are arranged in 2 circles of 10 hooks each, and measure 227–243 (distal) and 179–198 (proximal) in length (Table 1), which fits into the measurements given by Schmidt & Bush (1972) and Bona (1975) (distal hooks 221–240, proximal hooks 170–204). The hooks possess epiphyseal thickenings and striations on the base of the handle and on the guard (Figure 1B).

Adults of *C. ibisae* have been found in different groups of piscivorous birds, but existing records are limited to the southeastern USA (Florida, Georgia), Cuba and southeastern Mexico (Yucatán Peninsula) (Schmidt & Bush, 1972; Rysavy & Macko, 1973; Sepúlveda et al., 1994, 1999; Kinsella et al., 1996; Kinsella & Forrester, 1999; present study).

Metacestodes of *C. ibisae* have recently been found in the mesenteries of the mummichogs *Fundulus heteroclitus* (L.) and *F. majalis* (Walbaum) from South Carolina, USA (Scholz et al., 2002).

******Dendrouterina ardeae* **(Rausch, 1955) Bona, 1975**
(Figures 1C, 2A)

Host and locality: *Ardea herodias* L. – Estado de México: Almoyo del Río (2000).
Site: Intestine.
Specimens deposited: CNHE 4389.
Comments: These tapeworms resemble, in their morphology (Figures 1C, 2A), the species *D. ardeae*, described as *Cyclustera ardeae* from *Ardea herodias* in the USA (Wisconsin) by Rausch (1955). There is a great discrepancy in the measurements of the rostellar hooks between the original description (hooks reported to be 43 and 33 long) and the data provided by Bona (1975), who redescribed the species on the basis of his examination of the type and reported that the hooks are 50.5–51.5 and 48–48.5 in length. The only scolex of the specimens from Mexico was not sufficiently flattened, which made it difficult to measure the hooks accurately. Measurements of four best visible hooks (45–48 and 44–45; Table 1) correspond more closely to the measurements presented by Bona (1975) than to those of the original description.

The length of the hooks of the Mexican specimens best corresponds to that reported for *Dendrouterina macrosphincter* (Fuhrmann, 1909). This cestode species has been found in several species of herons in Africa, Europe and Asia, and its hooks were reported to measure 42.5–49 and 39–47 according to Bona (1975). However, the hooks of Mexican specimens and *D. macrosphincter* differ markedly in the shape of the guard, which is slightly widened and directed posteriorly in the former species (versus more slender and directed perpendicularly in *D. macrosphincter* – see plate 3 of Bona, 1975). In the shape of the hooks, the specimens from Mexico do not differ from those of *D. ardeae* (see plate 3 of Bona, 1975). They also correspond to *D. ardeae* in the number of testes (56–70 in total [mean 63 ± 4; $n = 9$], with 12–17 in the anterior group in the present study; 58–73 in total, with 6–16 in the anterior group in *D. ardeae* according to Bona, 1975). The number of testes in *D. macrosphincter* is considerably lower (38–59). Both the species also differ in the extent of the proximal (internal) end of the cirrus-sac. In *D. ardeae* the cirrus-sac overlaps the dorsal osmoregulatory canal medially, whereas it only reaches between the ventral and dorsal osmoregulatory canals, not overlapping the dorsal canal, in *D. macrosphincter* (Bona, 1975, p. 67).

The present finding is the first record of *D. ardeae* from Mexico and the first finding of this cestode since its original description in 1955. Metacestodes of this tapeworm have not yet been found.

******Dendrouterina herodiae* **Fuhrmann, 1912**
(Figures 1D, 2B)

Host and locality: *Egretta thula* – Michoacán: Pátzcuaro Lake (January, 1991).
Site: Intestine.
Specimens deposited: CNHE 1314 (*in part*).
Comments: Examination of tapeworms found by P. Ramos-Ramos in the intestine of *Egretta thula* from Pátzcuaro Lake, Michoacán (CNHE 1314) and identified as *Dendrouterina botauri* Rausch, 1948 (syn. of *Dendrouterina fuhrmanni* (Clerc, 1906) according to Bona, 1975) has revealed that they do not belong to *D. fuhrmanni.* This species has much smaller hooks (distal hooks only 34–36 long; proximal hooks 15–17 long) and they also differ in shape (see Bona, 1975, plate 1).

The tapeworms from Mexico actually belong to two other species of *Dendrouterina* Fuhrmann, 1912. All specimens with large strobila and testes arranged in only one field are indistinguishable from *D. herodiae*. This species has hooks of identical shape (com-

pare Figure 1D with Bona, 1975, plate 1A) and similar size (38–40 and 25–30 in the present material, Table 1; 38–43 and 25.5–27.5 according to Bona, 1975). The internal morphology is also identical, including the presence of numerous testes (47–58 in number [52 ± 3; n = 21] in the present material; 46–57 testes according to Bona, 1975), which form one field posterior to the ovary, without any testes anterior to the ovarian lobes as occurs in other species of *Dendrouterina* (see Bona, 1975). The remaining specimen on the same slide as *D. herodiae* belongs to *D. papillifera* (see below).

Dendrouterina herodiae was described from *Egretta garzetta* (L.) from the Sudan, and then found in Italy and Central Africa (Zambia) (Bona, 1975). The present finding represents the first record of *D. herodiae* from the Americas and *E. thula* is a new definitive host.

