Mem. Inst. Oswaldo Cruz, Rio de Janeiro, Vol. *84* (3): 371-376, jul./set. 1989

HYPERPARASITISM BY HELMINTHS: NEW RECORDS OF CESTODES AND NEMATODES IN PROTEOCEPHALID CESTODES FROM SOUTH AMERICAN SILURIFORM FISHES

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Proteocephalid cestode hyperparasites are reported from numerous proteocephalids occurring in pimelodid fishes in different regions of Brazil. In addition, three specimens of a nematode hyperparasite are reported from the proteocephalid cestode Choanoscolex abscissus *from the pimelodid fish* Pseudoplatystoma corruscans *in Brazil. Previous records of cestode and nematode hyperparasites of cestodes are listed, and the possible identities of the Brazilian records are discussed.*

Key words: hyperparasitism – proteocephalid cestode – nematode – pimelodid fishes – Brazil

Hyperparasitism has long intrigued parasitologists, and, although most reports are of Protozoa (see Dollfus, 1946; Canning, 1975), a number of helminth parasites of helminths have been recorded. Dollfus (1946) valuable monograph on this subject details the data on this topic known at that time.

During the course of studies on the taxonomy of proteocephalid cestode parasites of Brazilian pimelodid (siluriform) fishes, the senior author has often found larval cestodes encysted in the parenchyma of these worms. Such larvae have already been referred to briefly by Rego & Pavanelli (1985; 1987) as occurring in proteocephalids from the fish *Paulicea luetkeni* (Steindachner).

More recently, during a revision by the senior author of the proteocephalids of the common Brazilian fish genus *Pseudoplatystoma* Bleeker many worms were found to harbour encysted cestode larvae, sometimes in large numbers. In addition to the cestode hyperparasites, single nematode larvae were found in three strobila of the proteocephalid *Choanoscolex abscissus* (Riggenbach, 1896) from the fish *Pseudoplatystoma corruscans* Agassiz. Details of these records are presented below and they, along with previous South American records of hyperparasitism by helminths, are commented upon.

MATERIALS AND METHODS

The proteocephalid specimens were collected alive, and then fixed and stored in formalin. Whole-mounts were stained in Delafield's haematoxylin, dehydrated in an alcoholic series, cleared in beechwood creosote and mounted in Canada balsam. Some specimens were wax-embedded, serial sectioned at 5 μm, stained in haematoxylin and eosin and mounted in Canada balsam. The material is deposited in the Helminthological Collection of Instituto Oswaldo Cruz (IOC Collection) 32.547 – 32.552.

Drawing was made with the aid of a drawing apparatus and all measurements are given in micrometres unless otherwise stated.

RESULTS

Hyperparasitic cestodes

Description – Plerocercoid larvae encysted (Figs 1, 2); with thick, often brown cyst-wall of 6-10, except for specimens from *Megathylacus brooksi* Rego & Pavanelli, 1985, with thin cyst-wall of 4-5 thick. Cysts 150-240 diameter. Scolex withdrawn; 105-128 diameter; four suckers 42-58 diameter. Developing rostellum occasionally observed.

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Received February 22, 1989.
Accepted April 19, 1989.

Site and occurrence – Occurs intermittently in scolex, neck and immature, mature and gravid proglottids. Usually no more than one per proglottid, although occasionally two or even three have been found. Some species harbour more than others: one strobila of *Megathylacus brooksi,* for example, contained 18 cysts.

Pathology – There was no sign of a fibrous tissue reaction against the larvae, although in specimens with a thin cyst-wall the parenchymal tissue of the host-worm was not contiguous with the cyst, giving the impression that the latter was surrounded by a halo. Distortions of the muscle fibres of the host-worm were presumably caused by the progress of the larva through the tissues after penetration of the tegument.

Records

Cestode hosts: *Jauella glandicephalus* Rego & Pavanelli, 1985; *Megathylacus brooksi* Rego & Pavanelli, 1985; *Travassiella avitellina* Rego & Pavanelli, 1987; and *Peltidocotyle rugosa* Diesing, 1850.
Fish host: *Paulicea luetkeni* (Steindachner).
Locality: Itaipu Reservoir, Paraná State, Brazil.

