PLATE 23: *Cucullanus acanthopagri* n. sp.

A. Anterior end, lateral view.

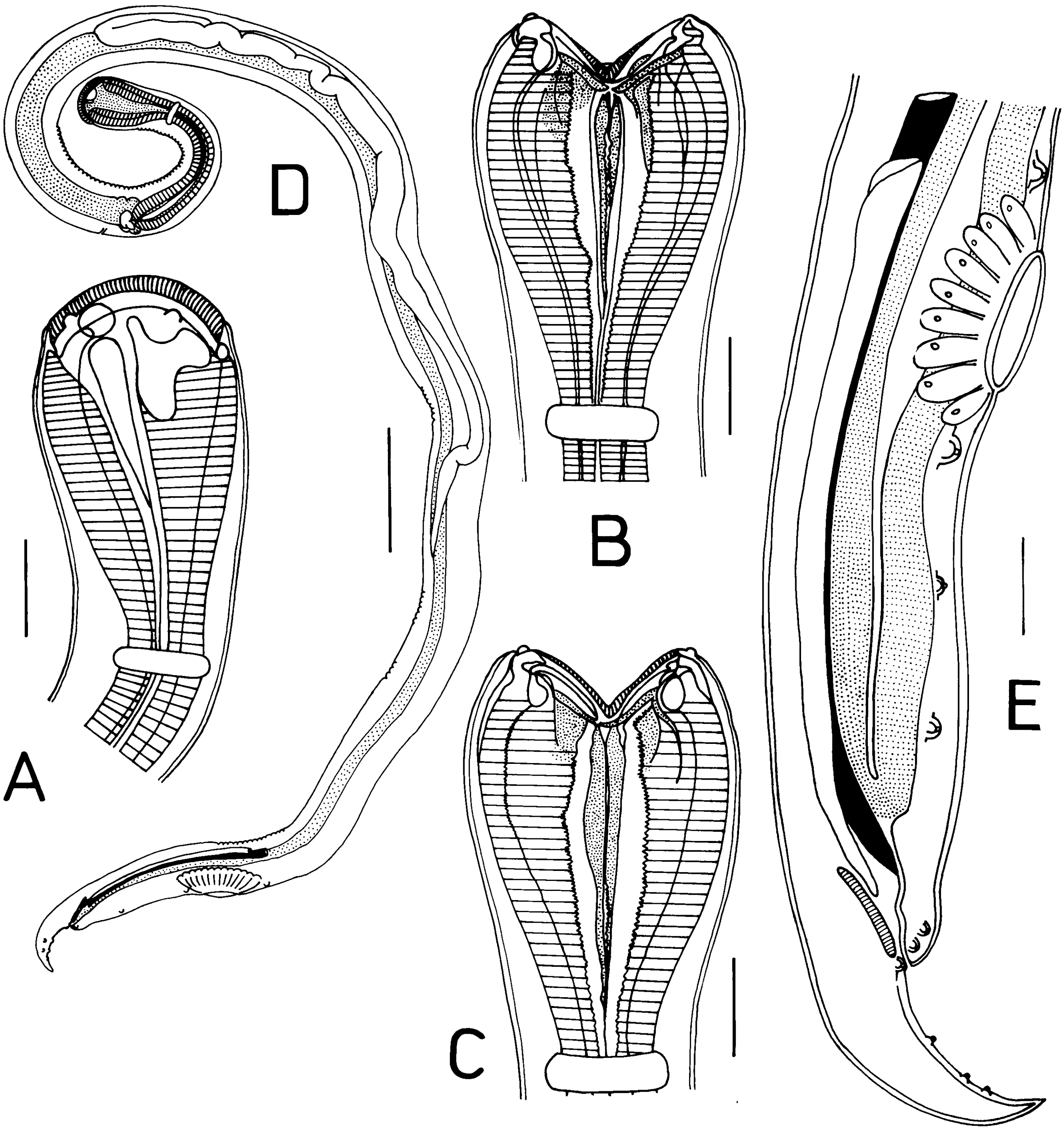
B. Anterior end, dorsal view.

C. Anterior end, ventral view.

D. Whole mount, lateral view.

E. posterior end, lateral view.

Scale length 0.1 mm.



D
A
B
C
E

Genus: *Indocucullanus* Ali, 1956

Indocucullanus sp.

Specimens deposited: W199693.

Collection data:

- Number of worms measured: 5 females
- Site in host : intestine
- Locality : 2 specimens from Woolooweyah Estuary (NSW)
  3 specimens from Red Rock Estuary (NSW)

Description:

Body length 6.27 (5.0-7.6) mm. Pseudobuccal capsule formed by swelling of anterior end of oesophagus, pair of head papillae and pair of teeth with dentigerous ridge behind them. Oesophagus length 936 (891-974), % of body length 15 (12.71-18.51). Oesophagus anterior diameter 195 (167-207), posterior diameter 138 (132-141). Anterior end to: nerve ring 346 (331-364), excretory pore 994 (911-1036), vulva 4117 (3645-5261). Anus to tail 258 (215-322), end of tail conical. Diameters of body: in head region 207 (207-231), at nerve ring 177 (157-190), at oesophagus-intestine 243 (231-265), maximum 265 (231-306), at level of anus 102 (91-116). Cuticle striations inconspicuous without longitudinal lines; cuticle thickness 4. One pair of preanal and one pair of postanal sessile papillae present.

Remarks:

At present there are six species of the cucullanid genus *Indocucullanus* Ali, 1956 recognized, i.e. *I. jaiswali* (Ali) 1956; *I. arabiansae* Ali and Kalyankar 1966; *I. longispiculum* Khan, 1969; *I. calcariferii* Zaidi and Khan, 1975; *I. karachii* Zaidi and Khan, 1975; and *I. guerreroi* Arya and Johnson, 1975. All species were found in Pakistan and India.

The present specimens are slightly larger than the described species.

My material differs from *I. longispiculum* Khan, 1969, *I. karachii* Zaidi and Khan, 1975, *I. calcariferii* Zaidi and Khan, 1975, and *I. guerreroi* Arya and Johnson, 1975 in the absence of cuticular striations. It differs from *I. longispiculum* Khan, 1969 in a different shape of the tail spine which is forked in *I. longispiculum* and simple in my material. Whereas my material has one pair of preanal and one pair of postanal papillae, *I. karachii* has 6 pairs of pre- and 6 pairs of postanal papillae, *I. longispiculum* and *I. calcariferii* have only one pair of postanal papillae. My specimens differ from *I. jaiswali* and *I. guerreroi* in the presence of head papillae which are absent in both *I. jaiswali* and *I. guerreroi*. In *I. arabiansae*, the cuticle is marked with fine longitudinal lines, (see Arya and Johnson, 1975), whereas there are no longitudinal lines in my material. There are 2 pairs of caudal papillae in my specimens (5 females), whereas there are 11 pairs in the male of *I. arabiansae*.

It is very likely that my specimens of *Indocucullanus* are a new species, however, the establishment of a new species is postponed, since the male of *I. arabiansae* has not been described and a comparison cannot be made.

Indocucullanus is recorded for the first time from the black bream and from Australia.

Table 4.19. Morphological comparison between *Indocucullanus* sp. and related species. All measurements are in micrometers unless otherwise indicated.

Character	*I. acanthopagri*	*I. jaiswali* (mm)	*I. longispiculum* (mm)	*I. longispiculum* (mm)	*I. calcariferii* (mm)	*I. guerreroi* (mm)
Body length (mm)	6.27 (5.0-7.6)	9.519	4.488-5.004	4.698	3.103-4.147	14-15
Oesophagus: - length	936 (891-974)	1.0	0.612-0.693	0.778	0.669-0.738	0.85-0.95
- % of body length	15 (12.71-18.51)	-	-	-	-	-
- anterior diameter	195 (167-207)	-	-	0.137	0.099-0.118	-
- posterior diameter	138 (132-141)	-	0.122			-
Anterior end to: - nerve ring	346 (331-364)	0.32	0.272	0.292	0.252-0.262	0.30-0.31
- deirids	not observed	-	-	-	-	-
- excretory pore	974 (911-1036)	0.637	middle	middle	1.56-1.98	10.4-11.0
- vulva	4117 (3645-5261)	5.83	-	-	-	-
- Anus to tail	258 (215-322)	0.23	0.095-0.163	-	-	0.185-0.190
Diameter of body: - in head region	207 (207-231)	-	-	-	-	-
- at nerve ring	177 (157-190)	-	-	-	-	-
- at oesophagus-intestine	243 (231-265)	0.44	0.380-0.476	0.43	0.340-0.370	0.21-0.24
- maximum	265 (231-306)	-	-	-	-	-
- at level of anus	102 (91-116)	-	-	-	-	-
Cuticle striations	inconspicuous	lacking	fine	not striated	throughout body	prominent, well developed
Cuticle thickness	4	-	-	-	-	-
Head papillae	1 pair	absent	present	present	3 lip papillae	absent
Caudal papillae	2 pairs	absent	1 pair postanal	1 pair	1 pair postanal	-
Tail terminal	simple, slightly pointed	?	forked-spike	forked-spike	blunt, no spine	short prominent spine
Host:	*Acanthopagrus australis*	*Barbus sarana*	*Sciaena diacanthus*	*Lates calcarifer*	*Lates calcarifer*	*Cybium guttatum*
Site in host:	intestine	?	intestine	stomach	intestine	intestine
Locality	Woolooweyah Estuary and Red Rock Estuary, NSW	Hyderabad, India	Karachi Coast	Karachi Coast	Karachi Coast	Jodhpur Fish Market - India
Source:	This study	Arya and Johnson, 1975	Khan, 1969	Zaidi and Khan, 1975	Zaidi and Khan, 1975	Arya and Johnson, 1975

PLATE 24: *Indocucullanus* sp.

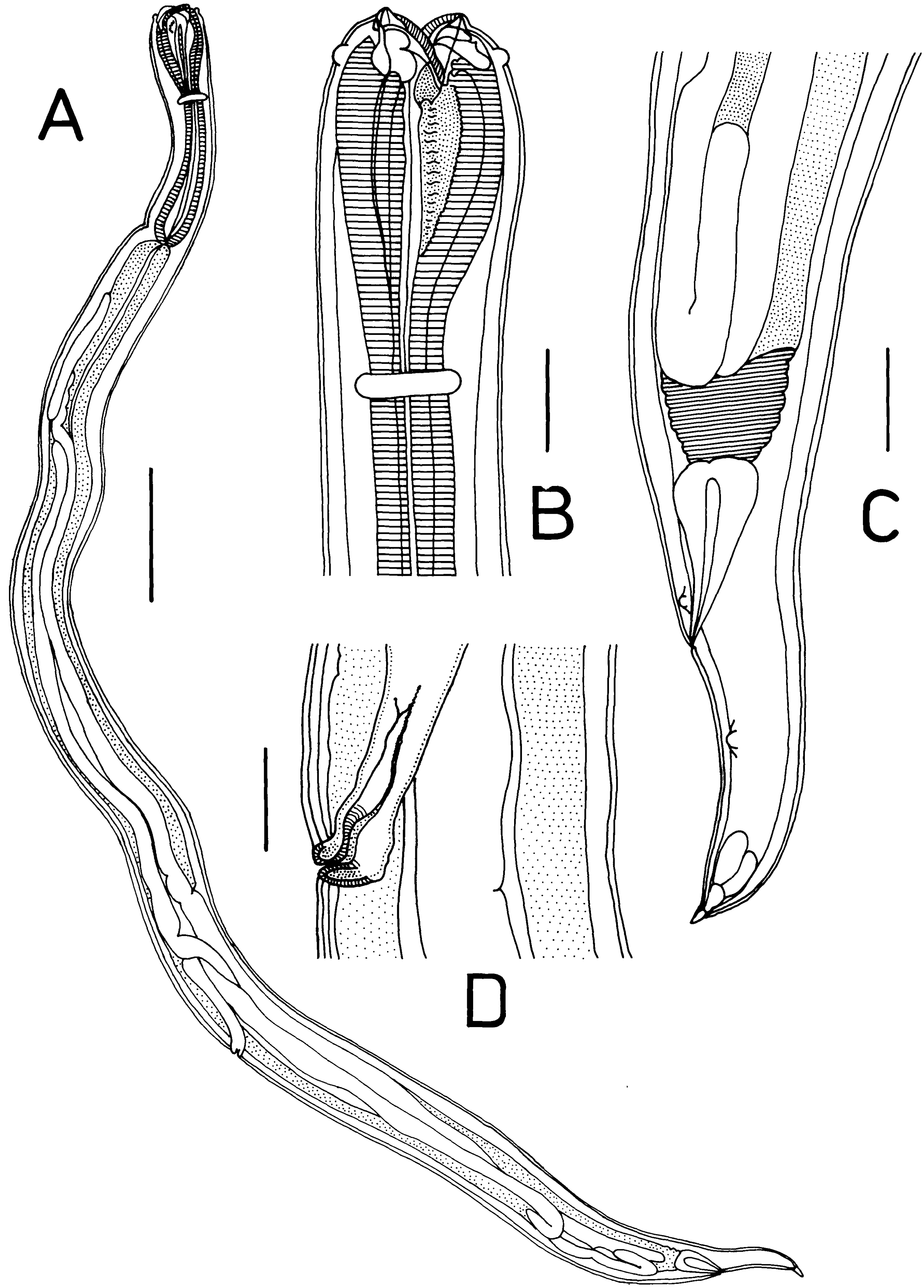
A. Whole mount, lateral view.

B. Anterior end, ventro-lateral view.

C. Posterior end, lateral view.

D. Vulva.

Scale length - A, 0.5 mm; B, C, D - 0.1 mm.


A
B
C
D

Subfamily: DACNITOIDINAE York and Maplestone, 1926

Genus : *Cucullanellus* Törnquist, 1931

C. acanthopagri n. sp.

Specimens deposited: W199690.

Collection data:

- Number of worms measured: 7 males
- Site in host : intestine
- Locality : 6 specimens from WoolooweyahEstuary (NSW)
  1 specimen from Red Rock Estuary (NSW)

Description:

Body slender, not swollen at anterior extremity, body length 4840 (2982-6110). Oesophagus length 776 (620-870), anterior diameter 200 (165-231), posterior diameter 146 (107-174). Nerve ring 337 (289-380) from anterior end. Excretory pore just behind junction of intestine and oesophagus, 846 (579-1139) from anterior end. Intestinal caecum present, with lobed appendix at posterior end. Anus to tail 171 (145-198). Diameter of body: in head region 285 (248-306), at nerve ring 359 (273-422), at oesophagus-intestine 396 (273-513), at anus 103 (91-124), maximum 429 (289-612). Cuticle thickness at nerve ring 43 (27-50) and in middle of body 28 (25-31). Cuticle striations very fine throughout body. Seven pairs of caudal papillae, one just anterior to anal sucker, second to fourth between sucker and anus, fifth to seventh postanal. Prominent spine-like structure at anterior part of anus. Two similar and almost equal spicules. Right spicule 855 (725-1036), left spicule 87 (736-1056). Small simple gubernaculum 46 (37-54). Testis beginning near ventral sucker, proceeding forward and turning back at level of base of intestinal caecum.

Remarks

This species closely resembles *Cucullanellus sheardi* Johnston and Mawson, 1945a, *C. cnidoglanis* Johnston and Mawson, 1945a and *C. pleuronectidis* Yamaguti, 1935a. However, measurements are larger than in *C. sheardi* which is 720-2500 and smaller than in *C. pleuronectidis* which is 8000 compared with 4840 (2982-6110) in my material. Other differences are as follows. *C. sheardi, C. cnidoglanis* and *C. pleuronectidis* have 11 pairs of caudal papillae whereas *C. acanthopagri* has 7 pairs. Both *C. cnidoglanis* and *C. pleuronectidis* have 3 pairs of preanal, 4 pairs of adanal and 4 pairs of postanal papillae whereas my species has 4 pairs of preanal and 3 pairs of postanal papillae. In my material the excretory pore is just posterior to the oesophagus, in *C. cnidoglanis* and *C. pleuronectidis* it is behind the oesophagus. The spicules are unequal and wave-shaped in my material, whereas they are equal and almost straignt in *C. sheardi, C. cnidoglanis* and *C. pleuronectidis*. The most obvious difference is the presence in my material of a spine in the anterior lip of the anus which is not a papillae; it is absent in all the other species.

On the basis of those differences, I propose a new species, *C. acanthopagri*. The species name refers to the host genus.

Table 4.20. Comparison between *Cucullanellus acanthopagri* n. sp. and related species. All measurements are in micrometres unless otherwise indicated.

Character	*C. acanthopagri*	*C. pleuronectidis*	*C. sheardi*	*C. cnidoglanis*	*C. sheardi*
Body length	4840 (2982-6110)	8.0 mm	0.72-2.5 mm	6 mm	2.4 mm
Oesophagus: - length	776 (620-870)	0.68-0.91 mm	-	0.8-1.0 mm	0.52 mm
- anterior diameter	200 (165-231)	0.13-0.25 mm	-	-	-
- posterior diameter	146 (107-174)	0.13-0.25 mm	-	-	-
Anterior end to: - nerve ring	337 (289-380)	0.28-0.46 mm	-	-	-
- excretory pore	846 (579-1139)	-	-	-	0.22 mm
Diameter of body: - in head region	285 (248-306)	-	-	-	-
- at nerve ring	359 (273-422)	-	-	-	-
- at oesophagus-intestine	396 (273-513)	-	-	-	-
- at level of anus	103 (91-124)	-	-	-	-
- maximum	429 (289-612)	0.35 mm	-	-	-
Tail	171 (145-198)	-	-	-	-
Cuticle striations	fine	-	-	-	-
Cuticle thickness	-	4.5 mm			
Spicules: - right	855 (725-1036)	0.75-0.87 mm	-	0.8-1.0 mm	0.55 mm
- left	877 (736-1056)	0.75-0.87 mm	-	0.8-1.0 mm	equal
Gubernaculum	46 (37-54)	33-48	-	-	-
Caudal papillae	7 pairs	11 pairs	-	11 pairs	11 pairs
Host:	*Acanthopagrus australis*	*Paralichthys olivaceus* *Pleuronichthys cornutus* *Pseudorhombus cinnamomeus* etc.	a) *Dactylophora nigricans* b) *Latridopsis forsteri* c) *Pagrosomus auratus*	Catfish *Cnidoglanis megastomus*	*Threpterius maculosus*
Site in host:	intestine	intestine	?	?	?
Locality:	Woolooweyah and Red Rock Estuaries, NSW	Toyama Bay, Inland Sea and Mutu Bay, Japan	a) Backstairs Passage and Rapid Bay b) Kangaroo Island c) Glenelg	Port Willunga	Cape Borda (coll. K. Sheard) Althrorpe Islands (Adelaide fish markets)
Source:	This study	Yamaguti, 1935a	Johnston and Mawson, 1945a		Johnston and Mawson, 1944

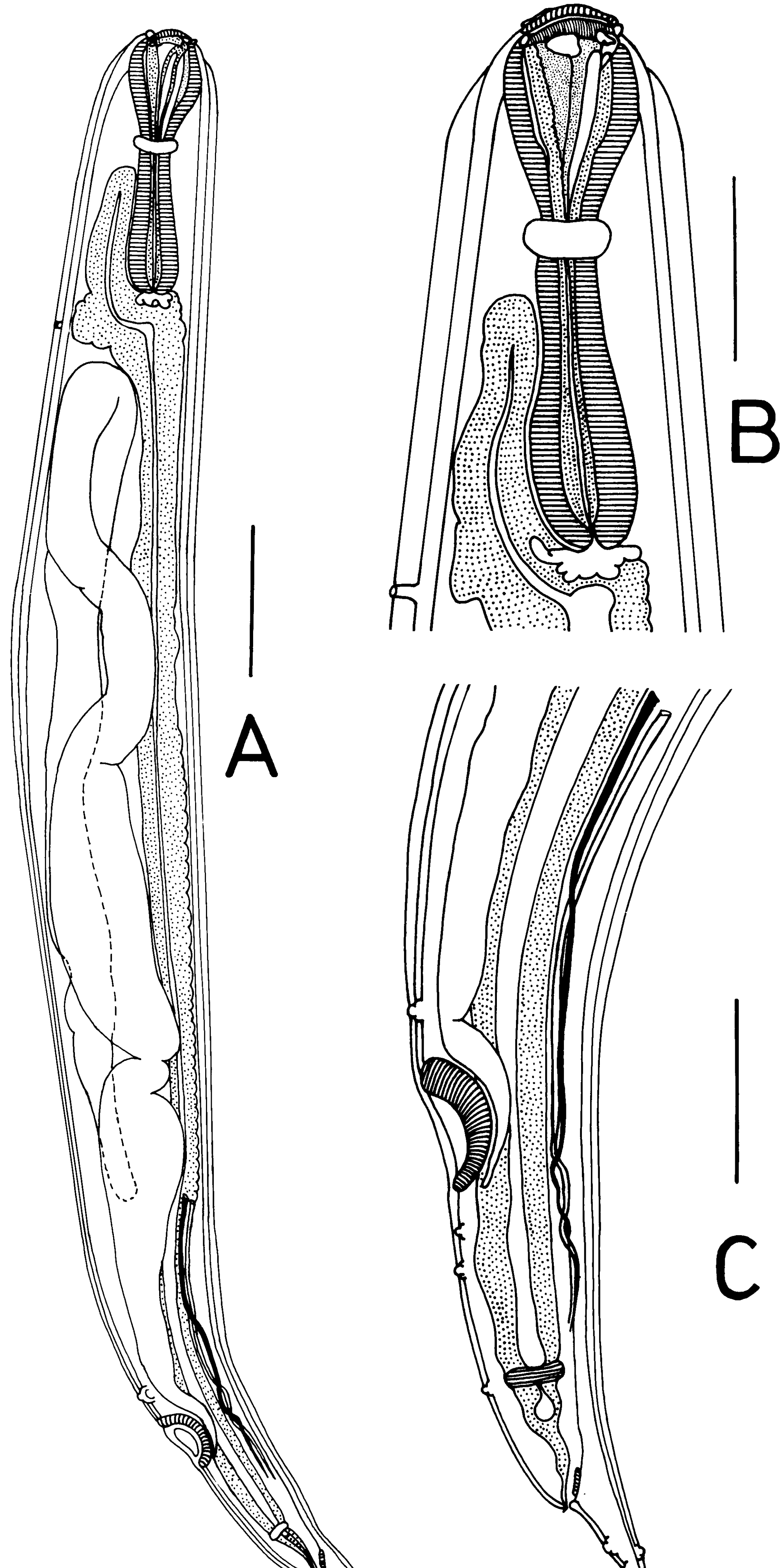
PLATE 25: *Cucullanellus acanthopagri* n. sp.