******Dendrouterina papillifera* **(Fuhrmann, 1908) Baer & Bona, 1960** (Figure 1E, 2C)

Syn. *Dilepis hilli* Polk, 1941 (see Baer & Bona, 1960; Bona, 1975)
Host and locality: *Bubulcus ibis* – Tabasco: Teapa (1985, 1987 – see Lamothe-Argumedo et al., 1997); *Egretta thula* – Michoacán: Pátzcuaro Lake (January, 1991).
Site: Intestine.
Specimens deposited: CNHE 393 and CNHE 1314 (*in part*).
Comments: The tapeworms from *B. ibis* from Tabasco (CNHE 393), identified as *Dilepis hilli* (see Lamothe-Argumedo et al., 1997), actually belong to this species, which was synonymised with *D. papillifera* by Baer & Bona (1960). Both the taxa occur in the same host (*Hydranassa caerulea* (L.) = *Egretta caerulea*) and have been found in the USA, Cuba and Brazil (see Bona, 1975). The latter author (Bona, 1975) confirmed the synonymy of *D. papillifera* and *D. hilli* and reported that they differ only in total size ('*papillifera* ressemble à une miniature de *hilli*') and distribution of testes, which form two separate groups in *D. papillifera* (versus uninterrupted by an ovarian lobe aporally in *D. hilli*; see p. 34 and plate 5, figure B1 of Bona, 1975).

The specimens from Mexico possess hooks of identical shape (Figure 1E) and size (41–42 and 26–27; Table 1) as those of *D. papillifera* (42–43 and 27, according to Bona, 1975, plate 1E). Their internal morphology also corresponds to that of this species, including the presence of a large genital papilla (Figure 2C) and an almost identical number of testes (29–36 [33 ± 2; n = 17] in Mexican specimens; 27–36 in *D. papillifera*, according to Bona, 1975).

As mentioned above, the tapeworms from *E. thula* (CNHE 1314) were misidentified as *D. botauri* Rausch, 1948 (syn. *D. fuhrmanni*) and all but one belong to *D. herodiae*. One specimen without a scolex, mounted on the same slide as specimens of *D. herodiae*, also corresponds to *D. papillifera* in its strobilar morphology, including the number of testes (31–36).

Scholz et al. (1996) reported metacestodes of *D. papillifera* from the gall-bladder of the pimelodid catfish *Rhamdia guatemalensis* (Günther) from Yucatán, but they belonged in fact to *Valipora minuta* (Coil, 1950) (see Scholz & Salgado-Maldonado, 2001). Therefore, metacestodes of *D. papillifera* are still unknown and have been found neither in Mexico nor in other countries where adult cestodes have been recorded. Scholz & Salgado-Maldonado (2001) provided illustrations of the hooks of a *D. herodiae* specimen from *E. thula* (CNHE 1314), which was erroneously designated as *D. papillifera*.

Glossocercus auritus **(Rudolphi, 1819) Bona, 1994** (Figures 1F, 2D)

Host and locality: *Casmerodius albus* and *Egretta thula* – Veracruz: Río Papaloapán at Tlacotalpan (September, 2000).
Site: Intestine.
Specimens deposited: CNHE 4391, 4392; IPCAS C-344; USNPC 88229, 90350, 91731.
Comments: The cestodes from Veracruz correspond to the species *Glossocercus auritus*, which was redescribed as *Parvitaenia aurita* by Bona (1975) and then transferred by the same author (Bona, 1994) to *Glossocercus* Chandler, 1935. The present material does not differ in its internal morphology (Figure 2D) from that of *G. auritus*, including the number of testes (45–53 in the present material; 39–58, according to Rysavy & Macko, 1973, and Bona, 1975) and the size of the cirrus-sac (179–192 × 38–58 and 174–220 × 40–46, respectively).

The rostellar hooks of *G. auritus* are large, with well-developed epiphyseal thickenings, and are rather variable in size (length 237–285 and 160–224 in the Mexican specimens; Table 1). Rysavy & Macko (1973) and Bona (1975) reported the hooks to be