Cestode host: *Choanoscolex abscissus* (Riggenbach, 1896).
Fish hosts: *Pseudoplatystoma corruscans* Agassiz and *P. fasciatus* (L.).
Localities: Salobra, Porto Jofre and Porto Caracará, Mato Grosso State; Pirapora, Minas Gerais State; Barra do Rio Grande, Bahia State; and Itaipu Reservoir, Paraná State, Brazil.

Cestode host: *Nomimoscolex arandasregoi* Fortes, 1981 (sp. inq.: see Rego, 1987).
Fish host: *Tachysurus* sp.
Locality: Guaíba River, Rio Grande do Sul State, Brazil.

Cestode host: *Proteocephalidea* sp. (not identified).
Fish host: *Rhamdia sapo* Valenciennes.
Locality: Guaíba River, Rio Grande do Sul State, Brazil.

Hyperparasitic nematodes

Description – Larvae (apparently third-stage), 1,500 long, 35 wide (Figs 3, 4). Lips two (? or three), difficult to discern. Buccal capsule present, shallow. Oesophagus 290; not divided into two parts, without posterior bulb or ventriculus.

Site and occurrence – On three occasions single specimens were found in strobila.

Records

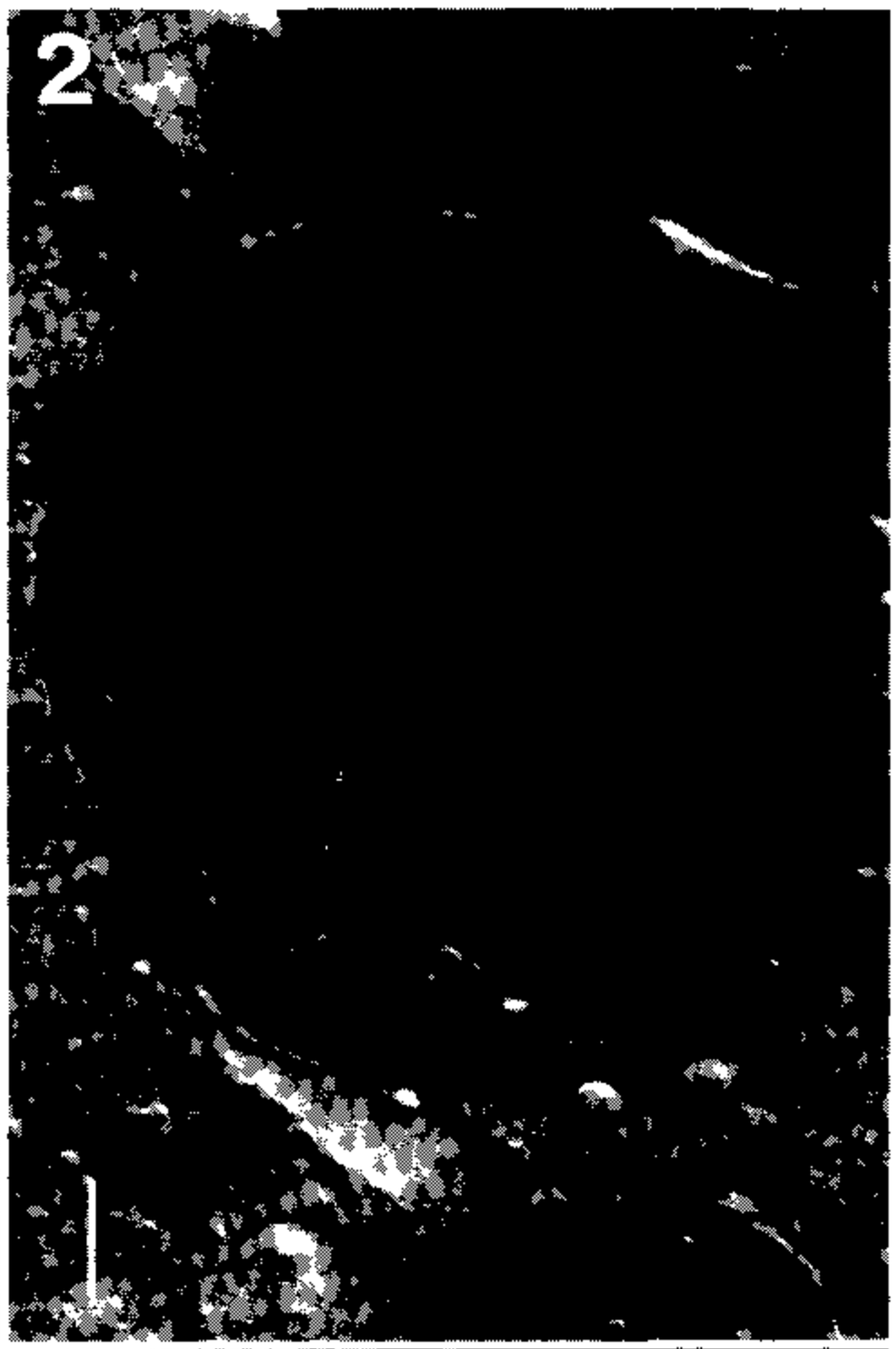
Cestode host: *Choanoscolex abscissus* (Riggenbach, 1896).
Fish host: *Pseudoplatystoma corruscans.*
Locality: Mato Grosso State, Brazil.