A. Whole mount, lateral view.

B. Anterior end, lateral view.

C. Posterior end, lateral view.

Scale length - A, 0.5 mm; B, C, 0.3 mm.


A
B
C

Genus: *Neocucullanellus* Yamaguti, 1941

N. australis n. sp.

Specimens deposited: W199696.

Collection data:

- Number of worms measured: 6 females
- Site in host : debris
- Locality : Woolooweyah Estuary (NSW)

Description:

Body 5491 (4453-5820) x 543 (504-579). Widest part at middle of body. Oesophagus 1008 (974-1015), anterior diameter 241 (231-156), posterior diameter 185 (174-207). Nerve ring, cephalic papillae and excretory pore 416 (372-471), 840 (777-911) and 836 (891-1201) respectively from anterior tip of body. Intestinal caecum 484 (446-537), measured from base of oesophagus. Diameter of body: in head region 342 (265-380), at nerve ring 430 (389-471) and at anus 142 (124-165). Cuticle thickness at nerve ring 51 (37-58), in middle of body 31 (25-41). Tail 226 (198-265) including horn-like chitinous process at tip. Vulva 1844 (1699-2692) from posterior end. Eggs thin-shelled and rounded oval 76 (62-91) x 43 (37-50).

Remarks:

Lebedev (1968) recorded *Neocucullanellus tasmanicus* from the intestine of *Chrysophrys auratus* in Tasmania which is relatively close to the area where my material was found. My specimens are of similar size, except that mine have a longer oesophagus and intestinal caecum and that the excretory pore and the nerve ring are further from the anterior end. Other characters are not easy to compare, since he had only a male specimen, whereas I have only females.

Yamaguti (1941) recorded *N. apharei* from the small intestine of *Aphareus furcatus* in Japan. His species differs from mine as follows: the body width is smaller although the worms are of about the same length; the excretory pore is closer to the anterior end, and the intestinal caecum is much shorter.

Based on those differences mentioned above, I propose a new species, i.e. *Neocucullanellus australis*. The species name refers to the southern distribution of the species.

Table 4.21 Morphological comparison between *Neocucullanellus australis* n. sp. and related species. Measurements are in micrometres or as indicated.

Characters	*N. australis*	*N. apharei* female (mm)	*N. apharei* male (mm)	*N. tasmanicus* male (mm)
Body length	5491 (4453-5820)	4.0-6.43	3.5-4.9	4.83
Oesophagus:				
- length	1.008 (974-1015)	0.75-0.86	0.65-0.75	0.787
- % of body length	19 (13.80-22.79)	-	-	-
- anterior diameter	241 (231-256)	-	-	-
- posterior diameter	185 (174-256)	-	-	-
Intestinal caecum	484 (446-537)	0.12-0.025	0.15-0.23	0.171
Anterior end to:				
- nerve ring	416 (372-471)	0.35-0.40	0.30-0.35	0.3-0.35
- deirids	840 (777-911)	-	-	-
- excretory pore	836 (891-1201)	0.56-0.73	0.45-0.65	0.53
Tail	226 (198-265)	0.23-0.27	0.19-0.23	-
Diameter of body:				
- in head region	342 (265-380)	-	-	-
- at nerve ring	430 (389-471)	-	-	-
- maximum	543 (504-579)	0.31-0.48	0.22-0.35	0.57
- at level of anus	142 (124-165)	-	-	-
Sucker	absent	absent	absent	weakly developed
Caudal papillae	-	-	15-17 pairs	15 pairs
Eggs	76 (62-91) x 43 (37-50)	?	-	-
Host:	*Acanthopagrus australis*	*Aphareus furcatus*	*Aphareus furcatus*	*Chrysophris unicolor*
Site in host:	debris	small intestine	small intestine	intestine
Locality:	Woolooweyah Estuary, NSW	Naha, Okinawa Prefecture, Japan	Naha Okinawa Prefecture, Japan	Tasmania
Source:	This study	Yamaguti, 1941	Yamaguti, 1941	Lebedev, 1968

PLATE 26: *Neocucullanellus australis* n. sp.

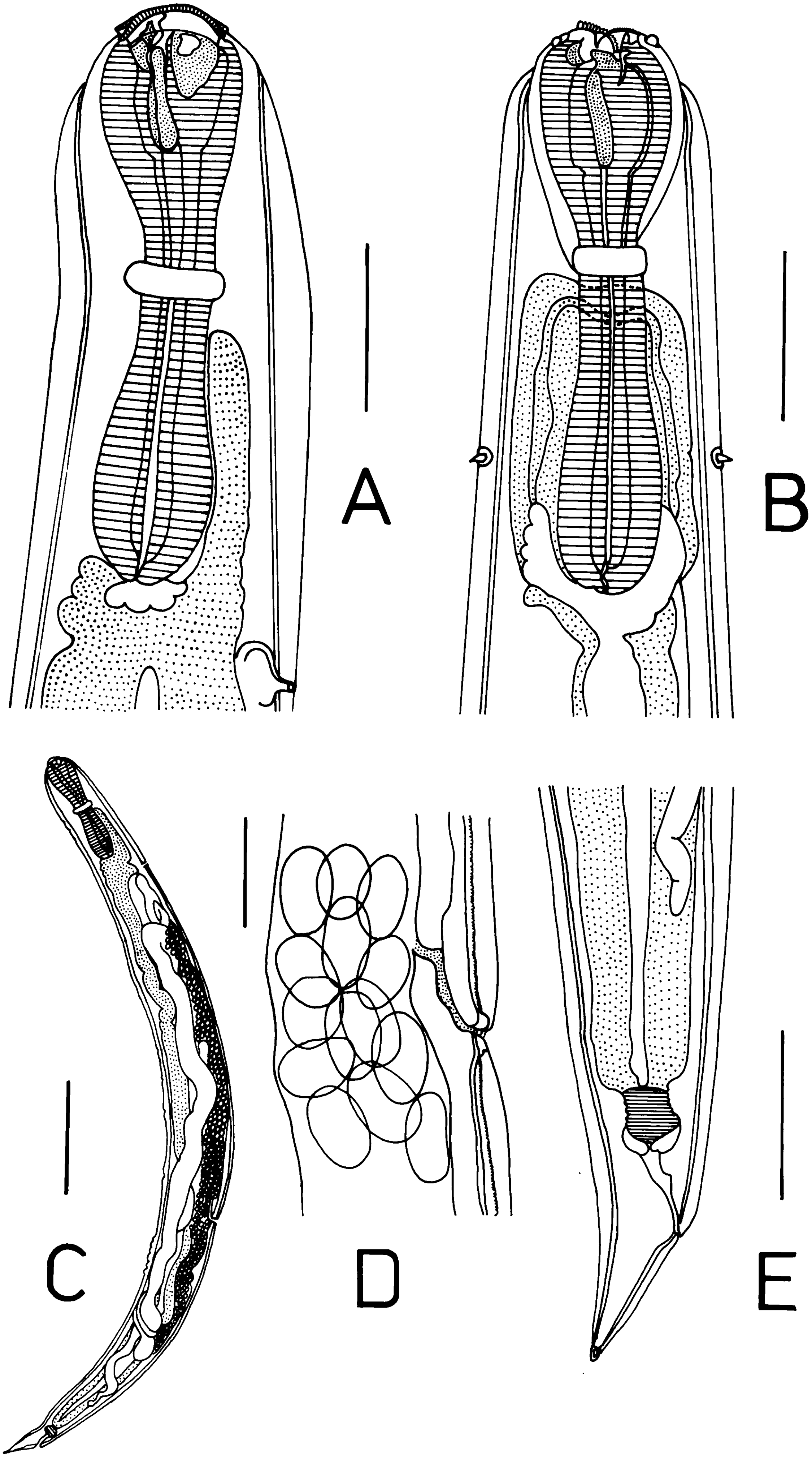
A. Anterior end, lateral view, scale length 0.3 mm

B. Anterior end, ventral view, scale length 0.3 mm

C. Whole mount, lateral view, scale length 1.0 mm

D. Vulva, scale length 0.1 mm

E. Posterior end, lateral view, scale length 0.3 mm


A
B
C
D
E

Superfamily: GNATHOSTOMATOIDEA sensu Chabaud

Family : GNATHOSTOMATIDAE Railliet, 1895

Subfamily : GNATHOSTOMATINAE (Railliet, 1895, family)

Genus : *Echinocephalus* Molin, 1858

E. uncinatus Molin, 1858 (Baylis and Lane, 1920; p. 276; fig. 24)

Specimens deposited: W199697.

Collection data:

- Number of worms measured: 2 immature females
- Site in host : intestine
- Locality : Red Rock National Park (NSW)

Description:

Body length 11.9(10.9-0-12.9) mm, maximum width 339 (306-372). Head 232 (207-256). Head bulb with 6 rows of hooks, 36-48 hooks per row. Hooks increase in size posteriorly from 6 to 31. Distance between anterior two rows 10 (8-12), between second and third rows 12, between third and fourth rows 16 (14-17), between fourth and fifth rows 17, and between posterior two rows 22 (21-23). Two raised trilobed lips around mouth, one pair of dorsal and one pair of ventral papillae on each side of lips. Two incomplete rudimentary rows of hooks surrounding lips. Width of lips 20 (19-31). Distance of nerve ring from anterior end 389 (290-488). Four cervical glands 119 (1139-1158). Distance from head end to end of oesophagus 2609 (2568-2561). Vulva just anterior to anus 463 (n = 1) from tip of tail. Tail 240 (231-348), elongate, conical, with transverse striations and pointed apically, and with small terminal spine. Body width at level of anus 141 (132-149).

Remarks:

This is the first record of this species from the black bream in Australia. My specimens agree in all important characters with *Echinocephalus uncinatus* (Molin, 1858) Khan and Begum 1971, found in *Cynoglossus sidensis* and *Lates calcarifer* on the Karachi Coast, having a similar size [(8.0-12.12) x (0.136-0.312) mm in males and (8.304-14.225) x (0.299-0.312) mm in females]. There are also a similar size and number of hooks per row. This species has also been found by Johnston and Mawson, 1945b in the mesentery of *Platycephalus bassensis* and *P. laevigatus* in Hobart, Tasmania.

This species also closely resembles *Echinocephalus* sp., found by Hooper (1983) in the pyloric caeca and the intestines of *P. bassensis* in the Coffs Harbour Region, but Hooper's specimens are longer and have the vulva in the anterior part of the body, which may be an erroneous observation.

Table 4.22. Comparison of females of *Echinocephalus uncinatus* Molin, 1858. Measurements are in micrometres or as indicated.

Character	Present specimens	Khan and Begum (1971)	Millemann (1963)
Body length	11.9 (10.9-12.9) mm	8.304-14.225 mm	30.9 mm
Maximum width	339 (306-372)	0.299-0.312 mm	0.86 mm
Head length	232 (207-250)	0.149-0.300 mm	0.75
No. of hooks in rows	36-48	26-40	30-40
Size of hooks	6-31	0.0454 mm	0.0125 mm
Width of lips	20 (19-31)	-	0.41 mm
Anterior end to: - nerve ring	389 (290-488)	-	0.8 mm
- excretory pore	-	-	1.15 mm
- posterior end of cervical sacs	1149 (1139-1158)	1.22-0.053 mm	3.3-3.8 mm
- posterior end of oesophagus	2609 (2568-2561)	1.89-3.1 mm	4.6-4.9 mm
Vulva	463	-	1.25-1.35 mm
Tail	240 (231-348)	?	0.70-0.75 mm
Body width at level of anus	141 (132-149	-	-
Host:	*Acanthopagrus australis*	*Cnydoglosus sidensis* *Lates calcarifer*	*Trygon brucco*
Site in host:	intestine	mesentery	spiral valve
Locality:	Red Rock National Park, NSW	Karachi Coast	Adriatic
Source:	This study	Khan and Begum, 1971	Millemann, 1963

PLATE 27: *Echinochephalus uncinatus* Molin, 1858

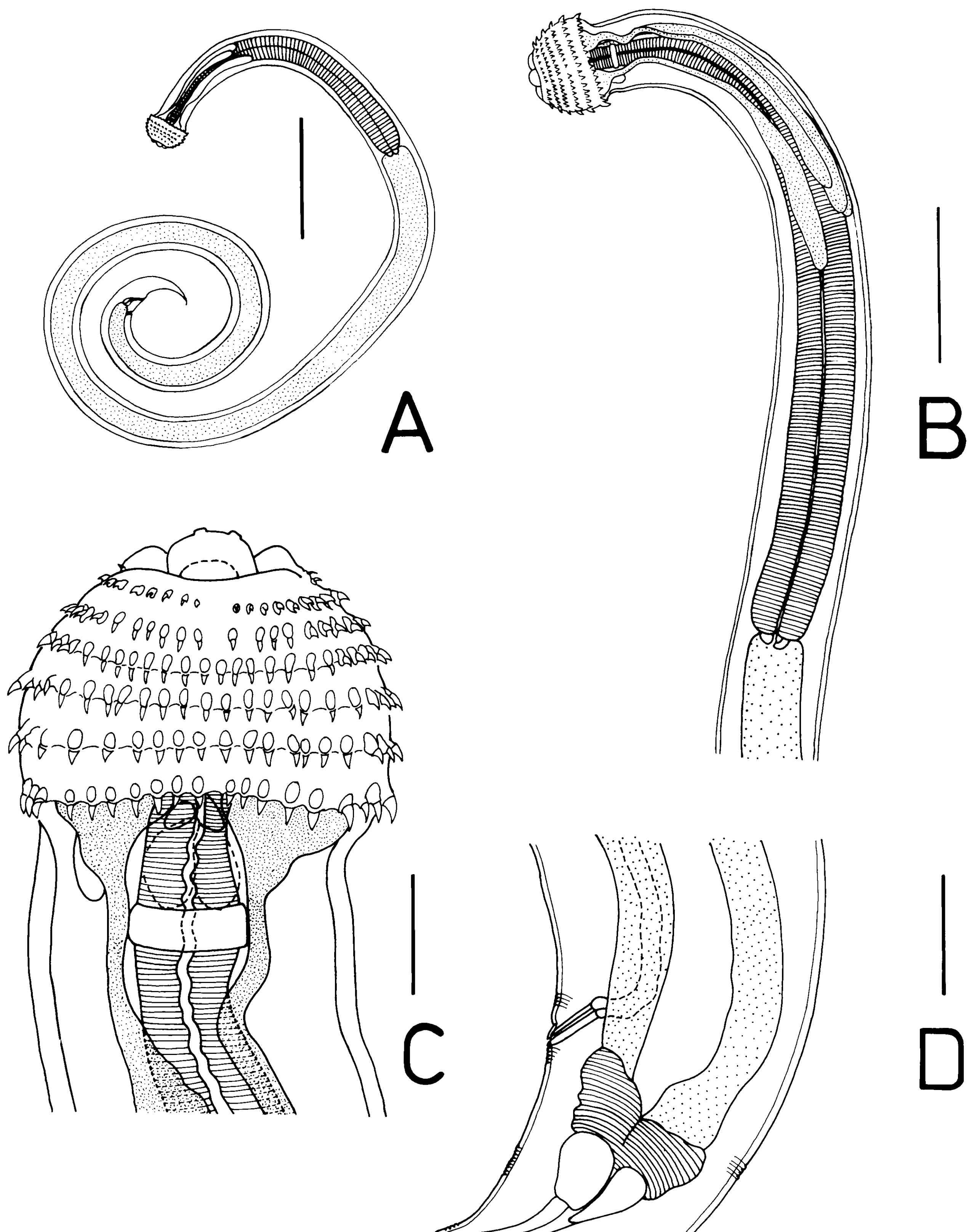
A. Whole mount, lateral view.

B. Anterior end, lateral view.

C. Head, lateral view.

D. Posterior end, lateral view.

Scale length - A, C, D - 0.1 mm; B - 0.5 mm.


A
B
C
D

Suborder : CAMALLANINA (sensu Chabaud)

Superfamily : DRACUNCULOIDEA sensu Chabaud

Family : PHILOMETRIDAE Baylis and Daubney, 1926

Subfamily : PHILOMETRINAE (Baylis and Daubney, 1926, family)

Genus : *Philometra* (*Alinema*) Rasheed, 1963

Philometra sp.

Specimen deposited: W199691.

Collection data:

- Number of worms measured: 1 gravid female
- Site in host : mouth cavity
- Locality : Red Rock Estuary (NSW)

Description:

144 mm long, maximum width 802. Cuticle relatively smooth, no striations, no bosses. Head 114 x 31, with one pair of dorsal and one of ventral papilla-like structures at each side. Lips simple, inconspicuous. Nerve ring 256 from anterior tip. Excretory pore 322 from anterior end, just posterior to nerve ring. Oesophagus not swollen 1284 x 149. Oesophageal gland prominent 1015 x 85, overlaps oesophagus, almost as long as oesophagus from nerve ring to ventriculus. Ventriculus very short, 97 x 27. Intestine slightly swollen at junction with ventriculus, its swollen part 277 x 165. Anterior ovary 1450 x 62 between ventriculus and uterus, its anterior end located at swollen part of intestine, its posterior part coiled at anterior part of uterus. Anterior part of uterus 1036 from posterior end of ventriculus. Posterior ovary 1844 x 83. No anus and no caudal papillae. Blunt posterior extremity. Eggs 41 (23-52) x 35 (21-43) relatively small and numerous especially in posterior part of body. Larvae 521 (496-579) x 16 (14-17) also numerous especially in anterior uterus.