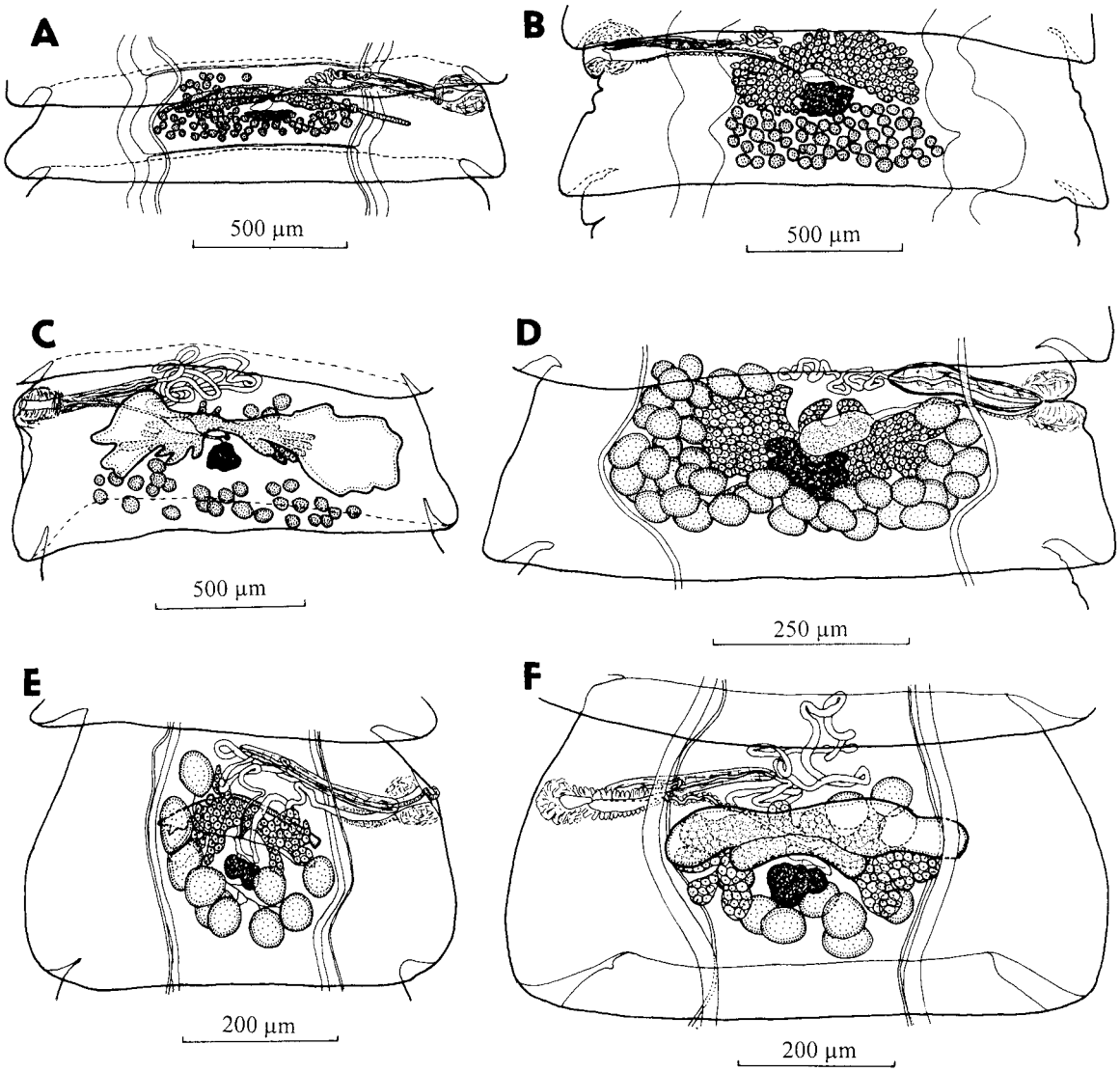

Figure 2. Mature and gravid (D) proglottids. A. *Dendrouterina ardeae* (Rausch, 1955); B. *Dendrouterina herodiae* Fuhrmann, 1912 (CNHE 1314); C. *Dendrouterina papillifera* (Fuhrmann, 1908) (CNHE 393); D. *Glossocercus auritus* (Rudolphi, 1819) from *Egretta thula*; E. *Valipora mutabilis* Linton, 1927 (CNHE 392); F. *V. mutabilis* (CNHE 1315). A,B,D,E, dorsal view; C,F, ventral view.

232-264 (distal) and 176–215 (proximal) long in material from Cuba and Brazil. The hooks of *G. auritus* metacestodes from poeciliid fish from Mexico measured 242–267 and 189–202 (Scholz & Salgado-Maldonado, 2001).

Both species of herons represent new definitive hosts for *G. auritus*, which was previously reported only from *Egretta caerulea* (L.) in Brazil and Nicaragua, and *E. tricolor* (P.L.S. Müller) from Cuba (Schmidt & Neiland, 1971; Rysavy & Macko, 1973; Bona, 1975). Existing records suggest that *G. auritus* is a specific intestinal parasite of herons of the genera *Egretta* and *Casmerodius*.

******Neogryporhynchus cheilancristrotus* **(Wedl, 1855) Baer & Bona, 1960** (Figure 1G)

Syn. *Gryporhynchus tetrorchis* Hill, 1941
Host and locality: *Phalacrocorax olivaceus* – Veracruz: Río Tecolutla (November, 1992).
Site: Intestine.
Specimens deposited: CNHE 4390.

Comments: Only a scolex of one specimen was found among several dilepidid tapeworms recovered from the intestine of *P. olivaceus* from Río Tecolutla. The morphology of the hooks and their size (65–75 and 39–44; Table 1) indicate that the tapeworm is conspecific with *Neogryporhynchus cheilancristrotus*, which has hooks 61-72 (distal) and 37-42 (proximal) in length (Bona, 1975).

Baer & Bona (1960) established a new genus, *Neogryporhynchus*, to accommodate Wedl's (1855) *Taenia cheilancristrota* from *Botaurus stellaris* (L.) from Hungary. This cestode has also been found in herons of the genera *Ardea* and *Nycticorax*, including *Ardea herodias* from the USA and Canada (reported as *Gryporhynchus tetrorchis* Hill, 1941; syn. of *N. cheilancristrotus,* according to Bona, 1975) (Hill, 1941; Mahon, 1956).