Accidental penetration

The accidental attachment of specimens of *Travassiela avitellina* to one another has been observed, and on one occasion the scolex penetrated the genital pore of another individual and reached as far as the medullary parenchyma (Fig. 5). This is considered to be accidental and not parasitism.

DISCUSSION

Cestode hyperparasites of cestodes are known. Hungerbühler (1910) and Fuhrmann (1930) reported gyrocotylid lycophores in gyrocotylids from chimaeras. Dollfus (1946) considered this to be accidental autoparasitism rather than hyperparasitism, and more recently, while recording post-larval specimens of *Gyrocotyle urna* (Wagener, 1852) in the parenchyma of adult specimens of the same species, Malmberg (1974) suggested that this is an integral part of the life-history, replacing a "first" host. Gaevskaja (1978) has found a larval trypanorhynch *Tentacularia coryphaenae* Bosc, 1802 in a larval tetraphyllidean, *Phyllobothrium* sp., in a squid. The only previous record of cestode hyperparasites of South American proteocephalids is that of Riggenbach (1896), who observed the plerocercoid larvae in *Rudolphiella lobosa* (Riggenbach, 1896), a parasite of the pimelodid fish *Luciopimelodus pati* Valenciennes from the Paraguay River. He described and figured the larvae as having an invaginated scolex and a developing rostellum. Two of the cysts measured 81 x 62 and 37 x 29 μm in diameter: one larva measured 148 x 119 μm, was enveloped by a thick wall, and possessed a scolex with a length of 62 μm and suckers with a diameter of 27 μm. Although smaller than those described above, they appear to be similar in morphology. It is also worth noting that Lamothe-Argumedo (1981) recorded proteo-