Remarks:

Various species of *Philometra* have been found in various fish hosts from all over the world (e.g. Baylis, 1929, Yamaguti, 1935a, Yamaguti, 1941, Rasheed, 1963 and 1965, Ashmead and Crites, 1975, Molnar, 1976, Sakaguchi and Matsusato, 1978, Nakajima and Egusa, 1979, Benz and Pohley, 1980, and Molnar, 1980).

My specimen is slightly larger than *P. paralisuri* Yamaguti, 1935a *P. sciaenae*, *P. sebastoides*, *P. inimici*, *P. pinnicola*, *P. sebastici* (Yamaguti, 1941) from Japan; *P. hyderabadensis* Rasheed, 1963; *P. cylindracea* Ward and Magath, 1916 (Ashmead and Crites, 1975) from Ohio (USA) and *P. pellucida* Jagerskiöld, 1893(Rasheed, 1965) from Australia. It is smaller than *P. lateolabracis* Yamaguti, 1935 (Yamaguti, 1941); *Philometra* sp. (Rasheed, 1965) from Angola, West Africa; *Philometra* sp. Sakaguchi and Matsusato, 1978 from Japan and *Philometra* sp. Benz and Pohley, 1980 from Georgia, USA. Some species have a similar length, e.g. *P. lateolabracis* Yamaguti, 1935 (Rasheed, 1963) from Karachi Coast, Pakistan; *P. sydneyi* (Rasheed, 1963) from Sydney, Australia; *Philometra* sp. Jagerskiöld, 1893 (Rasheed, 1965); and *P. obturans* (Prenant, 1886) Molnar, 1976 from Hungary.

Most similar to my material are *P. sebastici* (Yamaguti, 1941) from the ovary of *Sebasticus marmoratus* (Cuv. et Valenc.) in the East China Sea and Kyusyu; *P. hyderabadensis* (Rasheed, 1963) found in the mesentery of *Wallagu attu* in India; and *P. paralisuri* Yamaguti 1935a from the orbit of *Parasilurus asotus* in Japan. Only these three species, like mine, have an oesophageal gland, poorly developed in *P. sebastica*, prominent in *P. hyderabadensis*, and broad in *P. paralisuri*.

The ventriculus, which is short and almost rudimentary in my specimen is similar in *P. inimici* (indistinct), and *P. sebastici* (poorly developed). The anus is also absent in *P. sebastici* and *P. paralisuri*.

The differences do not permit inclusion of my material in any of the described species. However, I feel that a single specimen is not sufficient for the erection of a new species.

Table 4.23 Morphological comparison between *Philometra* sp. and related species. Measurements are in micrometres or as indicated.

Character	*Philometra* sp.	*P. paralisuri*	*P. paralisuri*	*P. scianae*	*P. managatuwo*	*P. inimici*	*P. pinnicola*
Body length	146 mm	34 mm	53 mm	10 mm	46 mm	140 mm	22-40 mm
Maximum width	802	0.5 mm	0.75 mm	0.55 mm	1.36 mm	1.3 mm	0.65-1.25 mm
Cuticle	smooth, not striated, no bosses	-	-	-	-	thin, smooth	-
Head	114 x 31	truncate	-	-	-	-	-
Head papillae	2 pairs	8 large broad base	-	rudimentary	rudimentary	absent	?
Lips	simple inconspicuous	-	-	-	-	-	-
Anterior end to: - nerve ring	256	0.12-0.2 mm	-	0.2 mm	0.2-0.25 mm	0.24 mm	0.15 mm
- excretory pore	322	-	-	-	-	-	-
Oesophagus	1284 x 149	75-96	-	1.06 mm x 90	(0.85-1.075) x (0.12-0.132 mm	1.66 x 0.17 mm	1.0-1.35 mm x 80-90
Oesophageal gland	1015 x 85	-	-	-	present	-	?
Ventriculus	97 x 27	-	-	-	0.13 x 0.35 mm	indistinct	-
Anterior ovary	1450 x 62	-	-	2.1 mm	3.0 x 0.12 mm	(?) x 0.1 mm	0.055-0.11 mm
Posterior ovary	1844 x 83	-	-	2.6 mm	-	0.31 x 0.1 mm	0.055-0.11 mm
Anus	absent	absent	-	?	?	?	?
Caudal papillae	absent	2	-	absent	-	absent	?
Posterior extremity	blunt	blunt	-	blunt pointed	tapering	blunt pointed	?
Eggs	41 (23-52) x 35 (21-43)	-	-	-	-	-	-
Larvae	521 (496-579)x 16(14-17)	-	-	-	(0.45-0.6)mm x 15	(0.31-0.36) mm x 12-15	(0.32-0.37 mm x (0.02-0.025) mm
Host:	*Acanthopagrus australis*	*Parasilurus asotus* *Mogurnda obscura*	*Parasilurus asotus*	*Sciaena schlegeli*	*Stromateoides argenteus*	*Inimicus japonicus*	?
Site in host:	mouth cavity	orbit	orbit	ovary	ovary	outside of stomach	?
Locality:	Red Rock Estuary, NSW	Lake Ogura, Japan	Lake Suwa, Japan	Hamazima, Mie Prefecture, Japan	Tosa, Japan	Hamazima, Japan	?
Source:	This study	Yamaguti, 1935a	Yamaguti, 1941	Yamaguti, 1941	Yamaguti, 1941	Yamaguti, 1941	Yamaguti, 1941

Table 4.23 (cont'd)

Character	*P. sebastici*	*P. sebastoides*	*P. lateolabracis*	*P. hyderabadensis*	*P. sydneyi*	*P. lateolabracis*
Body length	135 mm	5.45-5.54 mm	130-200 mm	23 mm	30-150 mm	190-320 mm
Maximum width	2.0 mm	0.30-0.37 mm	0.8-0.9 mm	0.63 mm	0.35 mm	0.73-0.95 mm
Cuticle	thin and smooth	-	-	smooth	-	thin and smooth
Head	-	-	-	-	rounded	-
Head papillae	absent	absent	8	8	8	?
Lips	-	-	-	-	with 3 sharp teeth	-
Anterior end to: - nerve ring	0.25-0.30 mm	0.12-0.13 mm	0.2-0.25 mm	0.19 mm	0.3 mm	0.11-0.12 mm
- excretory pore	-	-	-	-	-	-
Oesophagus	(1.25-1.45) x (0.12-0.17) mm	(0.24-0.27) mm x 22-30	(0.9-1.4) x (0.09-0.1) mm	3.28 mm x 85	-	1.1-1.3 mm
Oesophageal gland	poorly developed	-	-	prominent	large	-
Ventriculus	poorly developed	cylindrical 45x18-21	having glandular cell	-	well developed	-
Anterior ovary	(?) x 0.12-0.17 mm	70-90	-	?	long, thin	-
Posterior ovary	(?) x 0.12-0.17 mm	0.3-0.38 mm x 32-45	-	?	long, thin	-
Anus	absent	-	-	-	-	-
Caudal papillae	absent	absent	-	2		
Posterior extremity	blunt	blunt pointed	-	tapering, rounded	pointed	tapering and rounded tip
Larvae	0.32-0.35 mm x15-20	0.17-0.19 mm x 3	-	0.18-0.25 mm x 15-17	0.36 x 0.01 mm	0.49 x 0.02 mm
Host:	*Sebasticus marmoratus*	*Sebastoides joyneri*	a) *Otholithes ruber* b) *Hemiramphus gorgii*	*Wallagu attu*	'Large white fish'	*Lates calcarifer*
Site in host:	ovary	pectoral fin	ovary	mesentery	subcutaneous tissues	ovary
Locality:	East China Sea West Coast of Kyusyu, Japan	Suruga Bay, Japan	a) West Pakistan, Karachi b) Malabar, India	Hyderabad, India	Sydney, Australia	Karachi, Pakistan
Source:	Yamaguti, 1941	Yamaguti, 1941	Rasheed, 1963	Rasheed, 1963	Rasheed, 1963	Rasheed, 1965

Table 4.23 (cont'd)

Character	*P. lateolabracis*	*Philometra* sp.	*Philometra* sp.	*P. pellucida* (A)	*P. pellucida* (B)	*P. pellucida* (1)
Body length	160-205 mm	132 mm	100-190 mm	85 mm	45-85 mm	75 mm
Maximum width	0.5-0.93 mm	1.2 mm	1.6-1.9 mm	0.6 mm	0.76-1.0 mm	0.87 mm
Cuticle	smooth	-	-	-	-	-
Head	-	-	-	-	-	-
Head papillae	-	-	faintly developed	-	-	-
Lips	-	-	-	-	-	-
Anterior end to: - nerve ring	0.11-0.12 mm	-	-	-	-	-
- excretory pore	-	-	-	-	-	-
Oesophagus	1.1-1.3 mm	-	1.34-1.5 mm	0.9 mm	1.40-1.56 mm	0.95 mm
Oesophageal gland	-	-	-	-	-	-
Ventriculus	-	-	glandular	glandular	-	-
Anterior ovary	-	-	-	-	-	-
Posterior ovary	-	-	-	-	-	-
Anus	-	-	-	-	-	-
Caudal papillae	-	absent	-	2 minute	minute	-
Posterior extremety	rounded tip	-	-	tapering, rounded	rounded	rounded
Larvae	0.49 x 0.02 mm	-	0.35 mm x 8	-	0.33 mm x 7	0.44 mm x 7
Host:	*Johnius sina*	*Tetradon* sp.	*Tetradon* sp.	Toad fish and *Tetradon hispidium*	*Tetradon* sp. and *T. hispidium*	*Tetradon* sp. *T. hispidium*
Site in host:	ovary	ovary	ovary	testis	testis	testis
Locality:	Karachi	Australia	Australia	Australia	Australia	Australia
Source:	Rasheed, 1965	Rasheed, 1965	Rasheed, 1965	Rasheed, 1965	Rasheed, 1965	Rasheed, 1965

Table 4.23 (cont'd)

Character	*P. pellucida* (2)	*Philometra* (*P. globiceps* sensu Baylis, 1929)	*P. obturans* (Prenant, 1886)	*P. cylindracea* (Ward and Magath, 1916) (mature)	*P. cylindracea* (Ward and Magath, 1919 (gravid)
Body length	55 mm	170 mm	140-210 mm	2.62 (1.98-3.83) mm	122.2 (92-6.154) mm
Maximum width	-	0.75 mm	0.75-0.85 mm	61 (32-101)	448 (356-594)
Cuticle	-	-	smooth and thin	smooth	smooth
Head	-	-	rounded	-	-
Head papillae	-	-	-	6 circumoral	-
Lips	-	-	3	3	3
Anterior end to: - nerve ring	-	-	-	109 (101-120)	163 (136-221)
- excretory pore	-	-	-	-	-
Oesophagus	0.9 mm	1.0 mm	1.7 (1.6-1.8) x 0.8 (0.07-0.09) mm	654 (529-889)	1.27 (0.976-1.53) mm
Oesophageal gland	-	-	rudimentary	-	-
Ventriculus	-	glandular	-	-	-
Anterior ovary	-	-	-	-	-
Posterior ovary	-	-	-	-	-
Caudal papillae	-	2 phasmid-like	2	-	-
Posterior extremity	-	rounded	blunt	-	rounded
Larvae	-	0.25 mm x 7	0.48 (0.46-0.50) mm	-	-
Vulva	-	-	-	863 (625-1,160) from posterior end	638 x 14
Host:	*Tetradon* sp. *T. hispidium*	Percoid fish	*Esox lucius* (Pikes)	Perch (*Perca flavescens*)	Perch (*Perca flavescens*)
Site in host:	testis	gonad	gill arteries, abdominal serous membranes	body cavity	body cavity
Locality:	Australia	St. Paul de Loanda, Angola, West Africa	Hungary	Lake Erie, Ohio, USA	Lake Erie, Ohio, USA
Source:	Rasheed, 1965	Rasheed, 1965	Molnar, 1976	Ashmead and Crites, 1975	Ashmead and Crites, 1975

Table 4.23 (cont'd)

Character	*Philometra* sp. sensu Nakajima and Egusa, 1978	*P. spari* Yamaguti, 1961	*Philometra* sp. sensu Sakaguchi and Matsusato, 1978	*Philometra* sp. sensu Benz and Pohley, 1980
Body length	unmeasured	110 mm	185 mm	680 (300-720) mm
Maximum width	0.50-0.57 mm	1.4 mm	1.2 mm	-
Cuticle	smooth	-	-	-
Head	rounded	-	-	-
Head papillae	absent	-	-	-
Lips	-	-	-	-
Anterior end to: - nerve ring	-	-	0.2 mm	-
- excretory pore	-	-	-	-
Oesophagus	-	0.83 mm	1.1 x 0.13 mm muscular	-
Oesophageal gland	-	-	-	-
Ventriculus	-	-	-	-
Anterior ovary	-	-	-	-
Posterior ovary	-	-	-	-
Caudal papillae	-	-	-	-
Posterior extremity	-	-	-	-
Larvae	16 x 18	13 x 26	-	-
Host:	*Chrysophrys major*	*Sparus macrocephalus*	*Chrysophrys major*	Bluegills (*Lepomis macrochirus*) and Warmouth (*L. gulosus*)
Site in host:	testes and ovary	swim-bladder	body cavity	oculo-orbits
Locality:	Amami Island, Kagoshima Prefecture, Japan	Seto Inland Sea, Japan	Japan	Georgia, USA
Source:	Nakajima and Egusa, 1978	Yamaguti (1961) Sakaguchi and Matsusato, 1979	Sakaguchi and Matsusato, 1978	Benz and Pohley, 1980

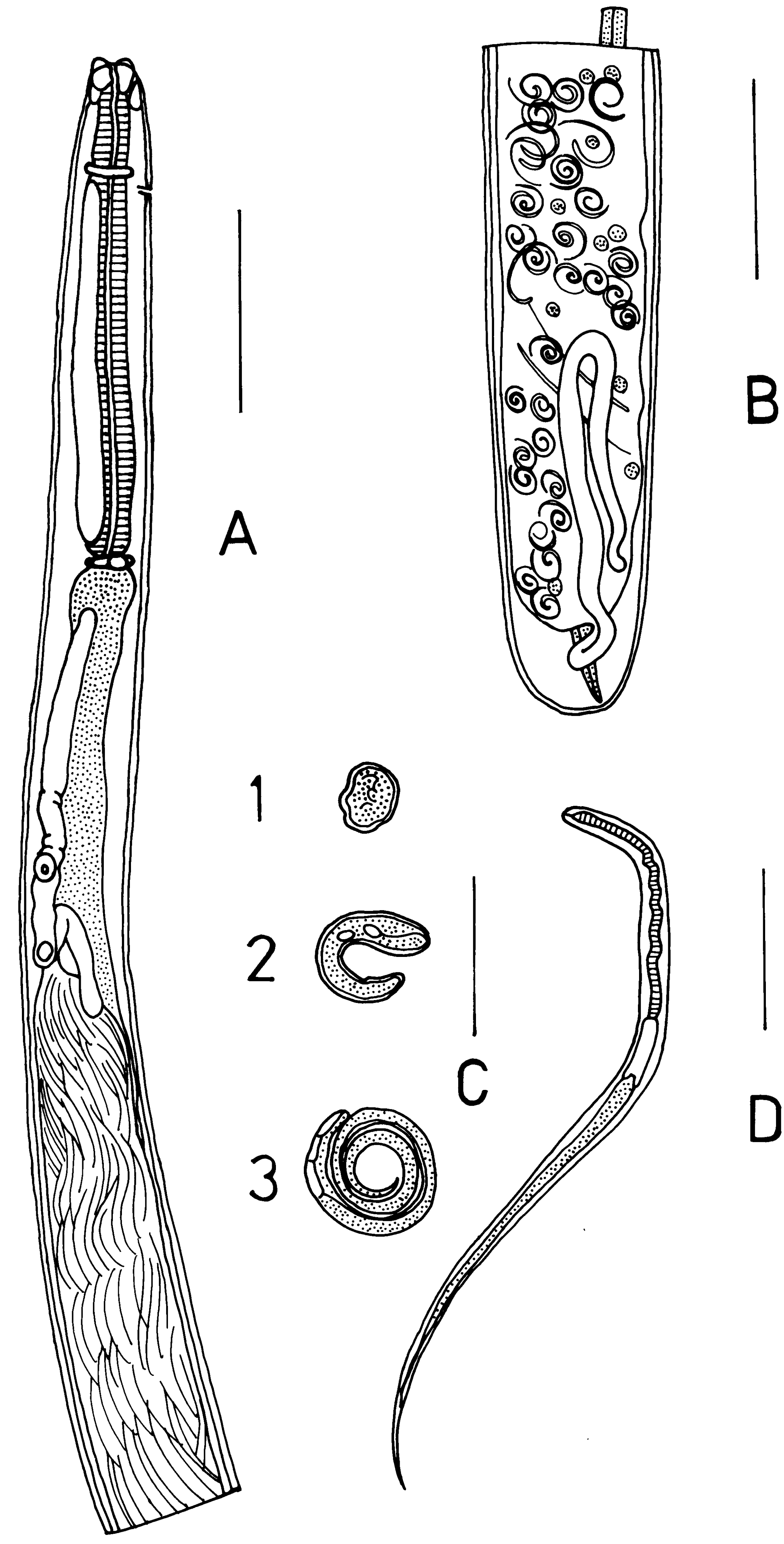
PLATE 28: *Philometra* sp.

A. Anterior end, lateral view,
scale length 0.5 mm

B. Posterior end, lateral view,
scale length 0.5 mm

C. (1) egg; (2) first stage larva;
(3) third stage larva,
scale length 0.1 mm

4. Fourth stage larva, scale length 0.1 mm


A
B
1
2
3
C
D

Genus: *Philometroides* Yamaguti, 1935

(*Pseudophilometroides* Parukhin, 1966)

P. roubali n. sp.

Specimens deposited: W199703.

Collection data:

- Number of worms measured: 7 gravid females (5 complete)
- Site in host : mouth cavity and around anus
- Locality : Red Rock Estuary (NSW)

Description:

Body length (n=5) 6507 (4395-9529), maximum body width 760 (601-911). Cuticle with numerous bosses scattered throughout body. Body width at nerve ring 318 (248-364) and at oesophagus-intestine (n=6) 476 (331-653). Oesophagus not swollen near mouth, length (n=6) 1297 (953-1781). Nerve ring 215 (166-248) from anterior end. Uterus with developed larvae 355 (322-397) x 18 (14-21). Uterus winding from level of nerve ring. No head papillae, no bosses at tip of head and no cervical gland. Excretory pore not observed. No oesophageal gland. Ventriculus inconspicuous. Two ovaries. Anterior end of anterior ovary at level of nerve ring, extends along oesophagus. Posterior ovary long, slender, tubular, close to posterior extremity, V-shaped. Posterior part of uterus filled with numerous first-stage larvae.

Remarks:

In 1963, Rasheed described two species of *Philometroides* Yamaguti, 1935, i.e. *Ph. plectroplites* (Johnston and Mawson, 1940) n. comb. and *Ph. anguillae* (Ishii, 1916) n. comb. found in the thoracic cavity of *Anguilla reinhardtii* in Queensland. In 1965, *Ph. denticulatus* was recorded from the body cavity and the bladder of *Phistipoma hasta* and *Otholithes ruber* in Karachi, Pakistan (Rasheed, 1965).

My specimens are longer than *Ph. anguillae* and *Ph. plectroplites*, but shorter than *Ph. denticulatus* (see the comparisons in Table 4.24). The cuticle with prominent cuticular bosses throughout the body agrees with *Ph. plectroplites* and *Ph. denticulatus*, but differs from *Ph. anguillae* which has a smooth cuticle with only a few bosses near the tail and in some other parts of the body. The head differs from *Ph. plectroplites* and *Ph. anguillae* which have papillae. *Ph. denticulatus* has minute papillae which, however, are seen with great difficulties. The oesophagus with no appendix in some of my specimens and a small appendix in others and without glands, agrees with *Ph. denticulatus*. There is no anus in my specimens and in *Ph. anguillae*. *Ph. denticulatus* has an anus.

Differences are sufficient to establish a new species for my material, i.e. *Ph. roubali*. The species is named after F.R. Roubal of the Zoology Department, U.N.E.