N. cheilancristrotus is considered to be specific to Ciconiiformes (Bona, 1975). Its occurrence in *Phalacrocorax olivaceus* may be accidental and gravid worms need to be found to confirm that cormorants can serve as suitable definitive hosts of this cestode.

Larval stages (metacestodes) of *N. cheilancristrotus* occur in the intestinal lumen of freshwater fish, especially cyprinids, in the Palaearctic Region (Baer & Bona, 1960; Bona, 1975). The distal hooks of metacestodes are shorter than those of adults due to the incomplete growth of amorphous parts (epiphyseal thickenings) of the handle in the fish intermediate host. Scholz (1989) and Baccarani et al. (1998) reported the hooks of metacestodes from fish to be 51–57 and 36–39 long. The most extensive material of metacestodes of *N. cheilancristrotus* was studied by Pietrock & Scholz (2000), who found the hooks of larvae from *Abramis ballerus* (L.) from Central Europe to measure 52 ± 2 (range 49–57; n = 210) and 38 ± 2 (34–40; n = 190).

Paradilepis caballeroi **Rysavy & Macko, 1973**
(Figure 1H)

Host and locality: *Phalacrocorax olivaceus* – Veracruz: Río Tecolutla (November 1992) and Río Papaloapan at Tlacotalpan (September, 2000).
Site: Intestine.
Specimens deposited: BMNH 2002.4.18.21; CNHE 4393; IPCAS C-313; USNPC 91730.
Comments: The cestodes studied are apparently conspecific with *Paradilepis caballeroi* described from *Phalacrocorax auritus* from Cuba (Rysavy & Macko, 1973). This species is typified by the presence of 24 robust hooks arranged in 2 circles, with the distal hooks measuring 105–112 and proximal 79–82 (Rysavy & Macko, 1973), which corresponds well to the present material (98–119 and 75–88; Table 1).

Paradilepis caballeroi is morphologically almost indistinguishable from *P. scolecina* (Rudolphi, 1819), a frequent parasite of cormorants and widely distributed in Europe, Asia, Africa and Australia (Matevosyan, 1963; Ryzhikov et al., 1985). According to Rysavy & Macko (1973), these species differ from one another in the size of the scolex, which is larger in *P. caballeroi* (scolex diameter 742 versus 170-387 in *P. scolecina*) and in the number of rostellar hooks (24 in the former species versus 20–22 in *P. scolecina*).

In the present material, considerable differences in the size of the scolex were found between unflattened specimens fixed with hot formaldehyde solution (scolex size 288–560 × 272–440) and those fixed under pressure (flattened), which were much larger (720–760 × 540–660). As the type-specimens of *P. caballeroi* (PISAS 9673) were strongly flattened, their larger size in relation to specimens of *P. scolecina* may have been due to the different methods of fixation. Moreover, the present study has demonstrated that measurements of the scolex of *P. caballeroi* may overlap those of *P. scolecina*.

Therefore, the only difference between *P. caballeroi* and *P. scolecina* is in the number of the hooks. All specimens from Mexico, in which hooks could be counted (14 adults and 3 metacestodes; see Scholz & Salgado-Maldonado, 2001), invariably possessed 24 hooks, which corresponds with the original description of *P. caballeroi*. A total of 20 hooks (10 + 10) were found in almost all adults of *P. scolecina* from *Phalacrocorax carbo* (L.) from the Czech Republic and Italy (IPCAS C-168; n = 164) and from Ireland (BMNH 1946.5.6.41–55; n = 6), and metacestodes from different species of cyprinid fish from the Czech Republic, Mongolia and Japan (IPCAS C-127; n = 91). Only four adult specimens (i.e. 1.5% of the specimens evaluated) had a different number of hooks: three possessed only 19 hooks (10 + 9 or 9 + 10) and one worm had as many as 27 hooks (13 + 14). Despite the presence of these specimens with apparently aberrant numbers of hooks, it seems that *P. scolecina* is typified by possessing 20 rostellar hooks.

The only author who reported the number of the rostellar hooks higher than 20 in *P. scolecina* was Burt (1940), who described *P. brevis* Burt, 1940 from *Phalacrocorax* sp. in Sri Lanka. Later, this cestode

was synonymised with *P. scolecina* (see Matevosyan, 1963). The examination of the type-specimens of *P. brevis* (BMNH 1983.7.19.13-17) has shown that all specimens labelled as 'syntypes' (n = 7) possess 20 rostellar hooks, whereas 22 hooks were found only in the worm designated as 'paratype' (see figure 112 of Matevosyan, 1963). Therefore, *P. scolecina* and *P. caballeroi* differ in the number of hooks, which supports the validity of the latter taxon, the distribution of which is at present restricted to Cuba and Mexico.

Metacestodes of *P. caballeroi*, recently found in the liver and mesenteries of *Cichlasoma callolepis* (Regan) (Cichlidae) and *Chirostoma jordani* Woolman (Atherinidae) from Mexico, have the hooks of the same shape (see figure 6 of Scholz & Salgado-Maldonado, 2001) and size (110-121 and 83-88) as the adults from cormorants (Figure 1H; Table 1).