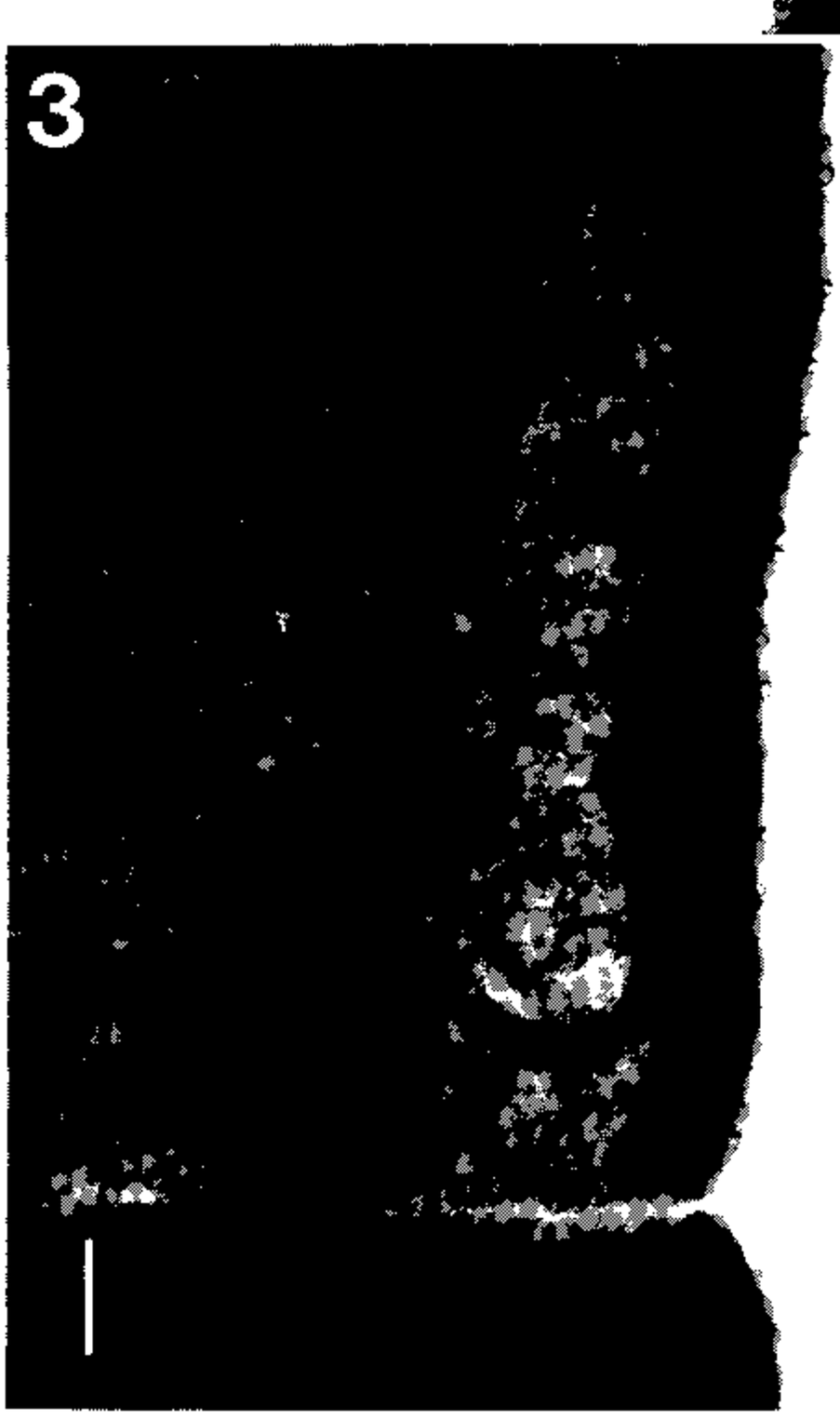


Fig. 1: two plerocercoid larvae encysted in a proglottid of an unidentified proteocephalid cestode from *Pseudoplatystoma fasciatus*. Scale-bar: 250 μm. Fig. 2: a plerocercoid larva encysted in an unidentified proteocephalid cestode from *Pseudoplatystoma fasciatus*. Scale-bar: 25 μm. Fig. 3: a larval nematode hyperparasite in proglottid of the proteocephalid *Choanoscolex abscissus* from *Pseudoplatystoma corruscans*. It was not possible to get the entire worm is focus at one time. Scale-bar: 100 μm. Fig. 4: anterior extremity of a larval nematode hyperparasite in proglottid of the proteocephalid *Choanoscolex abscissus* from *Pseudoplatystoma corruscans*. Scale-bar: 15 μm.