Table 4.24 Morphological comparison between *Philometroides roubali* n. sp. and related species. Measurements are in micrometres or as indicated.

Character	*P. roubali*	*P. anguillae* (Ishii, 1916)	*P. plectroplites* (Johnston and Mawson, 1940)	*P. denticulatus* (Rasheed, 1965)
Body length	6507 (4395-9529)	88-100 mm	105 mm	250-320 mm
Maximum width	760 (601-911)	0.7-0.8 mm	?	0.52-0.67 mm
Cuticle	with bosses scattered throughout	smooth but few bosses near tail and some other body parts	with bosses scattered irregularly	with prominent bosses
Head	no papillae	8 papillae	with papillae	'minute papillae'
Anterior end to nerve ring	215 (166-248)	0.18-0.20 mm	0.2 mm	0.38-0.45 mm
Oesophagus	1297(953-1781) swollen near mouth	1.59-1.622 x 0.17-0.19 mm	1.2 x 0.1 mm swollen	1.0-2.15 mm swollen anteriorly plus saccular gland
Ventriculus	inconspicuous	small plus appendix	-	-
Intestine	ending blindly	ending blindly	-	-
Tail	blunt	slightly tapering bluntly rounded	tapering to a fine point rounded	-
Larvae	355 (322-397) x 18 (14-21)	0.43-0.47 mm x 10-12	0.45-0.47 mm x 22-23	0.63-0.73 mm x 9-11
Host:	*Acanthopagrus australis*	*Anguilla reinhardtii*	(?)	*Pristipoma hasta* and *Otolithus ruber*
Site in host:	Mouth cavity	Thoracic cavity	(?)	Body cavity and bladder
Locality:	Red Rock Estuary, NSW	Queensland	Rasheed, 1963	Karachi, Pakistan
Source:	This study	Rasheed, 1963	Rasheed, 1963	Rasheed, 1965

PLATE 29: *Philometroides roubali* n. sp.

A. Anterior end.

B. Anterior end with a broken part of the body.

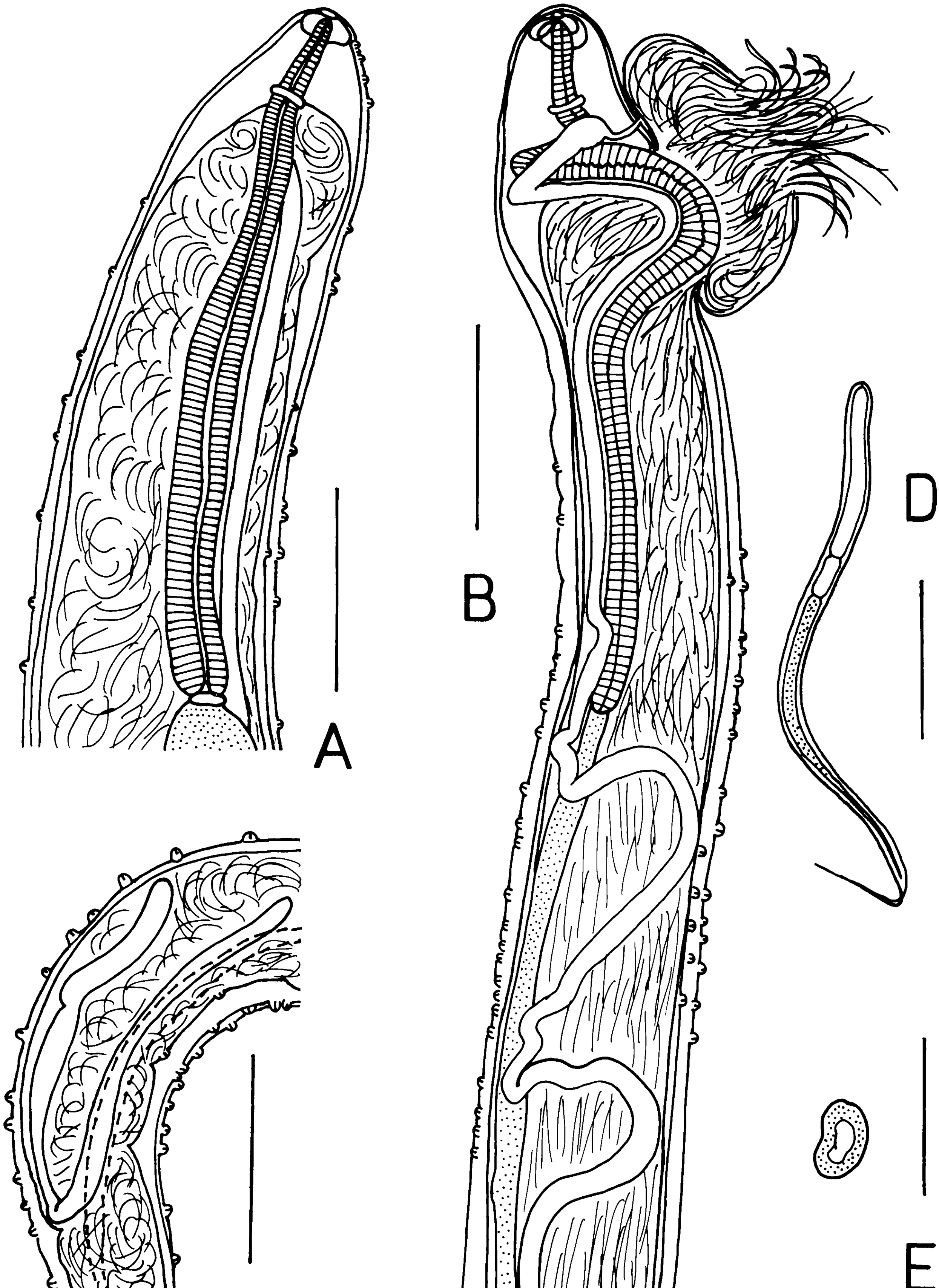
C. Posterior end.

D. Larva.

D. Egg.

Scale length - A, B, C - 0.5 mm;

D, E - 0.1 mm.


A
B
C
D
E

Phylum : ACANTHOCEPHALA

Class : METAACANTHOCEPHALA Van Cleave, 1948

Order : ECHINORHYNCHIDEA Southwell and Macfie, 1925

Family : POMPHORHYNCHIDAE Yamaguti, 1939

Genus : *Longicollum* Yamaguti, 1935

L. pagrosomi Yamaguti, 1935; Johnston and Edmonds (1951)

Specimen deposited: W199688.

Collection data:

- Number of worms measured: 1 female
- Site in host : proboscis embedded in the wall of the intestine
- Locality : Red Rock Estuary (NSW)

Description:

6213 long x 932 wide, widest part at level of posterior end of lemnisci. Combined length of neck and proboscis 4661: proboscis length 1636 and bulb diameter 559. Number of longitudinal rows of proboscis hooks 12: number of hooks per row 16. Lemnisci two, short lemniscus 829; long lemniscus 974. Neck width 476, slightly twisted. Neck and body unarmed. Hooks at anterior, middle and posterior levels of porboscis, 21 x 10, 31 x 10, and 41 x 12 respectively. Eggs 45 x 10.

Remarks:

Longicollum pagrosomi has been found in sparid fish, i.e. in *Pagrosomus unicolor* and *Sparus longispinis* (see Yamaguti, 1935b) in Japan; and in *Mylio australis* in Queensland, Australia (Johnston and Edmonds, 1951). Other species of *Longicollum* also seem to be common in Sparidae, i.e. *L. alemniscus* Harada, 1955) syn. *Spirorhynchus alemniscus* (Harada, 1955) in *Sparus macrocephalus* in Japan (after Yamaguti, 1961), and *L. minor* (Fukui and Morisita, 1936) syn. *Spirorhynchus alemniscus*

(Harada, 1955) in *Sparus macrocephalus* (Fukui and Morisita, 1938).

My specimen is apparently of similar size to males of *L.pagrosomi* described by Johnston and Edmonds, 1951, but only about half as long as *L. pagrosomi* Yamaguti, 1935 from *Pagrosomus unicolor* in Japan.

The arrangement of the proboscis hook and especially the number of longitudinal rows of hooks are similar to those described by Johnston and Edmonds. The average number of longitudinal rows of hooks also corresponds to that given by Yamaguti. However, the number of hooks per row differs both from Johnston and Edmonds' material which has 11-13 hooks per row, and from Yamaguti's which has 9-12 hooks per row.

The only other species of *Longicollum* which has an almost similar number of hooks per row, that is 14-15, is the female of *L. lutiani* (Jain and Gupta, 1980), fig. 5, p. 274 from the intestine and rectum of *Lutianus johnii* (Bl.), *Gerres filamentosus* (Russ.) and *Pomadasys johnii* (Cuv. and Val.) in Panaji (Goa). My specimen is also very similar to female *L. lutiani* (Jain and Gupta, 1980) in other characters except that my specimen is shorter. *L. lutiani* is possibly a synonym of *L. pagrosomi*.

The lemnisci of my specimen differ from those of Yamaguti's specimens which are reduced to a lobed collar around the proboscis sheath at its entrance to the trunk, whereas in my specimen they are well developed. Nevertheless, differences are not considered to be sufficient for putting my specimen in a different species. Possibly, Yamaguti dealt with a different geographical subspecies.

Table 4.25. Morphological comparison between the present specimen and other specimens of *Longicollum pagrosomi* Yamaguti, 1935. Measurements are in micrometres or as indicated.

Character	Present specimen	Johnston and Edmonds (1951) (mm)	Yamaguti (1935) (mm)
Body length	6213	4.9-5.1	12-17
Maximum width	932	0.53-1.1	-
Combined length of neck and proboscis	4661	4.7-5.6	-
Neck length	-	-	5.0-1.5
Proboscis length	1636	0.85	0.9-1.3
Proboscis hooks:			
- no. of longitudinal rows	12	12	11-15
- no. of hooks per row	16	11-13	9-12
Lemnisci:			
- short lemniscus	829	0.8	0.74
- long lemniscus	974	0.8	0.74
Testes:			
- anterior testis	-	(0.49-0.63 x	1.5
- posterior testis		(0.23-0.28	
Cement glands	-	3 pairs	?
Hooks:			
- anterior	21 x 10	?	anterior shorter, but recurved strongly
- middle	31 x 10	?	
- posterior	41 x 12	?	
Host:	*Acanthopagrus australis*	*Mylio australis*	Immature worms in various marine fishes. Mature ones in *Pagrosomus unicolor*
Site in host:	intestinal wall	intestine	intestine
Locality:	Red Rock Estuary, NSW	Queensland	Japan
Source:	This study	Johnston and Edmonds, 1951	Yamaguti, 1935b

PLATE 30: *Longicollum pagrosomi* Yamaguti, 1935

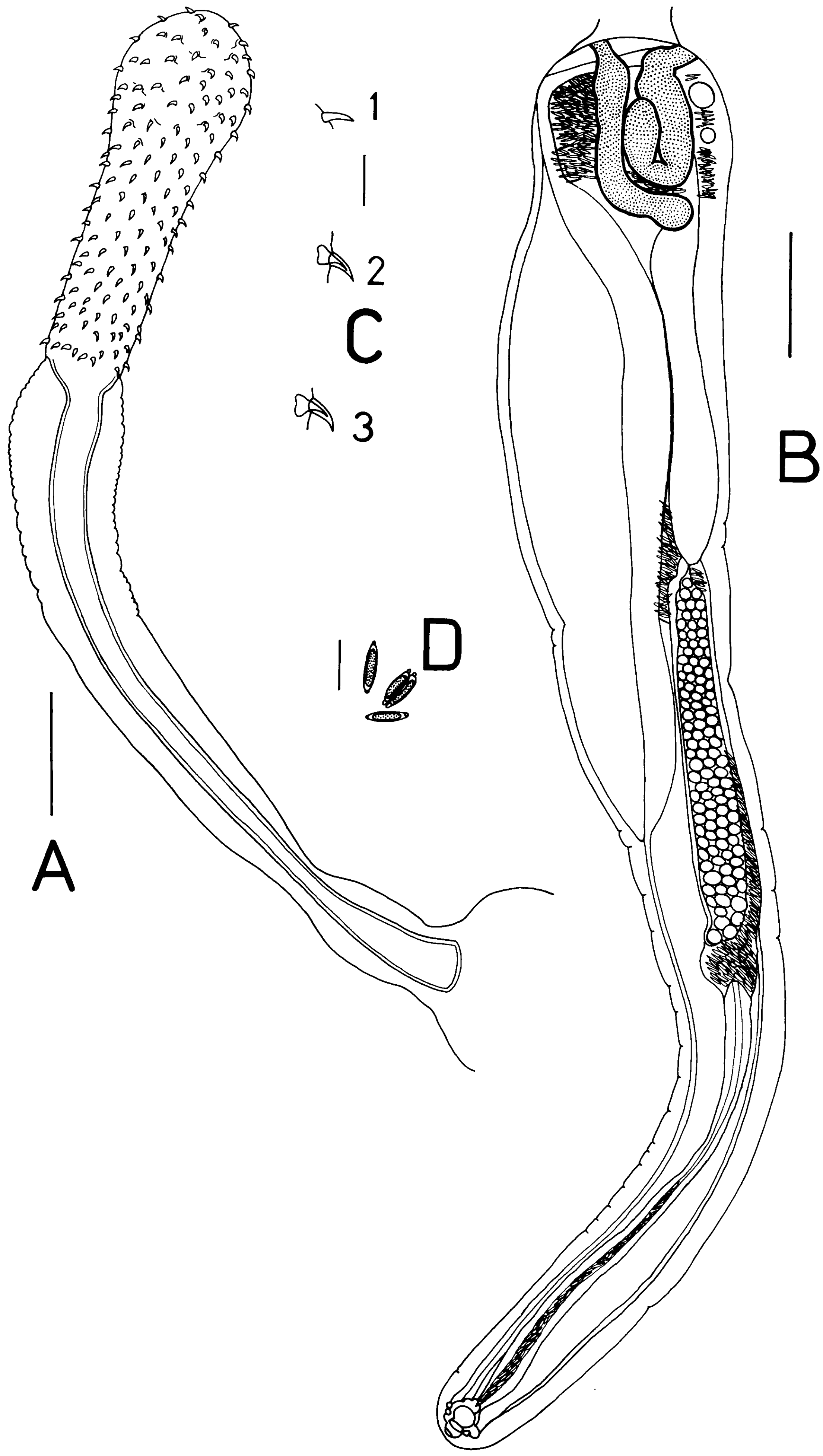
A. Neck and proboscis.

B. Body, lateral view.

C. Proboscis hooks: (1) anterior
(2) middle
(3) posterior

D. Eggs.

Scale length 0.5 mm



A
B
C
1
2
3
D

Genus: *Longicollum* Yamaguti, 1935

L. australis n. sp.

Specimens deposited: W199685.

Collection data:

- Number of worms measured: 2 males
- Site in host : intestine (proboscis of one embedded in intestinal wall)
- Locality : Yamba (NSW)

Description:

Body 2920-4308 x 612-736, widest part at level between two testes. Neck very long, almost as long as body, twisted slightly, broadest part in anterior region. Combined length of neck and proboscis 2190-2900. Proboscis length 932-1243, armed with hooks, number of longitudinal rows 14-16, and number of hooks per row 17. Lemnisci two, almost equal, short lemniscus 703-1098, long lemniscus 741-1139. Testes two, oval, tandem; anterior testis 331-587 x 273-398, posterior testis 322-694 x 298. Cement glands 6 (3 pairs) followed by long Saeftigen pouch before entering the copulatory bursa.

Remarks:

My specimens of *Longicollum australis* n. sp. differ from *L. pagrosomi* as described by Yamaguti (1935b) and Johnston and Edmonds (1951) and from my specimens of this species from NSW in the body length and the combined length of the neck and proboscis, which are much shorter in *L. australis*. They also differ in the arrangement of the proboscis hooks, both in the number of longitudinal rows which is 12 in Johnston and Edmonds' material, and 11-15 in Yamaguti's, and 12 in my specimens of *L. pagrosomi* from NSW, and in the number of hooks per row which is 11-13 in Johnston and Edmonds', 9-12 in Yamaguti's specimens and 16 in *L. pagrosomi* collected from NSW. Yamaguti's material also differs in the shape of the lemnisci which are reduced in his, but well developed in my specimens.

The new species also differs from *L. psettodesai* (Gupta and Gupta, 1979) and *L. lutiani* (Jain and Gupta, 1980) in the arrangement of the proboscis hooks, both in the number of longitudinal rows of hooks, which is 14-16 in Gupta and Gupta's material and 12-13 in Jain and Gupta's, and in the number of hooks per row, which is 10-12 in Gupta and Gupta's and 14-15 in Jain and Gupta's specimens.

The testes which are unequal in my material differ from *L. lutiani* and *L. pagrosomi* which have equal testes. The buccal capsule in Jain and Gupta's material is prominent, whereas in mine it is inconspicuous or absent.

Bray (1974) reported a relatively small-sized specimen of *Longicollum* sp. from the intestine of *Solea bleekeri* from Klein River Estuary, Hermanus, Cape Province, South Africa. It is only 4.2 mm in length and 0.58 mm in maximum diameter; however, the arrangement of the proboscis hooks is different. It has 9 longitudinal rows of hooks and 7 hooks per row. Bray's specimen also differs from mine in having much more posterior testes.

Based on those differences, I propose a new species for my material, i.e. *Longicollum australis*. The species name refers to the southern distribution of the species.

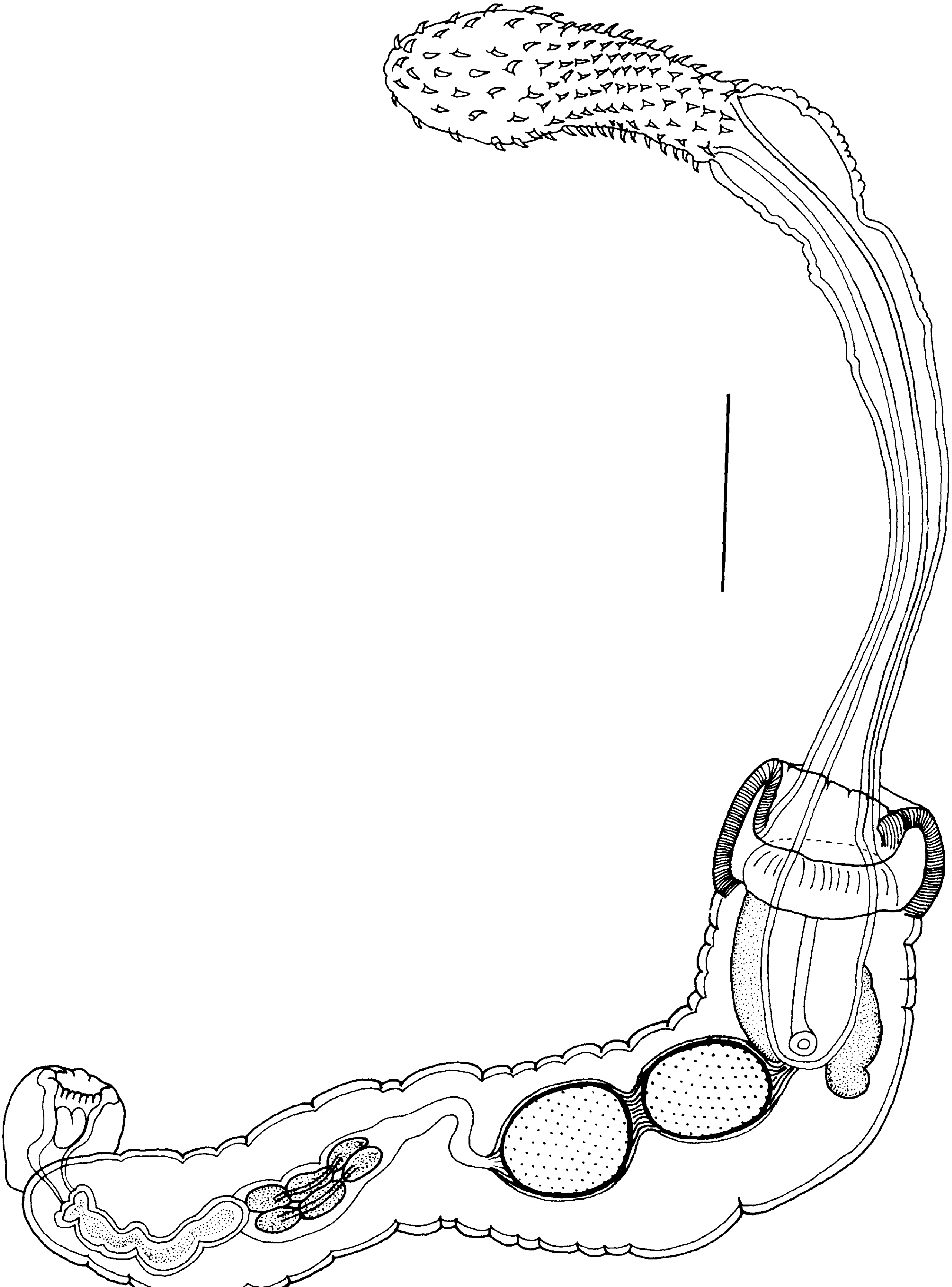
Table 4.26. Morphological comparison between *Longicollum australis* n. sp. and related species. Measurements are in micrometres or as indicated.