***Paradilepis* sp.** (Figure 1I)

Host and locality: *Phalacrocorax olivaceus* – Veracruz: Tecolutla (November, 1992).
Site: Intestine.
Specimens deposited: CNHE 4394.
Comments: Only one specimen was found in *Phalacrocorax olivaceus*. It was strongly flattened during fixation and quality of its permanent preparation is low. Therefore, only basic data on its strobilar morphology could be provided. Strobila craspedote, with proglottids much wider than long; total length 10 mm; maximum width 325. Scolex 740 long, 720 wide, with ovate rostellum (230 × 237) and 4 suckers (166–173 × 154–163). Hooks (22 in number) robust (Figure 1I), 95–101 (distal) and 65–71 (proximal) in length (Table 1). Testes large, widely oval to spherical, c. 30 in diameter, 4 in number (2 aporal, 1 median, 1 poral). Sperm ducts forming numerous coils, which overlap osmoregulatory ducts laterally. Cirrus-sac pyriform, thick-walled; cirrus armed with large spines. Genital pores unilateral, situated sinistrally. Ovary bilobed, biscuit-shaped; vitellarium spherical. Gravid proglottids not present.

This cestode apparently belongs to the genus *Paradilepis* Hsü, 1935 because of the shape of the hooks and aspects of the strobilar morphology, such as the small number of testes and unilateral genital pores situated sinistrally (Baer & Bona, 1960; Bona, 1975, 1994). The specimen studied differs markedly from congeneric species (see Matevosyan, 1963, and Bona, 1975 for a survey of the species) and may represent a new species. However, it is not formally described in this paper because only one worm, which was in poor condition and not fully mature, was available. Conspecific metacestodes possessing hooks of an almost identical shape (see figure 6C, F of Scholz & Salgado-Maldonado, 2001) and size (length 101–103 and 71–75) were found in *Chirostoma jordani* from Guanajuato, Mexico by Scholz & Salgado-Maldonado (2001).

***Parvitaenia cochlearii* Coil, 1955**

Host and locality: *Cochlearius cochlearius* (L.) – Chiapas: Palenque (1949); Oaxaca: Tututepec (type-locality).
Site: Intestine.
Specimens deposited: USNPC 37449 (holotype).
Comments: This species was described by Coil (1955b) from *C. cochlearius* in Mexico. According to the original description, the hooks of adult tapeworms measured 49.5–52.5 and 33–34.5, which is consistent with the length of the hooks of metacestodes from fish (49–56.5 and 32–37) found by Scholz & Salgado-Maldonado (2001) in Mexico. However, Bona (1975), who examined the type-specimen, reported the distal hooks to be longer (59–60; proximal hooks 36–37).

***Valipora mutabilis* Linton, 1927** (Figures 1J,K, 2E,F)

Syns *Dendrouterina lintoni* Olsen, 1937; *D. nycticoracis* Olsen, 1937; *Ophiovalipora nycticoracis* (Olsen, 1937)
Host and locality: *Nycticorax nycticorax* – Michoacán: Pátzcuaro Lake (August, 1992); Tabasco: Río Teapa (November, 1985).
Site: Intestine.
Specimens deposited: CNHE 392 (as *Ophiovalipora minuta*), CNHE 1315 (as *O. nycticoracis*).
Comments: Lamothe-Argumedo et al. (1997) reported adult tapeworms, found by P. Ramos-Ramos in the intestine of *N. nycticorax* from Pátzcuaro Lake (CNHE 1315), under the name *Ophiovalipora nycticoracis*. Examination of these specimens showed their conspecificity with *Valipora mutabilis*, which corresponds with the previous synonymy of *O. nycticoracis* with *V. mutabilis* proposed by Bona (1975). According to this author, the rostellar hooks of *V. mutabilis* are 28–32 and 14–17 long; those of Mexican specimens measure 27–31 and 11–12 (Table 1; Figure 1K).

Cestodes found in the same host (CNHE 392) and identified as *O. minuta* Coil, 1950 (CNHE 392) (see Lamothe-Argumedo et al., 1997) also belong in fact to *V. mutabilis* Linton, 1927. *Valipora minuta* has hooks that differ in shape (see Bona, 1975; figure 3 in Scholz & Salgado-Maldonado, 2001) and are considerably larger (35–40 and 17–21.5) than those of the tapeworms from Mexico (28–30 and 11.5–14; Figure 1J).

V. mutabilis closely resembles *V. campylancristrota* (Wedl, 1855), the metacestodes of which have recently been found in fish from Mexico (Scholz & Salgado-Maldonado, 2001). Both species can be distinguished by the slightly different shape of their hooks (see Bona, 1975; Scholz & Salgado-Maldonado, 2001) and the number of testes (9–16 in the former species versus 7–8 in *V. campylancristrota*; see Bona, 1975). In the present material, 9–11 (mean 10 ± 0.6; $n = 47$) testes were found, which, together with the shape of the hooks (Figure 1J,K), indicates that the specimens belong to *V. mutabilis*.

Adults of *V. mutabilis* have been found in *N. nycticorax* and *Butorides striatus virescens* L. from the USA, Cuba, Italy and China (Rysavy & Macko, 1973; Bona, 1975); they are now reported from Mexico for the first time. Metacestodes of *V. mutabilis* are known only from the gall-bladder of cichlid and pimelodid fish from Mexico (Scholz & Salgado-Maldonado, 2001). The measurements of their hooks correspond to those of adults, ranging from 28 to 30 (distal) and from 13.5 to 15.5 (proximal).