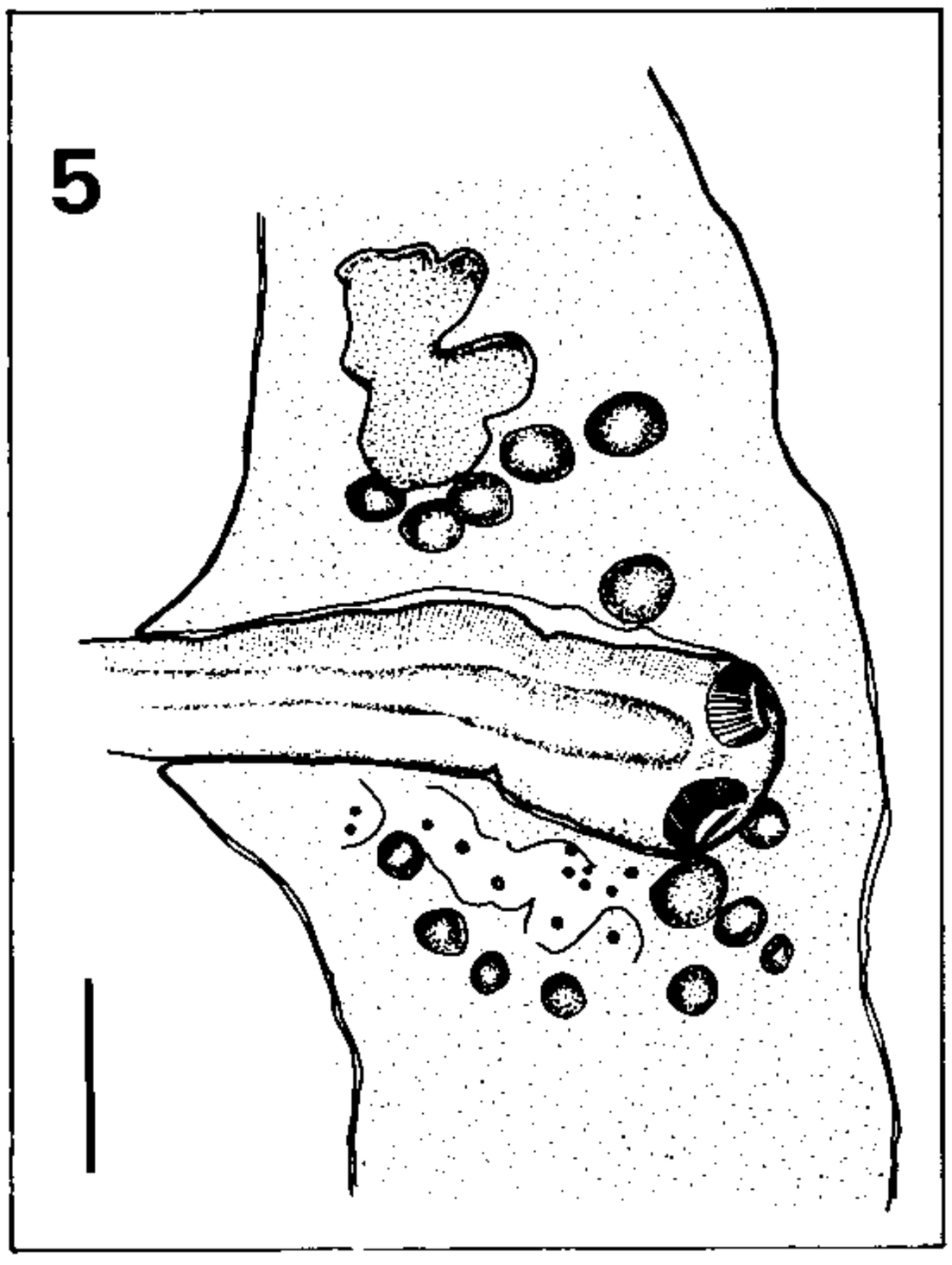


Fig. 5: accidental penetration of one specimen of the proteocephalid *Travassiella avitellina* by another. Scale-bar: 200 μm.

cephalid plerocercoids of 112-203 x 96-209 μm in size and with a sucker-diameter of 36-40 μm in the parenchyma of the temnocephalan *Temnocephala mexicana* Vayassiere, 1898 in Mexico.

The larvae described here are likely to be either proteocephalidean or cyclophyllidean. Representatives of both of these groups are common in the environs, e. g. dilepidids, by far the most likely cyclophyllidean candidates, occur in piscivorous birds. If these larvae were dilepidids, however, we would have expected to find some evidence of hooks on the rostellum. It is most likely that these larvae are proteocephalid plerocercoids which have been swallowed as procercoids in the crustacean diet of the pimelodid host. Alternatively, they might have entered the fish as plerocercoids in prey and re-encysted on finding themselves in a host not conducive to further development. These larvae would normally be expected to penetrate the gut-wall of the fish and encyst, and the senior author has found such larvae on the peritoneum of fishes such as the pimelodids *Pseudoplatystoma corruscans* and *P. fasciatus* and the cichlid *Astronotus ocellatus* (Agassiz). Rather than penetrating the host's gut-wall, some larvae have penetrated resident proteocephalids. As these have been able to develop in an environment protected from the fish's immune system, no tissue reaction has developed, whereas those larvae which encyst in the fish's tissue have a much thicker cyst-wall as the result of a tissue reaction.