Character	*L. australis*	*L. lutiani* (males)	*L. lutiani* (females	*L. psettodesai*	*L. pagrosomi*	*L. Pagrosomi*	*Longicollum* sp.
Body length	2920-4308	5.86-7.624 mm	8.186-10.467 mm	9.78 mm	4.9-5.1 mm	12-17 mm	4.2 mm
Maximum width	612-736	0.698-1.203 mm	1.29-1.765 mm	1.06 mm	0.53-1.1 mm	-	0.58 mm
Combined length of neck and proboscis	2190-2900	-	-	-	4.76-5.6 mm	-	-
Neck length	-	1.455-2.580 mm	1.455-3.07 mm	-	-	5.0 mm	0.64 mm
Proboscis length	932-1243	0.679-0.812 mm	0.698-1.067 mm	0.71 x 0.26 mm	0.85 mm	0.9-1.3 mm	0.52 mm
Proboscis hooks:							
- number of longitudinal rows	14-16	12-13	12-13	14-16	12	11-15	9
- number of hooks per row	17	14-15	14-15	10-12	11-13	9-12	7
Short lemniscus	703-1098	0.261-0.621 mm	0.388-0.757 mm	0.6 mm	equal	-	equal
Long lemniscus	741-1139	0.281-0.679 mm	0.465-0.776 mm	0.6 mm	0.8 mm	-	0.74 mm
Anterior testis	459(331-587) x 351(273-389)	0.194-0.621 mm	-	0.32 x 0.22 mm	(0.49-0.63 x)	(equal)	0.18 x 0.21 mm
Posterior testis	508(322-694) x 298	0.194-0.621 mm	-	0.34 x 0.22 mm	(0.23-0.28 mm)	(1.5 mm)	0.28 x 0.20 mm
Cement glands	3 pairs	6	-	6	3 pairs	6	?
Hooks:							
- anterior		32-41 x 6-7	32-41 x 6-7	0.05-0.055	-	anterior	0.45-0.5 mm
- middle		27-40 x (?)	27-40 x (?)	0.02-0.03	-	shorter, but	0.45-0.55 mm
- posterior		54-60 x 13-22	54-60 x 13-22	0.039-0.05	-	recurved strongly	0.9-0.95 mm
Host:	*Acanthopagrus australis*	*Lutianus johnii* *Gerres filamentosis*	*Lutianus johnii* and *Pomadasys johnii*	*Psettodes erumei*	*Mylio australis*	*Pagrosomus unicolor*	*Solea bleekeri*
Site in host:	intestinal wall	rectum and intestine		intestine	intestine	intestine	intestine
Locality:	Yamba, N.S.W.	Panaji (Goa), India		Arabian Sea, Quilon, Kerala	Queensland, Australia	Japan	South Africa
Source:	This study	Jain and Gupta, 1980		Gupta and Gupta, 1979	Johnston and Edmonds, 1951	Yamaguti, 1935b	Bray, 1974

PLATE 31: *Longicollum australis* n. sp.

Whole mount.

Scale length 0.5 mm.



Order : NEOECHINORHYNCHIDEA Southwell et Macfie, 1925

Family : NEOECHINORHYNCHIDAE Van Cleave, 1919

Subfamily : NEOECHINORHYNCHINAE Travassos, 1926 emend.

Genus : *Neoechinorhynchus* Hamann, 1892

Neoechinorhynchus sp.

Specimen deposited: W199686.

Collection data:

- Number of worms measured: 1 male
- Site in host : debris
- Locality : Red Rock Estuary (NSW)

Description:

Body long with very short proboscis slightly retracted into sheath, and unarmed trunk. Body length 7.55 mm, maximum width 787 in anterior testis region. Maximum thickness of body wall 352 at level of posterior testis. Proboscis very short, 83 long x 182 wide. Length of terminal hooks 78, middle hooks 50 and basal hooks 62. Proboscis sheath (-receptacle) 703 x 132. Cerebral ganglion at basal region of receptacle, of spiral shape. Lemnisci finger-like, very long, reaching end of posterior testis; long lemniscus 3625, short lemniscus 3210. Testes two, elliptical; contiguous with each other and with cement gland. Anterior testis 891 x 331, posterior testis 932 x 311. Cement gland cylindrical, 829 x 228. Cement reservoir sac-like with long duct, 539 x 414. Seminal vesicle bipartite, anterior part at end contiguous with cement gland, 725 x 269; posterior part just posterior to cement reservoir, long and contiguous with duct of cement reservoir. Bursa 1098 x 124; 1657 from posterior end of trunk.

Remarks:

The present specimen of *Neoechinorhynchus* agrees in a similar body length with females of *N. cylindratus* Van Cleave, 1913 (Ward, 1940) (7-11.2 mm); males of *N. agilis* (Rud. 1819) (Yamaguti, 1935) (7-22 mm); females of *N. crassus* Van Cleave, 1919 (Lynch, 1936) (6-9 mm); females of *N. prolixus* Van Cleave and Timmons, 1952 (7-16 mm); and males of *N. prolixus* (5.5-11.9 mm). The body width is about the same size as in females of *N. venustus* Lynch, 1936 [0.69 (0.55-1.00)mm]; males of *N. agilis* Yamaguti, 1935 (0.6-1.0 mm); and females of *N. prolixus* Van Cleave and Timmons, 1952 (0.42-0.99 mm).

The proboscis width of my specimen is similar to that of females of *N. cylindratus* Van Cleave, 1913 described by Ward (1940).

The proboscis hooks which are usually used as important characters in determining the species, are arranged in 3 circles of 6 (terminal, middle and basal hooks). The length of the terminal hooks agrees with that in *N. cylindratus* (Ward, 1940), both in females (0.061-0.088 mm) and in males (0.058-0.082 mm). However, the length of middle hooks is different. The species which have a similar length of the middle hooks are males of *N. agilis* (Rud. 1819) described by Yamaguti(1935b); males and females of *N. venustus* Lynch, 1936; males and females of *N. australis* Van Cleave, 1931 (emend.) (Van Cleave, 1949); and females of *N. strigosus* Van Cleave, 1949. The basal hooks are about the same length as in *N. crassus* Van Cleave, 1919 described by Lynch, 1936, both in males and females.

The longer lemniscus, which is about 48% of the body length, has about the same proportion as in males of *N. cristatus* Lynch, 1936 and in females of *N. prolixus* Van Cleave and Timmons, 1952, but there is only one species which has a similar proportion of the shorter lemniscus compared with the body length, i.e. females of *N. crassus* Lynch, 1936

(42-53%) as compared with 42.5% of body length in my specimen.

N. agilis (Rud. 1819) described by Yamaguti(1935b) has a similar size of the anterior testis; *N. venustus* Lynch, 1936 has a similar size of the posterior testis.

My specimen differs from all described species at least in some characters. However, a new species cannot be established because only a single specimen is available and morphological variability cannot be evaluated.

Table 4.27. Morphological comparison between the present specimen of *Neoechinorhynchus* sp. and related species. Measurements are in micrometres unless otherwise indicated.

Character	Present specimen of *Neoechinorhynchus* sp.	*N. cylindratus* ♀	*N. cylindratus* ♂	*N. agilis* (Rud., 1819)	*N. venustus* ♂	*N. venustus* ♀	*N. cristatus* ♂
Body length	7.55 mm	7.0-11.2 mm	4.7-6.3 mm	7.0-22.0 mm	5.2 (2.5-6.4) mm	9.15 (7.75-12.75 mm	3.0 (2.55-3.55) mm
Maximum width	787	0.35-0.7 mm	0.36-0.63 mm	0.6-1.0 mm	-	0.69 (0.55-1.0) mm	0.35 (0.3-0.4) mm
Thickness of body wall	352	0.03-0.07 mm	0.02-0.05 mm	-	64 (45-80)	-	-
Proboscis	83 x 182	0.1-1.14 x 0.16-0.19 mm	0.1-0.14 x 0.15-0.17 mm	0.13-0.15 mm	116 (93-143) x 127 (108-145)	122 (112-137) x 124 (110-147)	109 (95-127) x 84 (70-97)
Hooks:							
- terminal	78	0.061-0.088 mm	0.058-0.082 mm	(?) x 84-140	48 (40-57)	51 (45-57)	48 (45-51)
- middle	50	0.024-0.04 mm	0.024-0.034 mm	(?) x 39-81	50 (45-55)	51 (49-57)	28 (26-33)
- basal	62	0.017-0.027 mm	0.017-0.024 mm	(?) x 36-60	34 (35-41)	38 (35-41)	25 (23-26)
Proboscis sheath	703 x 132	0.028-0.35 x 0.11 -0.15 mm	0.24 - 0.35 x 0.13 - 0.14 mm	0.55-0.70 mm 0.13-0.24 mm	273 (210-335) x 102 (90-120)	290 (250-320) x 104 (85-125)	234 (205-288) x 75 (60-85)
Cerebral ganglion	spiral shape	at posterior extremity of the proboscis sheath		-	-	-	-
Lemnisci:							
- long lemniscus	3625	0.95-1.4 mm	0.84-1.20 mm	very long	30 (23-42)% of body length	19 (12-28)% of body length	41 (31-64)% of body length
- short lemniscus	3210	0.85-1.34 mm	0.74-1.05 mm	very long	20 (16-30)% of body length	12 (9.5-14.5)% of body length	26 (21-38)% of body length
Anterior testis	891 x 331	-	0.40-0.70 x 0.18-0.25 mm	0.65-1.82 mm	941 (630-1350) x 289 (160-330)	-	498 (390-585) x 199 (155-250)
Posterior testis	932 x 311	-	0.21-0.25 x 0.17-0.27 mm	0.37-0.56 mm	822 (725-1080) x 287 (180-370)	-	459 (365-560) x 195 (175-230)
Seminal vesicle	725 x 269	-	-	-	-	-	-
Cement glands	829 x 228	0.67-1.2 x 0.13-0.28 mm	0.67-1.2 x 0.13-0.28 mm	-	1321 (1020-1600) x 270 (190-300)	-	-
Cement receptacle	539 x 414	-	0.22-0.42 x 0.08-0.21 mm	0.53 x 0.28 mm	315 (230-340) x 195 (175-255)	-	-
Bursa copulatrix	1098 x 124	-	0.42 mm	1.0 mm	-	-	-
Host:	*Acanthopagrus australis*	*Huro salmoides*	*Huro salmoides*	*Mugil cephalus*	*Catostomus macrocheilus*	*Catostomus macrocheilus*	*Catostomus macrocheilus*
Site in host:	debris	-	-	-	-	-	intestine
Locality:	Red Rock Estuary, NSW	Indiana, USA	Indiana, USA	Inland Sea, Pacific Coast, Japan	Lake Washington, USA	Lake Washington, USA	Lake Washington, USA
Source:	This study	Ward, 1940	Ward, 1940	Yamaguti, 1935	Lynch, 1936	Lynch, 1936	Lynch, 1936

Table 4.27 (cont'd)

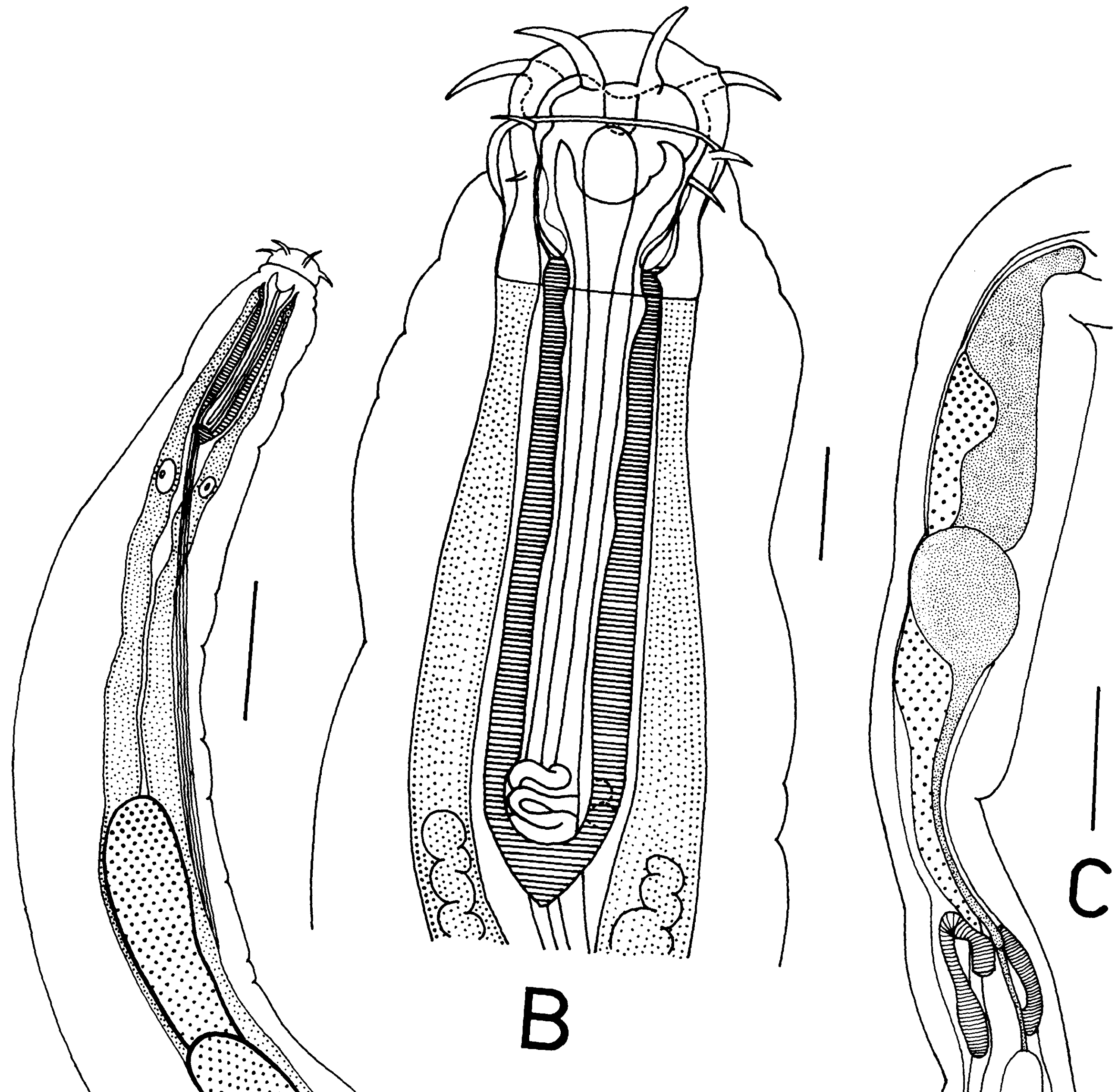
Character	*N. crassus* ♂	*N. crassus* ♀	*N. australis* ♂	*N. australis* ♀	*N. strigosus* ♂	*N. prolixus* ♂	*N. prolixus* ♀
Body length	4-7 mm	6-9 mm	3.4-6.5 mm	3.6-10.7 mm	3.7-5.5 mm	5.5-11.9 mm	7-16 mm
Maximum width	-	-	0.38-0.42 mm	0.34-0.67 mm	346	0.35-0.57 mm	0.42-0.99 mm
Thickness of body wall	74-95	78-124	-	-	-	-	-
Proboscis	270-325 x 235-260	270-325 x 225-270	146-230 x 117-170	146-230 x 117-170	105 x 146	0.084-0.112 x 0.098-0.126 mm	0.098-0.112 x 0.098-0.140 mm
Hooks:							
- terminal	94-100	98-105	88-90	88-90	-	0.042-0.056 mm	-
- middle	71-83	73-90	47-59	47-59	-	0.028 mm	-
- basal	47-71	60-63	23-50	23-50	-	0.028 mm	
Proboscis sheath	450-600	450-600	-	-	-	-	-
Lemnisci:							
- long lemniscus	60-71% of body length	52-65% of body length	-	-	-	-	1/4-1/3 of body length
- short lemniscus	57-64% of body length	42-53% of body length	-	-	-	-	over half of long lemniscus
Anterior testis	660-870 x 200-380	-	-	-	-	-	-
Posterior testis	440-870 x 220-380	-	-	-	-	-	-
Cement glands	-	-	-	-	-	1-2 mm	-
Cement receptacle	190-200 x 110-250	-	-	-	-	-	
Embryos	-	-	-	-	-	-	0.026-0.032 x 0.01 -0.015 mm
Host:	*Catostomus macrocheilus*	*Catostomus macrocheilus*	*Ictiobus* sp.	*Ictiobus* sp.	(1) *Ictiobus bulbalus* (2) *Catostomus commensonii* (3) *Moxostoma aureolum*	*Carpiodes carpio*	*Carpiodes carpio*
Site in host:	-	-	-	-	-	-	-
Locality:	US National Museum	US National Museum	Money, Mississippi, USA		(1) Reelfoot Lake, Tenn. (2) Lake Chetac Wisconsin (3) Mississippi River, West Wisconsin, USA	Lake Texona, Oklahoma, USA	Lake Texona, Oklahoma, USA
Source:	Lynch, 1936	Lynch, 1936	Van Cleave,1949	Van Cleave, 1949	Van Cleave, 1949	Van Cleave and Timmons, 1952	Van Cleave and Timmons, 1952

PLATE 32: *Neoechinorhynchus* sp.

A. Anterior half of body; scale length 0.5 mm

B. Head and proboscis sheath; scale length 0.1 mm

C. Posterior half of body; scale length 0.5 mm


A
B
C

Genus : *Hexaspiron* Dollfus and Golvan, 1956

Hexaspiron sp.

Specimen deposited: W199687.

Collection data:

- Number of worms measured: 1 female
- Site in host : stomach
- Locality : Yamba (NSW)

Description:

Total body length 14.5 mm. Trunk smooth, with uniform width except at level of end of shorter lemniscus which is widest, 891. Proboscis wider than long, very small and very short in relation to body length, not divided into three lobes, 124 x 165, armed with 24 hooks arranged in 4 circles of 6 hooks each. Length of terminal hooks 114, anterior middle hooks and posterior middle hooks 70, and basal hooks 31. Body wall relatively thick with distinct lacunae. Lemnisci two, unequal, short lemniscus only about 1/6 of body length; longer lemniscus very long, almost as long as body length between junction of proboscis and body and posterior extremity close to terminal vulva. Vagina with thick muscular wall. Eggs small and thin-shelled.

Remarks:

At present there is only one species representing the genus *Hexaspiron*, i.e. *Hexaspiron nigericum* Dollfus and Golvan, 1956 (see Yamaguti, 1963) found in *Synodontis membranaceus* in Nigeria.

In comparison, my species is slightly larger than males of Dollfus and Golvan's which are 11 mm long, but much smaller than the females which are 55 mm long.

The most prominent character in my specimen is the lemnisci, especially the longer lemniscus, which is almost as long as the body, whereas in Dollfus and Golvan's specimen both lemnisci are comparatively short, not reaching the posterior end of the body.

Although my specimen is likely to be a new species, a new species is not established since only a single specimen is available.