Discussion

A total of 11 species of dilepidid cestodes have been found as adults in fish-eating birds from Mexico, with five of them (*Cyclustera ibisae*, *Dendrouterina ardeae*, *D. herodiae*, *D. papillifera* and *Neogryporhynchus cheilancristrotus*) being reported from this country for the first time. Despite the relatively high number of the taxa listed in this survey, adults of at least seven other species must occur in Mexico because their larval stages have been found in fish: *Cyclustera* cf. *ralli* (Underwood & Dronen, 1986); *Dendrouterina pilherodiae* Mahon, 1956; *Glossocercus caribaensis* (Rysavy & Macko, 1973); *Paradilepis* cf. *urceus* (Wedl, 1855); *Parvitaenia macropeos* (Wedl, 1855); *Valipora minuta*; and *V. campylancristrota* (see Scholz & Salgado-Maldonado, 2001; Table 2).

Five of the species found in this study, namely, *C. ibisae*, *D. ardeae*, *D. herodiae*, *D. papillifera* and *N. cheilancristrotus*, are known from Mexico only as adult stages and their metacestodes have not been found (Table 2). In total, as many as 18 species of tapeworms of the family Dilepididae, parasitising fish as metacestodes and fish-eating birds as adults (according to some authors, the family Gryporhynchidae Spasskii & Spasskaya, 1973 – see Mariaux, 1998, and Hoberg et al., 1999), are now reported from this country. However, the data available are scarce and do not provide us with sufficient information on the actual occurrence of individual species. This is obvious from the fact that only six of the 18 species have been found as both metacestodes in fish and adults in piscivorous birds (Table 2), and that findings of different life-history stages of these species usually originate from different parts of Mexico.

Seven of the species listed (*Cyclustera capito*, *C. ibisae*, *D. papillifera*, *Glossocercus auritus*, *G. caribaensis*, *Paradilepis caballeroi* and *Valipora mutabilis*) have also been found in Cuba (Rysavy & Macko, 1973), which demonstrates the close similarity of the cestode faunas of piscivorous birds in Cuba and, especially in the southeastern region, Mexico.

It is obvious from the number of misidentifications of dilepidids from Mexico (Scholz et al., 1996; Lamothe-Argumedo et al., 1997) that the taxonomy of this group of cyclophyllidean cestodes still remains unresolved in some cases, even though comprehensive treatises of this group of cyclophyllidean tapeworms have been published (Bona, 1975, 1994). One of the major difficulties is caused by the poor quality of specimens available due to inappropriate fixation and processing. This makes it difficult to accurately describe the shape and size of the hooks and to study the internal morphology in sufficient detail. Shortage of data from Mexico is also related to the fact that hardly any attention has been paid to investigations into the helminth parasites of fish-eating birds. In addition, the results of the few existing studies on this topic remained unpublished, such as the data by P. Ramos-Ramos from Pátzcuaro Lake (see Lamothe-Argumedo et al., 1997).

Individual species of the Dilepididae found in Mexico exhibit different degrees of host-specificity, with *C. ibisae* being the most ubiquitous parasite, having been reported from a wide spectrum of definitive hosts (ibises, spoonbills, cormorants, herons, pelicans, common loons, ospreys) (see Scholz et al., 2002, for references). Other tapeworms, such as *N.*

Table 2. Distribution of species of the Dilepididae from second intermediate (fish) and definitive (birds) hosts in Mexican states (species found both as larvae and adults in bold).

Species	Fish (second intermediate host)	Birds (definitive hosts)
Cyclustera capito	Yucatán[1]	Oaxaca[2], Yucatán[3]
Cyclustera ibisae	–	Yucatán[3]
Cyclustera cf. *ralli*	Guanajuato, State of México, Michoacán[1]	–
Dendrouterina ardeae	–	Veracruz[3]
Dendrouterina herodiae	–	Michoacán[4]
Dendrouterina papillifera	–	Michoacán[4], Tabasco[5]
Dendrouterina pilherodiae	Yucatán[6]	–
Glossocercus auritus	Guerrero, Hidalgo, Oaxaca, Veracruz[1]	Veracruz[3]
Glossocercus caribaensis	Yucatán[1]	–
Neogryporhynchus cheilancristrotus	–	Veracruz[3]
Paradilepis caballeroi	Campeche, Guanajuato[1]	Veracruz[3]
Paradilepis cf. *urceus*	Guanajuato[1]	–
***Paradilepis* sp.**	Guanajuato[1]	Veracruz[3]
Parvitaenia cochlearii	Guerrero, Jalisco, Nayarit[1]	Oaxaca[7]
Parvitaenia macropeos	Guerrero[1]	–
Valipora campylancristrota	State of México, Yucatán[1]	–
Valipora minuta	Guerrero, Quintana Roo, Yucatán[1,8]	–
Valipora mutabilis	Campeche, Nayarit, Yucatán[1]	Michoacán[9,10]

[1]Scholz & Salgado-Maldonado (2001); [2]Coil (1955a); [3]Present study; [4]Lamothe-Argumedo et al. (1997, as *Dendrouterina botauri*); [5]Lamothe-Argumedo et al. (1997, as *Dilepis hilli*); [6]Scholz et al. (1996); [7]Coil (1955b); [8]Scholz et al. (1996, as *Dendrouterina papillifera*); [9]Lamothe-Argumedo et al. (1997, as *Ophiovalipora minuta*); [10]Lamothe-Argumedo et al. (1997, as *Ophiovalipora nycticoracis*).