There are several records of nematode hyperparasites in cestodes, including three species of protostrongylid larvae in hydatid cysts from sheep (Asadova, 1971) and an anisakid larva in a proteocephalid larva from the fish *Diplodus annularis* in the Black Sea (Parukhin & Parukhina, 1973). The only previous South American record of nematodes parasitic in cestodes is that of Monticelli (1892). This author described nematode larvae in the parenchyma of the proteocephalid *Monticellia macrocotyle* (Monticelli, 1891) (a *species inquirenda* according to Rego (1987)) from a fish which was called *"Silurus megacephalus"*. No locality data were given, but the host-name is a synonym of the Brazilian pimelodid fish *Pimelodus ornatus* Kner. Although he figured the worm, no diagnostic feature are visible. Monticelli, however, referred to the worm as being similar to the Old World species *Ascaris siluri* Linstow, 1878, a species which has also been known under the names of *A. glanidis* Linstow, 1880 and *A. linstowi* Stossich, 1896 and appears to be a *species inquirenda*. It is also worth noting that to the north in Mexico Lamothe-Argumedo (1981) has reported nematode larvae of about 1 mm in length, which he believed to belong to the anisakid genus *Raphidascaris* Railliet & Henry, 1915, in the temnocephalan *Temnocephala mexicana*.

Several nematode parasites recorded from the host-fish genus *Pseudoplatystoma* are candidates for the identity of the present material. According to the Host-Parasite Catalogue of the British Museum (Natural History), *Amplicaecum* sp. larvae, *Multicaecum* sp. larvae, *Cucullanus pinnai* Travassos, Artigas & Pereira, 1928, *Cucullanus* sp., *Spectatus spectatus* Travassos, 1923, *Goezia spinulosa* (Diesing, 1839) and *Eustrongylides* sp. larvae have been reported in *Pseudoplatystoma* spp. Our hyperparasitic larvae are clearly not *Eustrongylides*, and both *Goezia spinulosa* and *Multicaecum* can be dismissed as they possess a ventriculus. Our specimens are morphologically somewhat similar to the worm figured (no. 23)

as *Amplicaecum* sp. larvae by Travassos et al. (1928), although they also figure (no. 20) a larger worm possessing an intestinal caecum. Unfortunately, there are doubts as to the identity of Travassos et al's material, since the only known South American form of *Amplicaecum (sensu lato)* is *Freitascaris alata* (Baylis, 1947) (see Sprent, 1983), and *Freitascaris* Sprent, 1983, is a member of the Angusticaecinae *sensu* Gibson (1983), a group which does not utilize fish as intermediate hosts. The only ascaridoid groups which have piscine intermediate hosts are the acanthocheilids, anisakids and heterocheilines, and all of these can be dismissed because they possess a ventriculus. Cucullanids are a possibility, since the larvae we found bear some resemblance to the third-stage larva of the marine species *Cucullanus heterochrous* Rudolphi, 1802, as described by Gibson (1972). Unfortunately, the third-stage larva of *C. pinnai* is not known. Finally, the kathlanids, such as *Spectatus spectatus* Travassos, 1923 are also a possibility, as they are known to occur in *Pseudoplatystoma* spp. and their relatives in South American waters. The structure of the anterior extremity of our larvae, with its small buccal capsule, suggests an affinity, but one would have expected a cosmocercoid third-stage larva to exhibit at least some differentiation of an oesophageal bulb, although in adult specimens of *S. spectatus* it is not, in fact, all that distinct (see Travassos, 1955). In conclusion, therefore, although a cucullanid or kathlanid affinity is possible, it is not yet possible to identify this material.

RESUMO

Hiperparasitismo por helmintos: novas ocorrências de cestóides e nematóides em cestóides proteocefalídeos de peixes siluriformes da América do Sul –Cestóides hiperparasitos são descritos de espécies de proteocefalídeos, que ocorrem em peixes pimelodídeos de diferentes regiões do Brasil. Referimos ainda, a ocorrência de nematóide hiperparasito em espécimes de *Choanoscolex abscissus*, do peixe pimelodídeo, *Pseudoplatystoma corruscans*. São citadas as referências anteriores de cestóides e nematóides hiperparasitos, e discutida a possível identificação dos mesmos.

Palavras-chave: hiperparasitismo – cestóides proteocefalídeos – nematóides – peixes pimelodídeos

ACKNOWLEDGEMENTS

To Dr R. A. Bray, BM (NH), for reading the manuscript.