This is a new host and locality record of *Hexaspiron* sp.

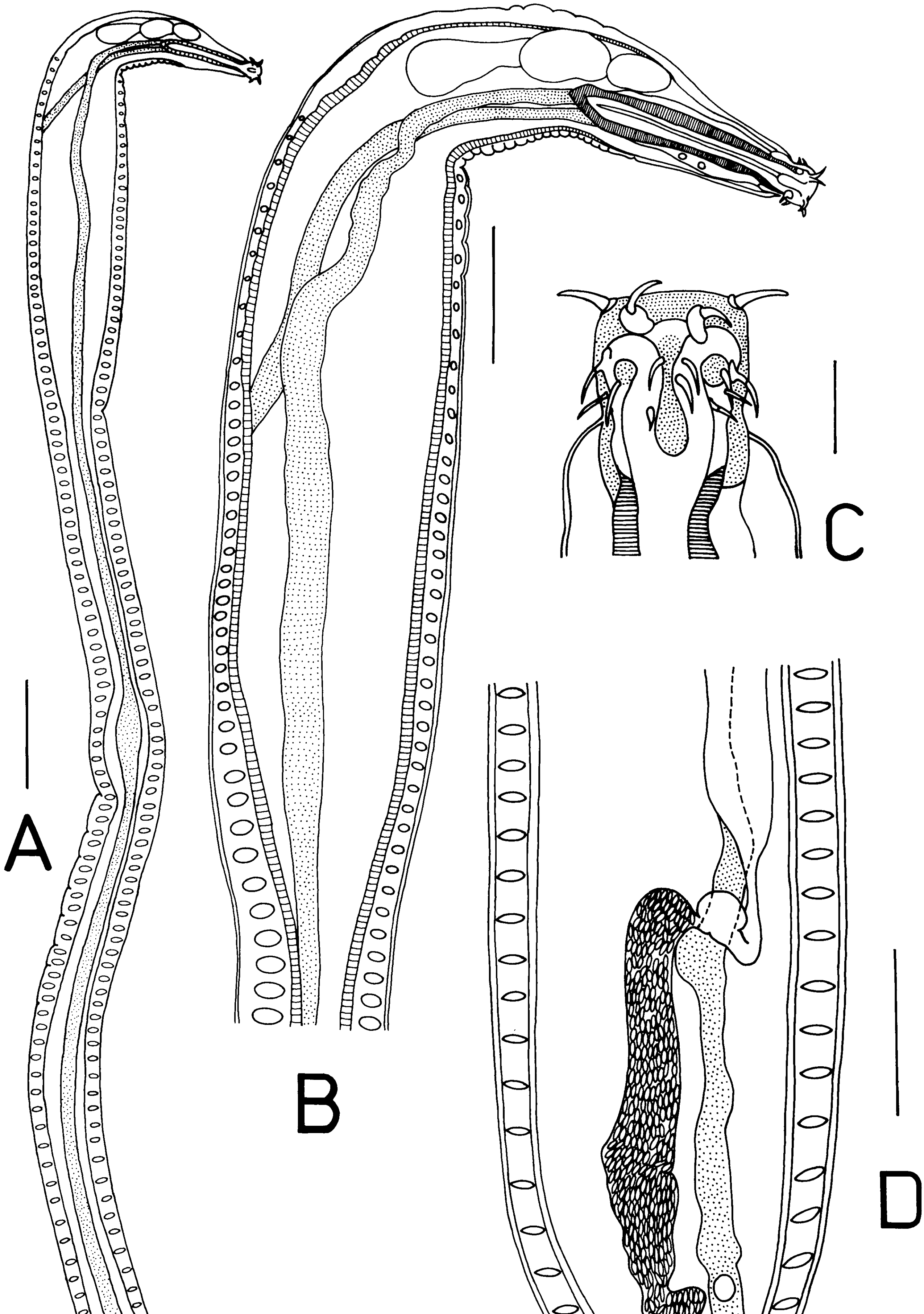
PLATE 33: *Hexaspiron* sp.

A. Whole mount; scale length 1.0 mm

B. Anterior end; scale length 0.5 mm

B. Head; scale length 0.1 mm

D. Posterior end; scale length 0.3 mm.


A
B
C
D

4.5 Seasonal Fluctuations of Infections

Seasonal fluctuations of infections were studied in fish from Red Rock Estuary of five common species, i.e. *Coitocaecum gymnophallum*, *Opecoelus* spp. (*O. lobatus* and *O. sphaericus* examined together), *Dactylostomum gracile* and *Erilepturus acanthopagri*. Data on sizes of fish examined (as indicated by head length = tip of snout to posterior end of operculum), intensities and prevalences of infection are given in Tables 4.28, 4.29, 4.30, 4.31 and 4.32; and fluctuations in intensity and prevalence of infection are also represented in Figures 4, 5, 6 and 7. The data on size show that there was little variation in the fish examined between different months and years.

Samples were pooled by seasons (summer = November-March, winter May-September) and by year and a 2 x 2 analysis of variance was performed. There were no significant seasonal fluctuations in any of the parasite species. The only clear-cut difference in infection intensities between subsequent years was that for *Coitocaecum gymnophallum* ($F = 70.225$; $p < 0.0005$).

Table 4.28. No. of fish from Red Rock Estuary examined and their head length.

Month and Year	No. of fish examined	Head length (cm) Mean/Range
November 1981	15	3.9 (2.4-6.2)
January 1982	32	4.5 (3.4-6.4)
March 1982	23	5.0 (3.5-7.4)
May 1982	32	5.1 (3.0-8.0)
July 1982	31	4.7 (3.6-7.5)
September 1982	12	4.4 (2.9-7.4)
Total	145	4.7 (2.4-8.0)
May 1983	18	4.4 (2.6-8.4)
July 1983	30	5.3 (3.5-8.8)
September 1983	29	4.9 (2.8-8.1)
November 1983	33	4.7 (3.1-6.9)
January 1984	32	4.9 (3.4-7.1)
March 1984	31	4.4 (3.0-6.1)
Total	173	4.8 (2.6-8.8)
Grand total	318	

Table 4.29. Infection of fish from Red Rock Estuary with *Coitocaecum gymnophallum*.

Month and Year	No. of fish examined	No. of fish infected	No. of parasites found	Mean Intensity (± 2 SE)	Prevalence (%)
November 1981	15	11	108	7.2 ± 4.1	73.3
January 1982	32	28	554	17.3 ± 5.6	8.75
March 1982	23	18	251	10.9 ± 5.5	78.3
May 1982	32	29	470	14.6 ± 4.6	90.6
July 1982	31	31	427	13.7 ± 3.4	100.0
September 1982	12	7	40	3.3 ± 2.8	58.3
May 1983	18	17	135	7.5 ± 4.7	94.4
July 1983	30	15	91	3.0 ± 1.7	50.0
September 1983	29	27	125	4.3 ± 2.2	93.1
November 1983	33	12	40	1.2 ± 0.9	36.4
January 1984	32	27	287	8.9 ± 4.2	84.4
March 1984	31	10	49	1.5 ± 1.3	32.3

Figure 4. *Coitocaecum gymnophallum*.

Monthly fluctuations in intensity (•———•) and prevalence (Δ-------Δ) of infection. Note: there are no significant differences between different months and seasons (summer vs. winter), but differences between years are significant for intensity of infection ($F = 70.225$; $p < 0.0005$).

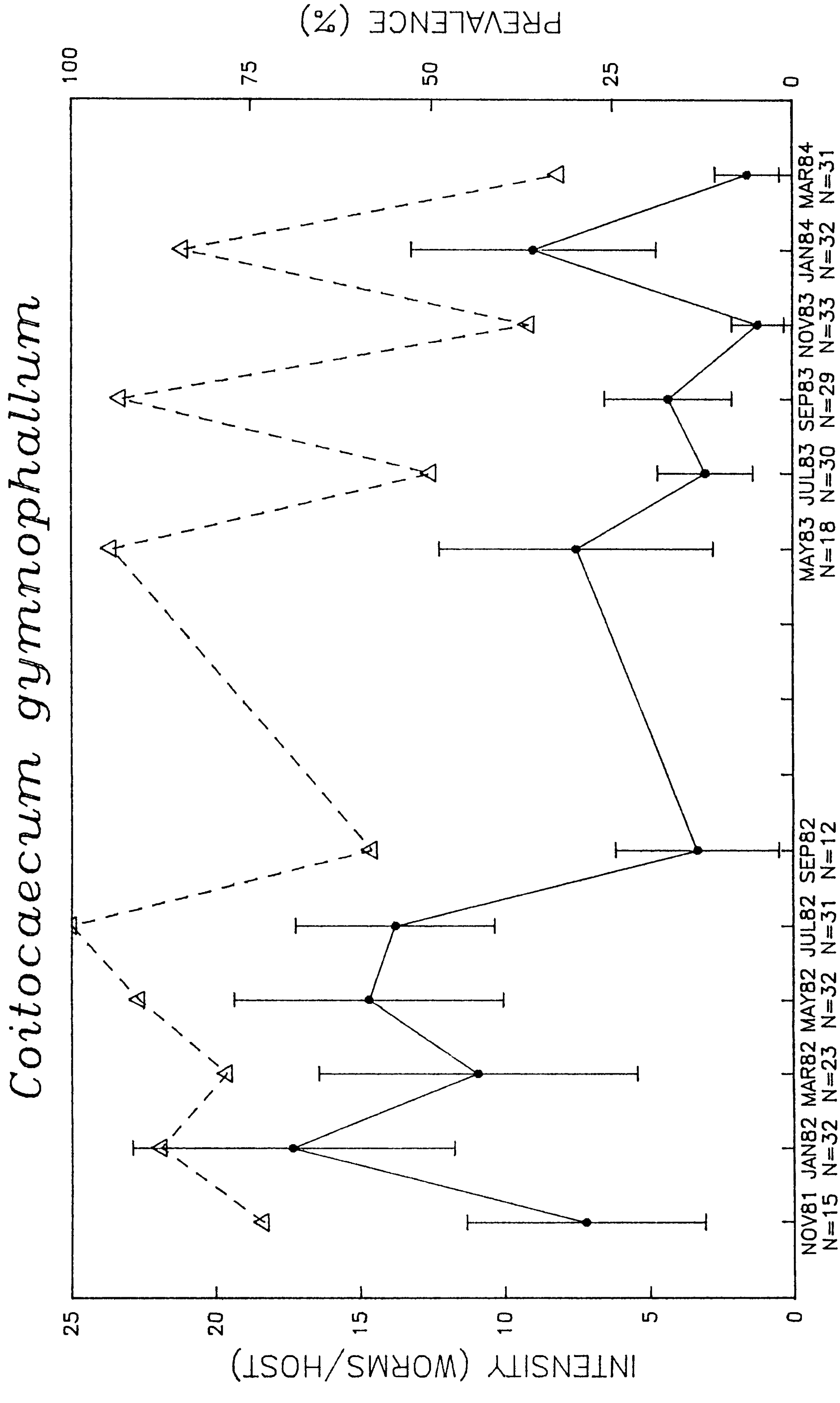

Coitocaecum gymnophallum
PREVALENCE (%)
100
75
50
25
0
INTENSITY (WORMS/HOST)
25
20
15
10
5
0
NOV81 N=15
JAN82 N=32
MAR82 N=23
MAY82 N=32
JUL82 N=31
SEP82 N=12
MAY83 N=18
JUL83 N=30
SEP83 N=29
NOV83 N=33
JAN84 N=32
MAR84 N=31

FIGURE 4

Table 4.30. Infection of fish from Red Rock Estuary with *Opecoelus* spp.

Month and Year	No. of fish examined	No. of fish infected	No. of parasites found	Mean Intensity (± 2 SE)	Prevalence (%)
November 1981	15	1	4	0.2 ± 0.5	6.7
January 1982	32	4	4	0.1 ± 0.1	12.5
March 1982	23	6	31	1.3 ± 1.6	26.1
May 1982	32	6	12	0.3 ± 0.3	18.8
July 1982	31	13	28	0.9 ± 0.5	41.9
September 1982	12	2	6	0.5 ± 0.7	16.7
May 1983	18	5	14	0.7 ± 0.7	27.8
July 1983	30	7	19	0.6 ± 0.6	23.3
September 1983	29	4	13	0.4 ± 0.5	13.8
November 1983	33	2	4	0.1 ± 0.2	6.1
January 1984	32	11	30	0.9 ± 0.6	34.4
March 1984	31	5	14	0.4 ± 0.5	16.1

Figure 5. *Opecoelus* spp.

Monthly fluctuations in intensity (•————•) and prevalence (Δ-------Δ) of infection.

Note: there are no significant differences between different months, seasons (summer vs. winter) and subsequent years.

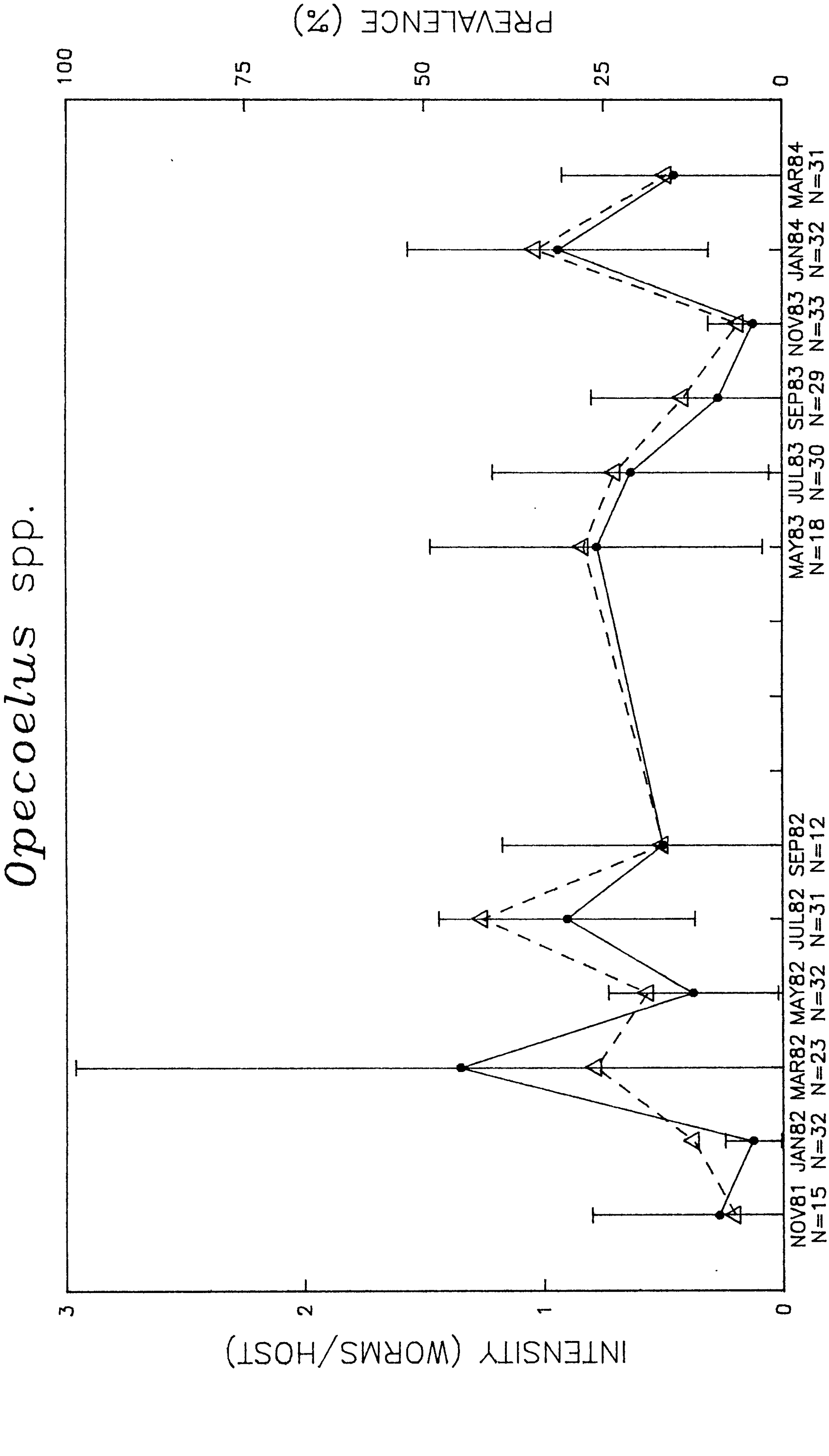

Opecoelus spp.
PREVALENCE (%)
100
75
50
25
0
INTENSITY (WORMS/HOST)
3
2
1
0
NOV81 N=15
JAN82 N=32
MAR82 N=23
MAY82 N=32
JUL82 N=31
SEP82 N=12
MAY83 N=18
JUL83 N=30
SEP83 N=29
NOV83 N=33
JAN84 N=32
MAR84 N=31

FIGURE 5

Table 4.31. Infection of fish from Red Rock Estuary with *Dactylostomum gracile*.

Month and Year	No. of fish examined	No. of fish infected	No. of parasites found	Mean Intensity (± 2 SE)	Prevalence (%)
November 1981	15	1	1	0.06 ± 0.1	6.7
January 1982	32	0	0	0	0
March 1982	23	0	0	0	0
May 1982	32	1	2	0.06 ± 0.1	3.1
July 1982	31	13	31	1 ± 0.5	41.9
September 1982	12	1	1	0.08 ± 0.2	8.3
May 1983	18	6	8	0.4 ± 0.3	33.3
July 1983	30	2	3	0.1 ± 0.1	6.7
September 1983	29	0	0	0	0
November 1983	33	0	0	0	0
January 1984	32	4	4	0.3 ± 0.4	12.5
March 1984	31	1	1	0.03 ± 0.1	3.2

Figure 6. *Dactylostomum gracile.*

Monthly fluctuations in intensity (•————•) and prevalence (Δ-------Δ) of infection. Note: there are no significant differences between different months, seasons (summer vs. winter) and subsequent years.

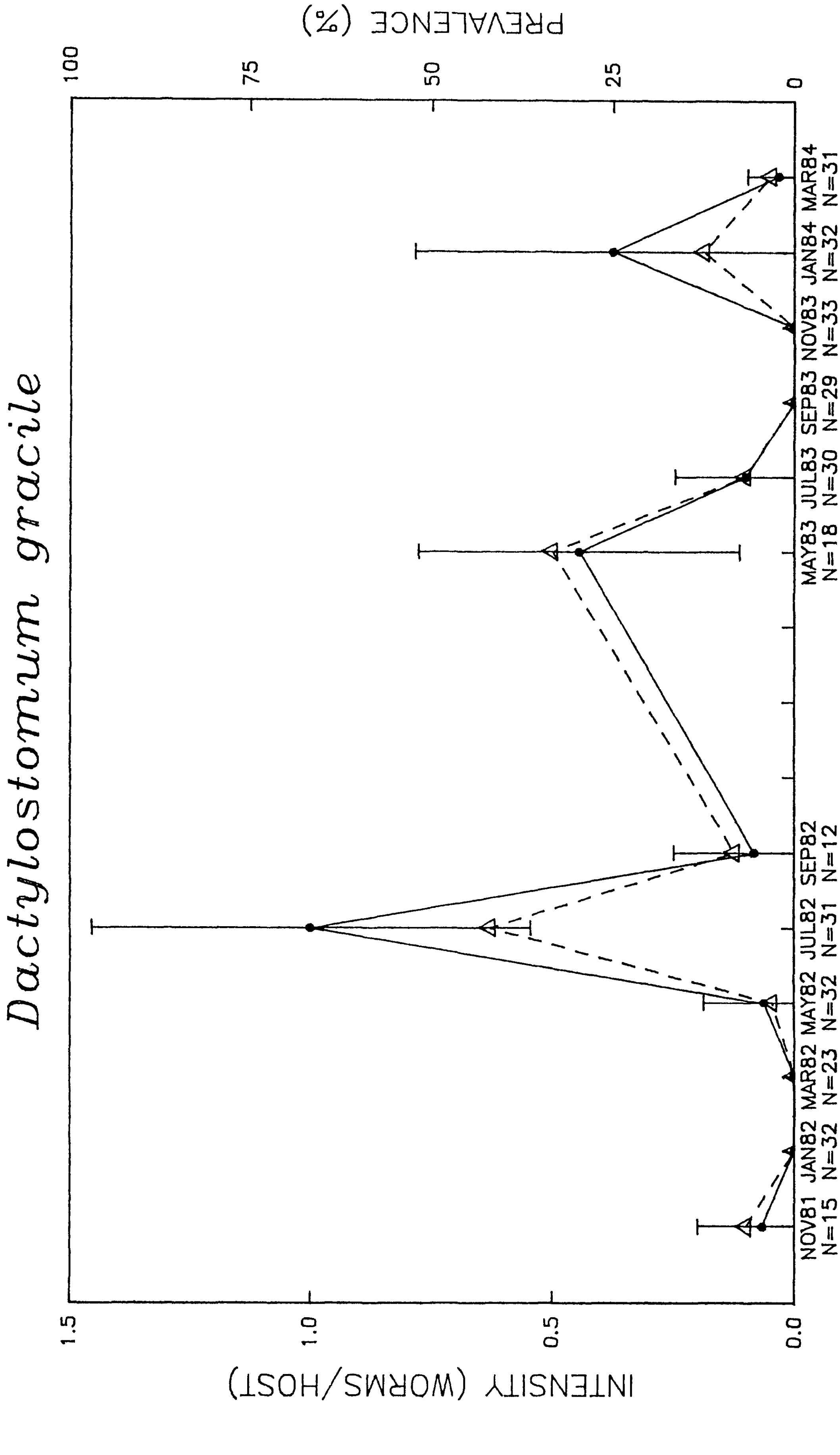

Dactylostomum gracile
PREVALENCE (%)
100
75
50
25
0
INTENSITY (WORMS/HOST)
1.5
1.0
0.5
0.0
NOV81 N=15
JAN82 N=32
MAR82 N=23
MAY82 N=32
JUL82 N=31
SEP82 N=12
MAY83 N=18
JUL83 N=30
SEP83 N=29
NOV83 N=33
JAN84 N=32
MAR84 N=31

FIGURE 6

Table 4.32. Infection of fish from Red Rock Estuary with *Erilepturus acanthopagri*.