cheilancristrotus and *C. capito,* also occur in members of more than one bird family but most taxa have been found in members of only one (*P. caballeroi*, *Paradilepis* sp., *Parvitaenia cochlearii*) or two (*D. ardeae*, *D. herodiae*, *D. papillifera*, *G. auritus*, *V. mutabilis*) genera. As many as five cestodes (*C. capito*, *C. ibisae*, *N. cheilancristrotus*, *P. caballeroi*, *Paradilepis* sp.) have been found in *Phalacrocorax olivaceus* from Mexico, but for some species, such as *C. capito* and *N. cheilancristrotus,* the cormorants may serve as accidental rather than definitive hosts. Other birds, such as herons, usually harbour only one dilepidid species.

Acknowledgements

The authors are indebted to Boyko B. Georgiev, Central Laboratory of Ecology, Sofia, Bulgaria, and Franco V. Bona, University of Torino, Italy, for helpful suggestions, to Rafael Lamothe-Argumedo and Luís García-Prieto, Instituto de Biología, Universidad Nacional Autónoma de México (UNAM), Mexico City, Mexico, for loan of voucher specimens of dilepidid tapeworms found in Mexico, Josef K. Macko, Parasitological Institute, Košice, Slovakia for the loan of paratypes of *Paradilepis cabelleroi* and David I. Gibson, Rodney A. Bray and Eileen Harris, The Natural History Museum, London, UK, for loan of types of *Paradilepis brevis* and vouchers of *P. scolecina*. Thanks are also due to the staff of the Laboratory of Parasitology, CINVESTAV-IPN Mérida, and the Laboratory of Helminthology, Instituto de Biología, UNAM, Mexico, for help in collecting and examining fishes, and to Martina Borovková, Institute of Parasitology, Academy of Sciences of the Czech Republic, České Budějovice, and Griselda Moreno-Navarette, Instituto de Biología, UNAM, for technical assistance. Sandie King, University of Glasgow, corrected the English of an early draft of this paper. This study was supported by the grants nos 206/98/0591 and 525/01/1314 of the Grant Agency of the Czech Republic to T.S. and no. 400355-5-27668a of the National Council for Science and Technology of Mexico (CONACyT) to G.S.-M. The visits of T.S. to Mexico were supported by CONACyT (catedra patrimonial), CINVESTAV-IPN Mérida, UNAM, Mexico and the Institute of Parasitology, AS CR, České Budějovice.

References

Baccarani, E.M., Bona, F.V., Buriola, E. & Canestri-Trotti, G. (1998) Larval cestode infections in tench (*Tinca tinca*). *Parassitologia*, **40** (Suppl. 1), 5.

Baer, J.G. & Bona, F.V. (1960) Révision des Cestodes Dilepididae Fuhrm., 1907 des Ardéiformes. Note préliminaire. *Bolletino del Istituto e Museo di Zoologico dell'Università di Torino*, **6**, 91–143.

Bona, F.V. (1975) Etude critique et taxonomique des Dilepididae Fuhrm., 1907 (Cestoda) parasites des Ciconiiformes. Considérations sur la spécificité et la spéciation. *Monitore Zoologico Italiano, N.S. Monografia,* **1**, 1975, xii + 750 pp.

Bona, F.V. (1983a) Variability and growth of cestodes; premises to a biometric analysis. *Dendrouterina pilherodiae meridionalis* n. subsp., parasite of *Egretta alba* (Ciconiiformes) in Argentina and redescription of the type of *D. pilherodiae* Mahon, 1956 (Cestoda, Dilepididae). Part I. *Rivista di Parassitologia*, **44**, 280–297.

Bona, F.V. (1983b) Variability and growth of cestodes; premises to a biometric analysis, *Dendrouterina pilherodiae meridionalis* n. subsp., parasite of *Egretta alba* (Ciconiformes) in Argentina and redescription of the type of *D. pilherodiae* Mahon, 1956 (Cestoda, Dilepididae). Part II. *Rivista di Parassitologia*, **44**, 427–469.

Bona, F.V. (1994) Family Dilepididae Railliet & Henry, 1909. *In*: Khalil, L.F., Jones, A. & Bray, R.A. (Eds) *Keys to the cestode parasites of vertebrates*. Wallingford, Oxon: CAB International, pp. 443–554.

Burt, D.R.R. (1940) New species of cestodes from Charadriiformes, Ardeiformes and Pelecaniformes in Ceylon. *Ceylon Journal of Science*, **22**, 1–63.

Coil, W.H. (1955a) The morphology of *Cyclustera capito* (Rudolphi, 1819) Fuhrmann, 1901. *Transactions of the American Microscopical Society*, **74**, 353–357.

Coil, W.H. (1955b) *Parvitaenia cochlearii* sp. nov. (Cestoda: Dilepididae) a new tapeworm parasitic in boat-billed heron, *Cochlearius cochlearius*. *Proceedings of the Helminthological Society of Washington*, **22**, 66–68.

Ergens, R. (1969) The suitability of ammonium picrate-glycerin in preparing slides of lower Monogenoidea. *Folia Parasitologica*, **16**, 320.