REFERENCES

ASADOVA, S. S., 1971. Unusual structure of hydatid cysts from the lungs of sheep and accumulation there of some pulmonary nematodes. *Izv. Akad. Nauk Azerb. SSR, Seriye Biolog. Nauk, 1971:* 101-104. (In Russian).

CANNING, E. U., 1975. The microsporidean parasites of Platyhelminthes: their morphology, development, transmission and pathogenicity. *Common. Inst. Helminth. Miscel.* Publ., No. 2: 32 p.

DOLLFUS, R. P., 1946. Parasites (animaux et vegetaux) des helminthes. Hyperparasites, ennemis et prédateurs des helminthes parasites et des helminthes libre. *Encycl. Biol., 27:* 1-482.

FUHRMANN, O., 1930. Cestoidea. p. 141-256. In: W. Kükenthal & T. Krumbach (Eds.). *Handbuch der Zoologie. Eine Naturgeschichte der Stämme des Tierreiches.* Walter de Gruyter & Co. Berlin & Leipzig, 2.

GAEVSKAJA, A. V., 1978. On accidental hyperparasitism in the cestodes. *Zool. Z., 57:* 1262-1263 (In Russian).

GIBSON, D. I., 1972. Contributions to the life history and development of *Cucullanus minutus* Rudolphi, 1819 and *C. heterochrous* Rudolphi, 1802. *Bull. British Mus. (Natural History) (Zoology), 22:* 151-170.

GIBSON, D. I., 1983. The systematics of ascaridoid nematodes – a current assessment. p. 321-328. In: A. R. Stone et al. *Concepts in nematode systematics.* The Systematics Association Special Volume no. 22. Academic Press, London.

HUNGERBÜHLER, M., 1910. Studien an *Gyrocotyle* und Cestoden. Ergebnisse einer von L. Schultze ausgefürhtes Zoologischen Forschungsreise in Südafrica. *Denk. Medizinisch-Naturw. Gerellschaft zu Jena, 16:* 495-522 (125-152).

LAMOTHE-ARGUMEDO, R., 1981. Un caso raro de parasitismo. *An. Inst. Biol. Univ. Mex., 51,* Ser. Zoologica: 675-682.

MALMBERG, G., 1974. On the larval protonephridial system of *Gyrocotyle* and the evolution of the Cercomeromorphae (Platyhelminthes). *Zool. Scripta, 3:* 65-81.

MONTICELLI, F. S., 1892. Notizie su di alcune specie di *Taenia*. *Boll. Soc. Nat. Napoli,* Ser. 1, *5:* 151-174.

PARUKHIN, A. M. & PARUKHINA, A. V., 1973. Study of hyperparasitism by nematode larvae in trematodes and cestodes. *Mat. Nauch Konf. Vsesoyuznogo Obshcehstva Gel'mintologov,* 1971-72, no. *25:* 172-175 (In Russian).

REGO, A. A., 1987. Cestóides proteocephalídeos do Brasil. Reorganização taxonômica. *Rev. Bras. Biol., 47:* 203-212.

REGO, A. A. & PAVANELLI, G., 1985. *Jauella glandicephalus* gen. n., sp. n. e *Megathylacus brooksi* sp. n., cestóides patogênicos para o jaú, *Paulicea luetkeni,* peixe pimelodídeo. *Rev. Bras. Biol., 45:* 643-652.

REGO, A. A. & PAVANELLI, G., 1987. Cestóides proteocefalídeos do jaú, *Paulicea luetkeni*, peixe pimelodídeo do Brasil. *Rev. Bras. Biol., 47:* 357-361.

RIGGENBACH, E., 1896. Das genus *Ichthyotaenia. Rev. Suisse Zool., 4:* 165-277.

SPRENT, J. F. A., 1983. Ascaridoid nematodes of amphibians and reptiles: *Freitascaris* n. g. *J. Helminthol., 57:* 283-290.

TRAVASSOS, L., 1955. Sobre Spectatus spectatus Travassos, 1923 (Nematoda Kathlaniidae). *Rev. Ibér. Parasit.*, Tomo Extraordinário, 888-909.

TRAVASSOS, L.; ARTIGAS, P. & PEREIRA, C., 1928. Fauna helminthologica dos peixes de água doce do Brasil. *Arch. Inst. Biol. Def. Agr. Anim.*, São Paulo, *1:* 5-68.