Month and Year	No. of fish examined	No. of fish infected	No. of parasites found	Mean Intensity (± 2 SE)	Prevalence (%)
November 1981	15	4	10	0.6 ± 0.8	26.7
January 1982	32	5	8	0.25 ± 0.2	15.6
March 1982	23	3	3	0.1 ± 0.1	13.0
May 1982	32	5	6	0.18 ± 0.2	15.6
July 1982	31	3	3	0.1 ± 0.1	9.7
September 1982	12	1	1	0.08 ± 0.2	8.3
May 1983	18	3	251	13.9 ± 27.5	16.7
July 1983	30	0	0	0	0
September 1983	29	2	44	1.5 ± 2.9	6.9
November 1983	33	2	3	0.1 ± 0.1	6.1
January 1984	32	7	10	0.3 ± 0.2	21.9
March 1984	31	2	2	0.06 ± 0.1	6.5

Figure 7. *Erilepturus acanthopagri*.

Monthly fluctuations in intensity (•———•) and prevalence (Δ-------Δ) of infection. Note: there are no significant differences between different months, seasons (summer vs. winter) and subsequent years. The high value for May 1983 is due entirely to a single heavily infected fish.

Erileptururus acanthopagri

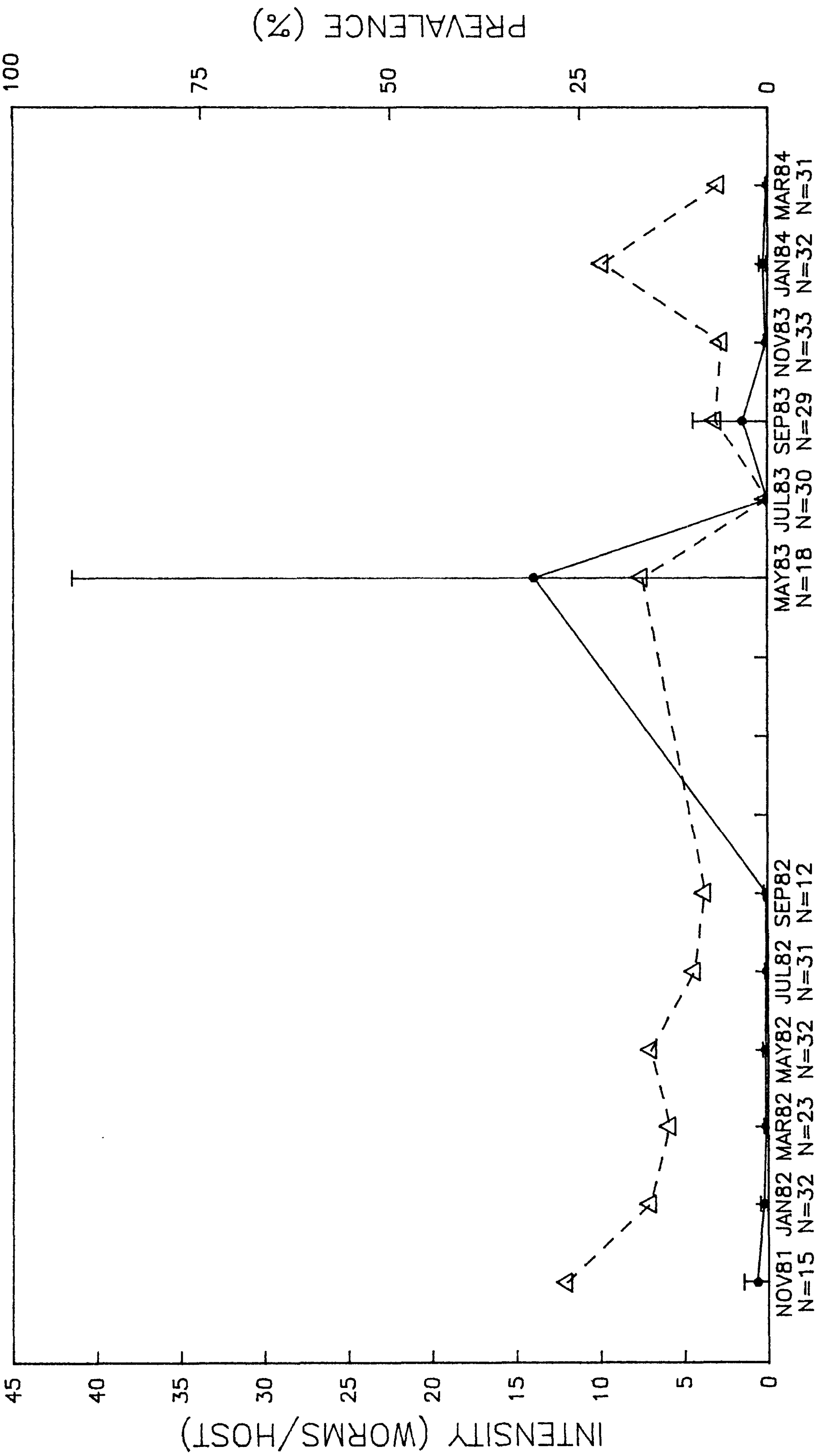


FIGURE 7

4.6 Allometric Growth of *Coitocaecum gymnophallum*

Body width and organ sizes in worms of different lengths are plotted in Figures 8-20. All the organs and body width grow more slowly than the whole body, that means they show negative allometric growth. A further important result is that measurements and slopes between worms fixed differently, i.e. in cold 10% formalin and in hot 10% formalin, differ strongly.

Figures 21 and 22 show that egg size is independent of the length of the worms.

Figure 8. *Coitocaecum gymnophallum.*

Allometric growth of maximum body width in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: $Y = 7.5685\ X^{0.570}$ $(p < 0.025)$

B: $Y = 15.6583\ X^{0.433}$ $(p < 0.01)$

Note: allometric growth negative for A and B, but more strongly negative for B.

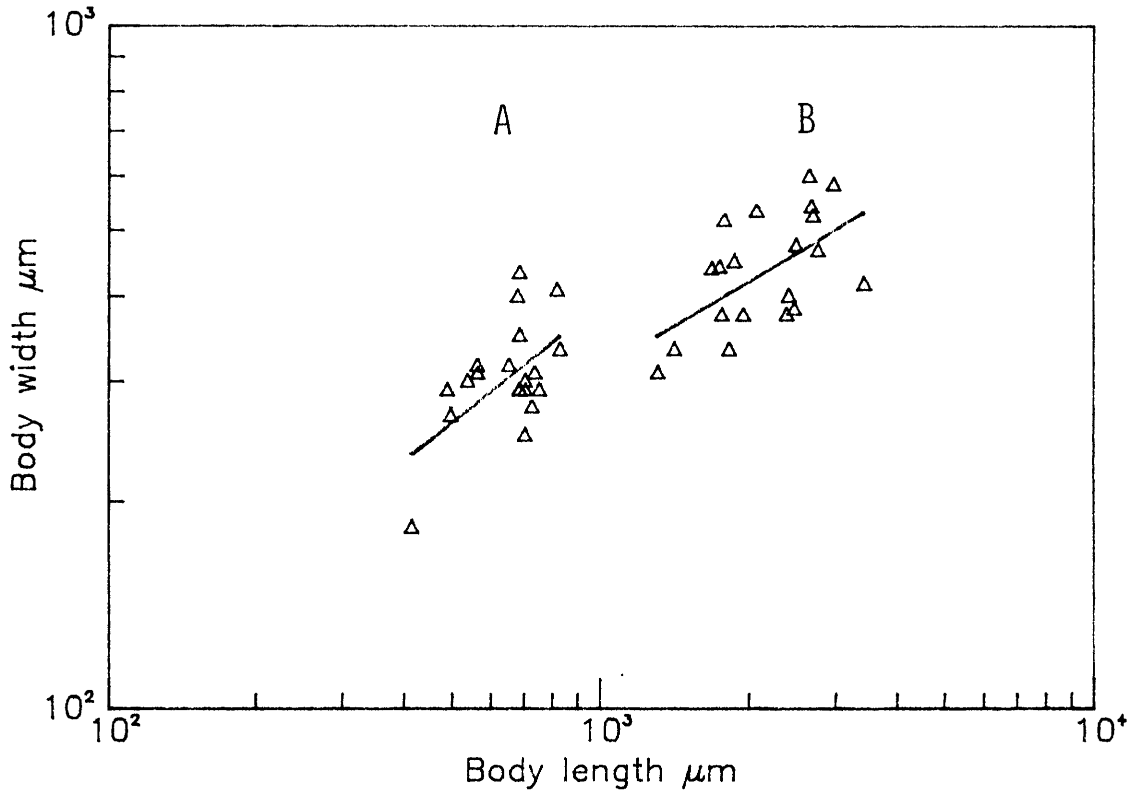


FIGURE 8

Figure 9. *Coitocaecum gymnophallum.*

Allometric growth of maximum oral sucker length in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: $Y = 1.8645\ X^{0 \cdot 632}$ ($p < 0.0005$)

B: $Y = 6.2902\ X^{0 \cdot 398}$ ($p < 0.005$).

Note: allometric growth negative for A and B, but more strongly negative for B.

Figure 10. *Coitocaecum gymnophallum.*

Allometric growth of maximum oral sucker width in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: $Y = 2.3537\ X^{0 \cdot 575}$ ($p < 0.0005$)

B: $Y = 6.4559\ X^{0 \cdot 385}$ ($p < 0.0025$).

Note: allometric growth negative for A and B, but more strongly negative for B.

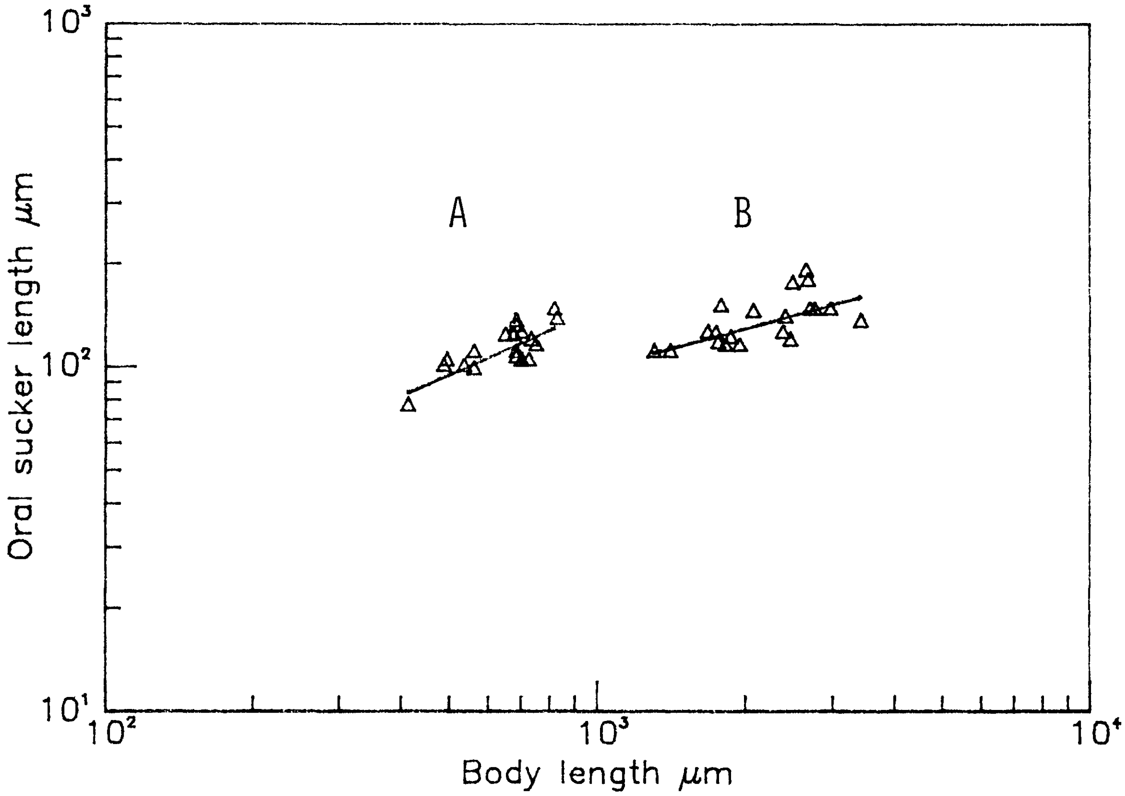


FIGURE 9

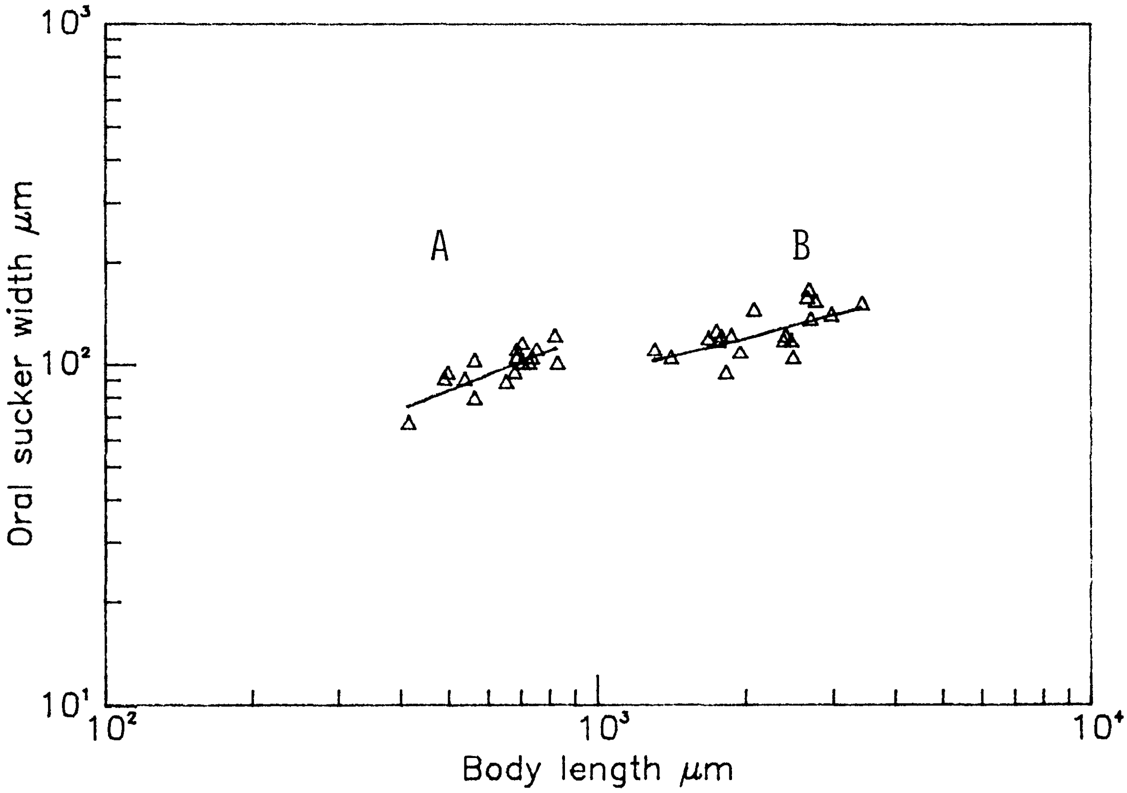


FIGURE 10

Figure 11. *Coitocaecum gymnophallum.*

Allometric growth of maximum pharynx length in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: $Y = 1.3758\ X^{0.629}$ ($p < 0.025$)

B: $Y = 2.1128\ X^{0.494}$ ($p < 0.0005$).

Note: allometric growth negative for A and B, but more strongly negative for B.

Figure 12. *Coitocaecum gymnophallum.*

Allometric growth of maximum pharynx width in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: regression not significant ($F < 1.42$)

B: $Y = 5.8416\ X^{0.355}$ ($p < 0.025$).

Note: the regression line is not drawn for A, since there is no significant slope; allometric growth negative for B.