Hoberg, E.P., Jones, A. & Bray, R.A. (1999) Phylogenetic analysis among the families of the Cyclophyllidea (Eucestoda) based on comparative morphology, with new hypotheses for co-evolution in vertebrates. *Systematic Parasitology*, **42**, 51–73.

del Hoyo, J., Elliott, A. & Sargatal, J. (Eds) (1992) *Handbook of the birds of the world*. Vol. 1. Barcelona: Lynx Edicions, 696 pp.

Hill, W.C. (1941) *Gryporhynchus tetrorchis*, a new dilepidid cestode from the great blue heron. *Journal of Parasitology*, **27**, 171–172.

Kinsella, J.M., Cole, R.A., Forrester, D.J. & Roderick, C.L. (1996) Helminth parasites of the osprey, *Pandion haliaetus*, in North America. *Journal of the Helminthological Society of Washington*, **63**, 262–265.

Kinsella, J.M. & Forrester, D.J. (1999) Parasitic helminths of the common loon, *Gavia immer*, on its wintering grounds in Florida. *Journal of the Helminthological Society of Washington*, **66**, 1–6.

Lamothe-Agumedo, R., García-Prieto, L., Osorio-Sarabia, D. & Pérez-Ponce de León, G. (1997) *Catálogo de la colección nacional de helmintos*. México, D.F.: Universidad Nacional Autónoma de México, 211 pp.

Mahon, J. (1956) *Dendrouterina pilherodiae* sp. nov. (Dilepididae) from *Pilherodius pileatus* (Bodd.). *Canadian Journal of Zoology*, **34**, 28–34.

Mariaux, J. (1998) A molecular phylogeny of the Eucestoda. *Journal of Parasitology*, **84**, 114–124.

Matevosyan, E.M. (1963) [Dilepidoidea – tapeworm helminths of domestic and wild animals]. Moscow: Nauka. *Osnovy Tsestodologii*, **3**, 688 pp. (In Russian).

Pietrock, M. & Scholz, T. (2000) Morphometrics and seasonal occurrence of metacestodes of *Neogryphorhynchus cheilancistrotus* (Cestoda: Dilepididae) in the blue bream (*Abramis ballerus*) from the Oder River (Germany/Poland). *Folia Parasitologia*, **47**, 181–185.

Rausch, R. (1955) *Cyclustera ardeae* n. sp. and the status of *Dendrouterina* Fuhrmann, 1912 (Cestoda: Dilepididae). *Proceedings of the Helminthological Society of Washington*, **22**, 25–29.

Rysavy, B. & Macko, J.K. (1973) Bird cestodes of Cuba. I. Cestodes of birds of the orders Podicipediformes, Pelecaniformes and Ciconiiformes. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología*, **42** (1971), 1–28.

Ryzhikov, K. M., Ryšavý, B., Khokhlova, I.G., Tolkatcheva, L.M. & Kornyushin, V.V. (1985) *Helminths of fish-eating birds of the Palaearctic region II. Cestoda and Acanthocephales*. Praha: Academia, 412 pp.

Schmidt, G.D. & Bush, A.O. (1972) *Parvitaenia ibisae* sp. n. (Cestoidea: Dilepididae), from birds in Florida. *Journal of Parasitology*, **58**, 1,095–1,097.

Schmidt, G.D. & Neiland, K.A. (1971) Helminth fauna of Nicaragua. IV. *Sacciuterina mathevossiani* sp. nov. (Dilepididae) and other cestodes of birds. *Parasitology*, **62**, 145–149.

Scholz, T. (1989) Amphilinida and Cestoda, parasites of fish in Czechoslovakia. *Acta Scientiarum Naturalium Brno* **23**, No. 4, 56 pp.

Scholz, T. & Salgado-Maldonado, G. (2001) Metacestodes of the family Dilepididae (Cestoda: Cyclophyllidea) parasitising fishes in Mexico. *Systematic Parasitology*, **49**, 23–39.

Scholz, T., Steele, E., Beckham, M. & Bray, R. A. (2002) Larval tapeworms (Cestoda: Dilepididae) from the mummichog *Fundulus heteroclitus* (Linnaeus, 1766) and striped killifish *Fundulus majalis* (Walbaum, 1792) from South Carolina, U.S.A. *Comparative Parasitology* (in press).

Scholz, T., Vargas-Vázquez, J., Moravec, F., Vivas-Rodríguez, C. & Mendoza-Franco, E. (1996) Cestoda and Acanthocephala of fish from cenotes (sinkholes) of the Peninsula of Yucatan, Mexico. *Folia Parasitologica*, **43**, 141–152.

Sepúlveda, M.S., Spalding, M.G., Kinsella, J.M., Bjork, R.D. & McLaughlin, G.S. (1994) Helminths of the roseate spoonbill, *Ajaia ajaja*, in southern Florida. *Journal of the Helminthological Society of Washington*, **61**, 179–189.

Sepúlveda, M.S., Spalding, M.G., Kinsella, J.M. & Forrester, D.J. (1999) Parasites of the great egret (*Ardea albus*) in Florida and a review of the helminths reported for the species. *Journal of the Helminthological Society of Washington*, **66**, 7–13.

Wedl, C. (1855) Charakteristik mehrerer gröstenteils neuer Taenien. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften Wien, Mathematische Naturwissenschaften*, **18**, 2–27.