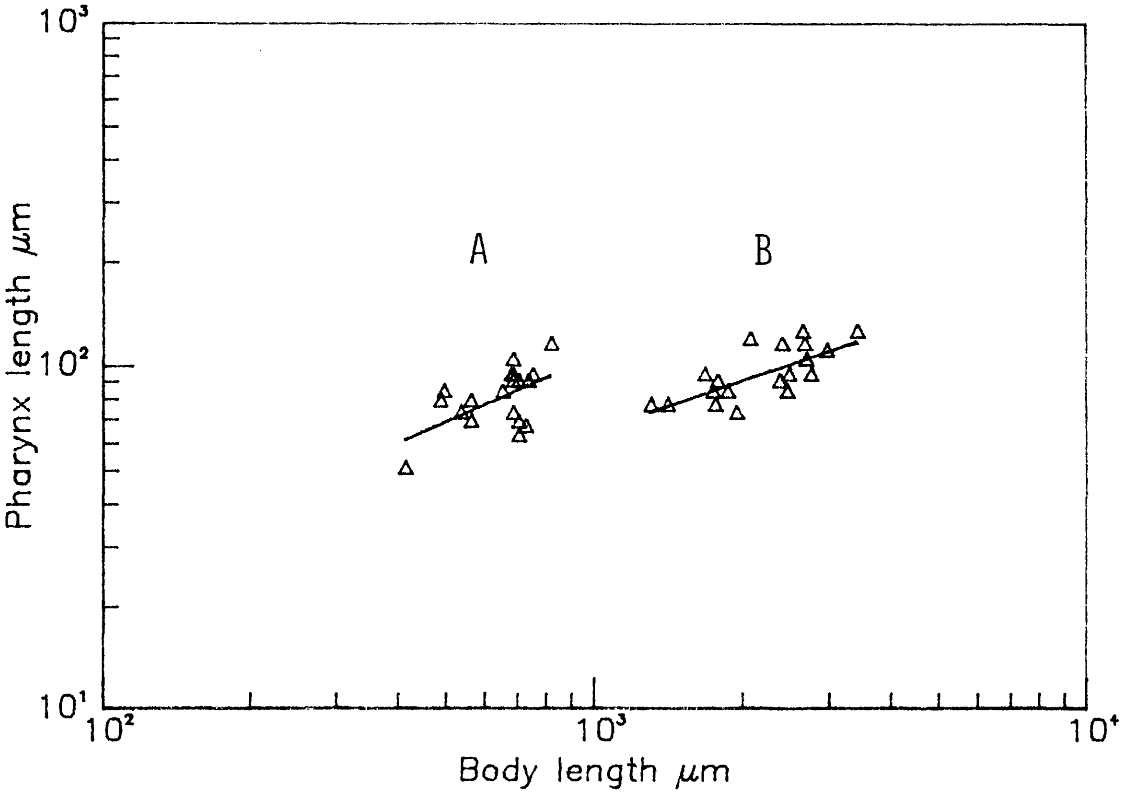


FIGURE 11

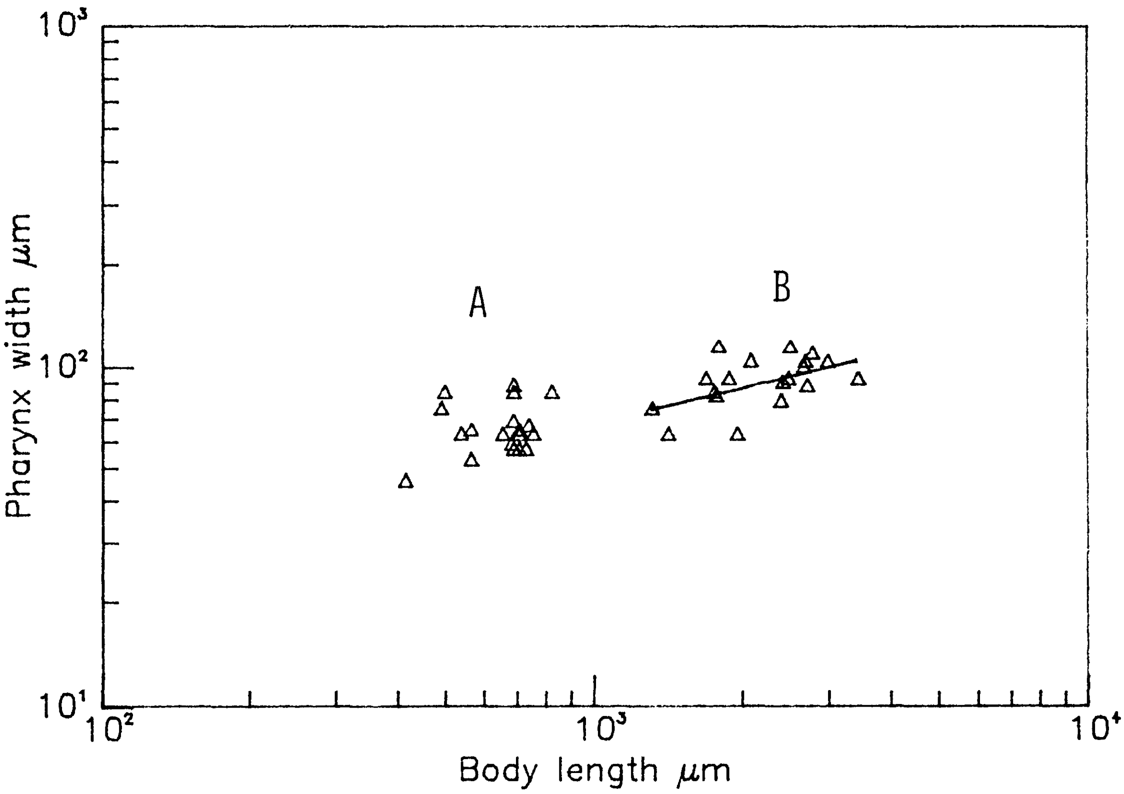


FIGURE 12

Figure 13. *Coitocaecum gymnophallum.*

Allometric growth of maximum acetabulum length in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: $Y = 7.0287\ X^{0.467}$ ($p < 0.0005$)

B: $Y = 8.4401\ X^{0.396}$ ($p < 0.005$).

Note: allometric growth negative for A and B, but more strongly negative for B.

Figure 14. *Coitocaecum gymnophallum.*

Allometric growth of maximum acetabulum width in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: $Y = 1.3418\ X^{0.698}$ ($p < 0.0005$)

B: regression not significant ($F < 1.41$).

Note: allometric growth negative for A, the regression line is not drawn for B, since there is no significant slope.

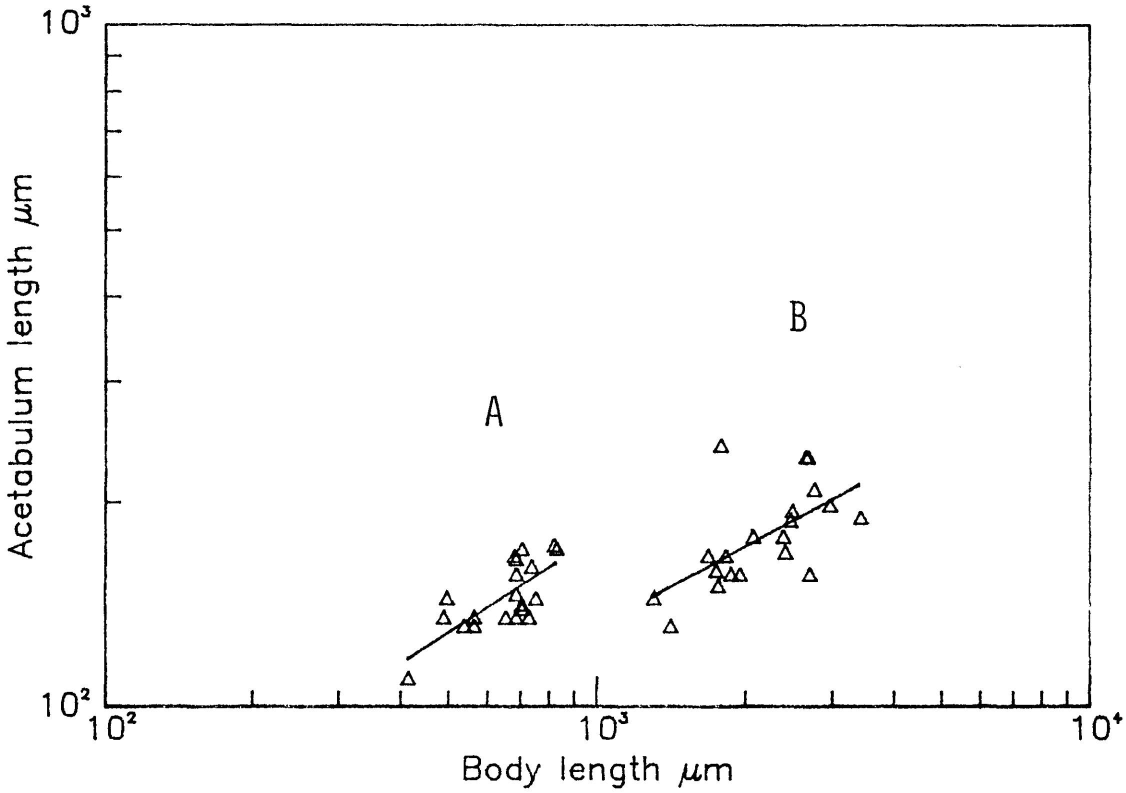


FIGURE 13

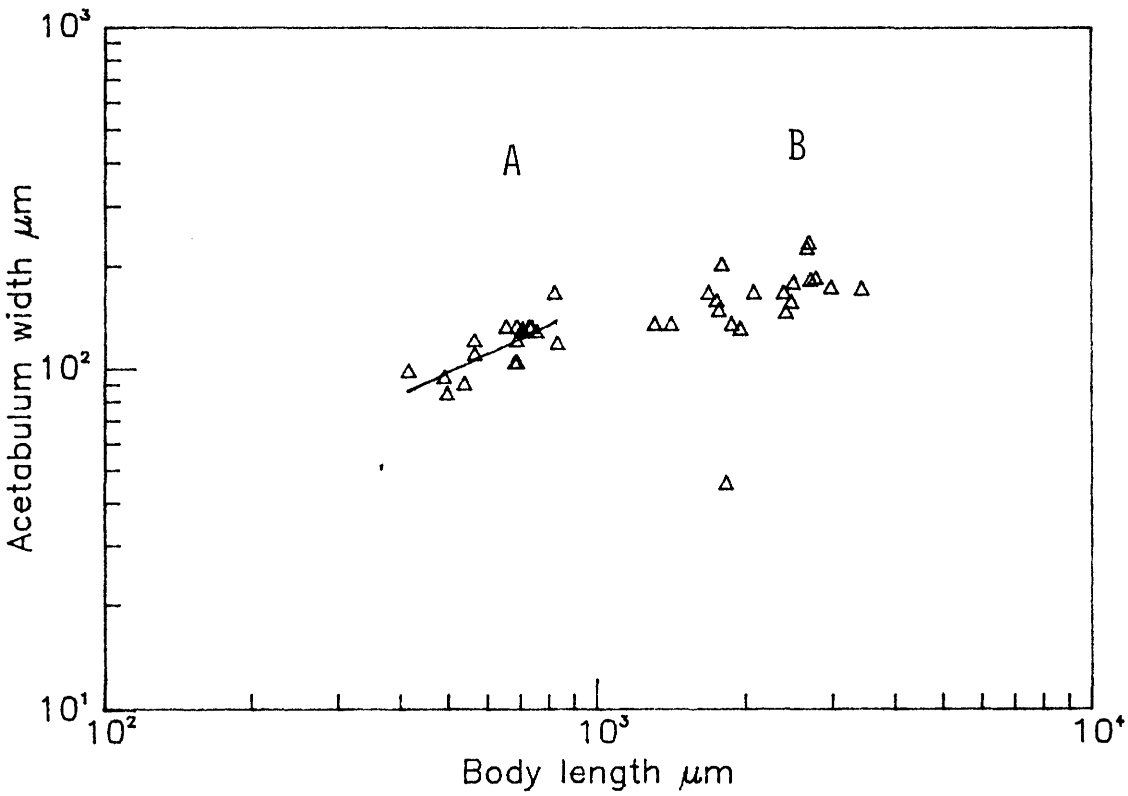


FIGURE 14

Figure 15. *Coitocaecum gymnophallum.*

Allometric growth of maximum ovary length in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: $Y = 0.1060\ X^{1.019}$ ($p < 0.005$)

B: regression not significant ($F < 1.41$).

Note: allometric growth negative for A, the regression line is not drawn for B, since there is no significant slope.

Figure 16. *Coitocaecum gymnophallum.*

Allometric growth of maximum ovary width in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: regression not significant ($F < 1.42$)

B: $Y = 0.3802\ X^{0.733}$ ($p < 0.0025$).

Note: the regression line is not drawn for A, since there is no significant slope, allometric growth negative for B.

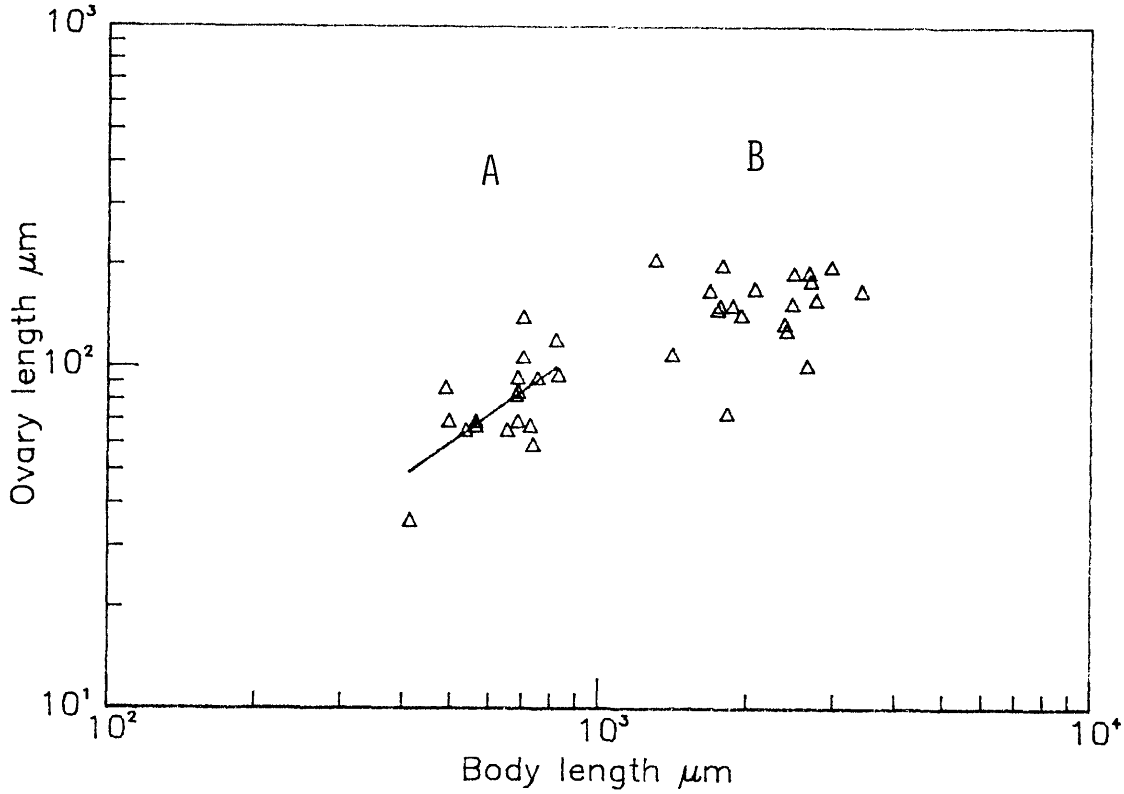


FIGURE 15

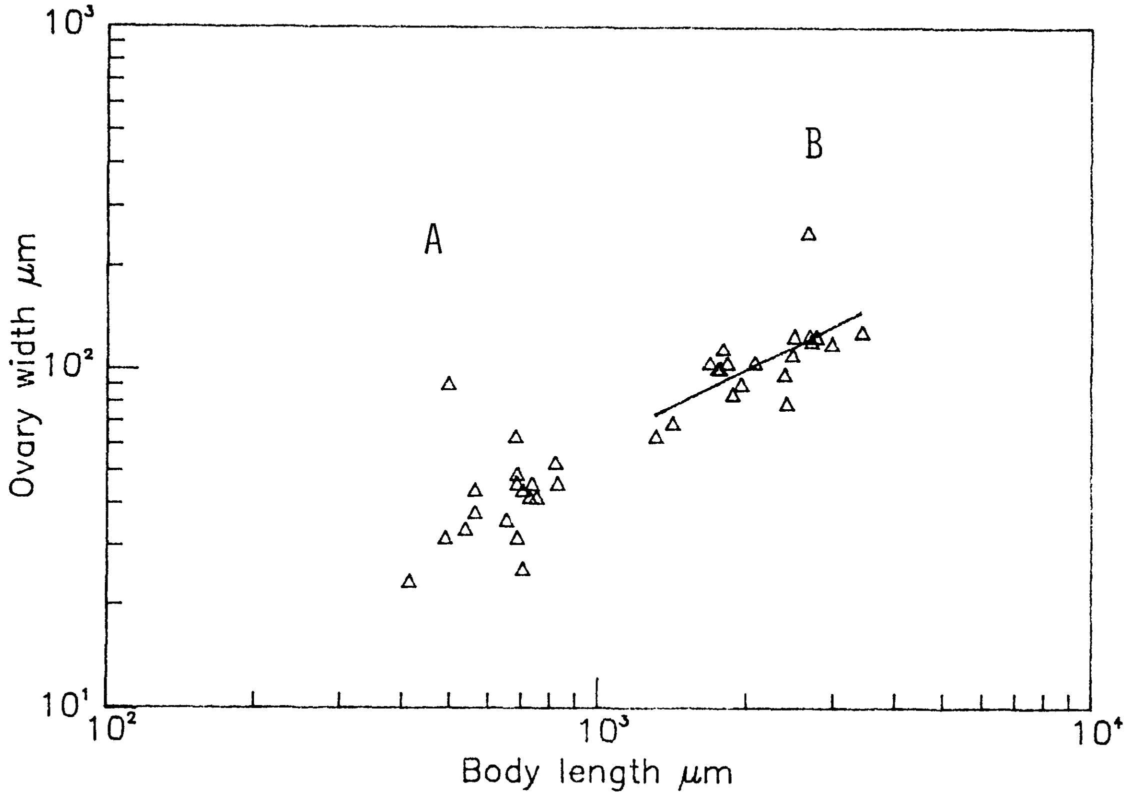


FIGURE 16

Figure 17. *Coitocaecum gymnophallum*.

Allometric growth of maximum anterior testis length in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: $Y = 0.0863\ X^{1.136}$ ($p < 0.005$)

B: $Y = 0.2736\ X^{0.872}$ ($p < 0.0005$).

Note: allometric growth negative for A and B, but more strongly negative for B.

Figure 18. *Coitocaecum gymnophallum*.

Allometric growth of maximum anterior testis width in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: $Y = 0.0394\ X^{1.104}$ ($p < 0.0025$)

B: $Y = 1.6770\ X^{0.618}$ ($p < 0.0025$).

Note: allometric growth negative for A and B, but more strongly negative for B.

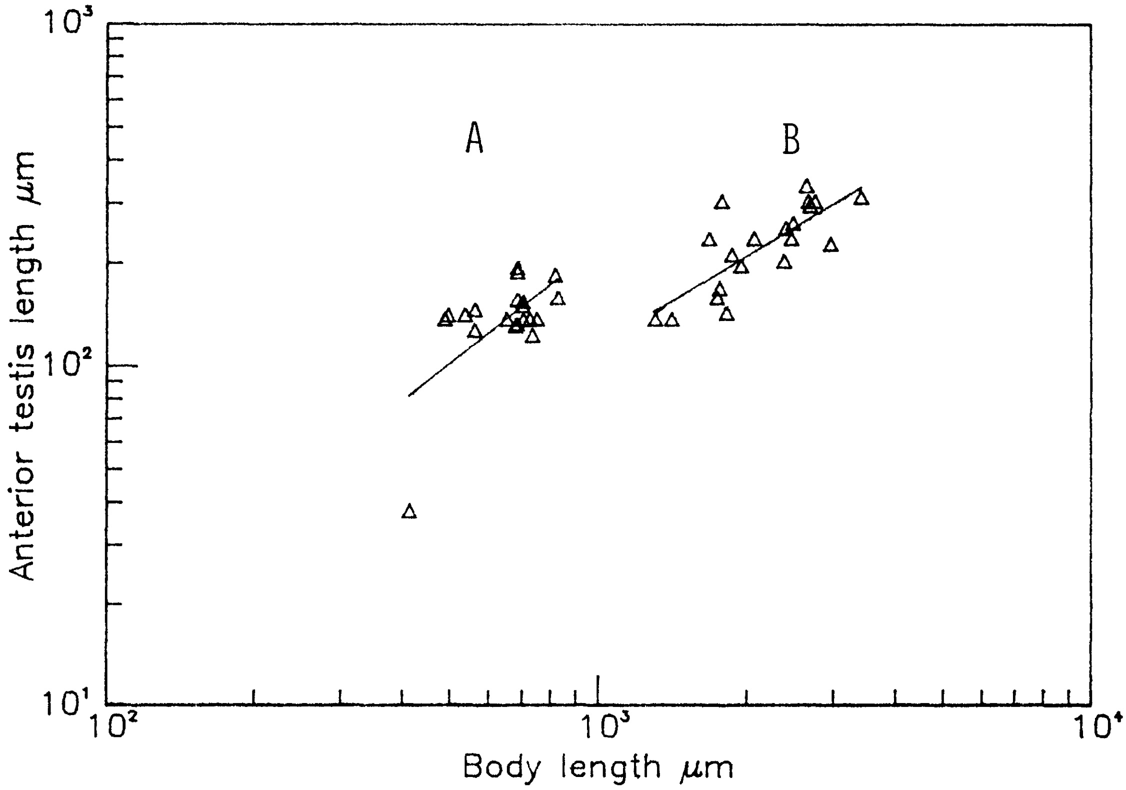


FIGURE 17

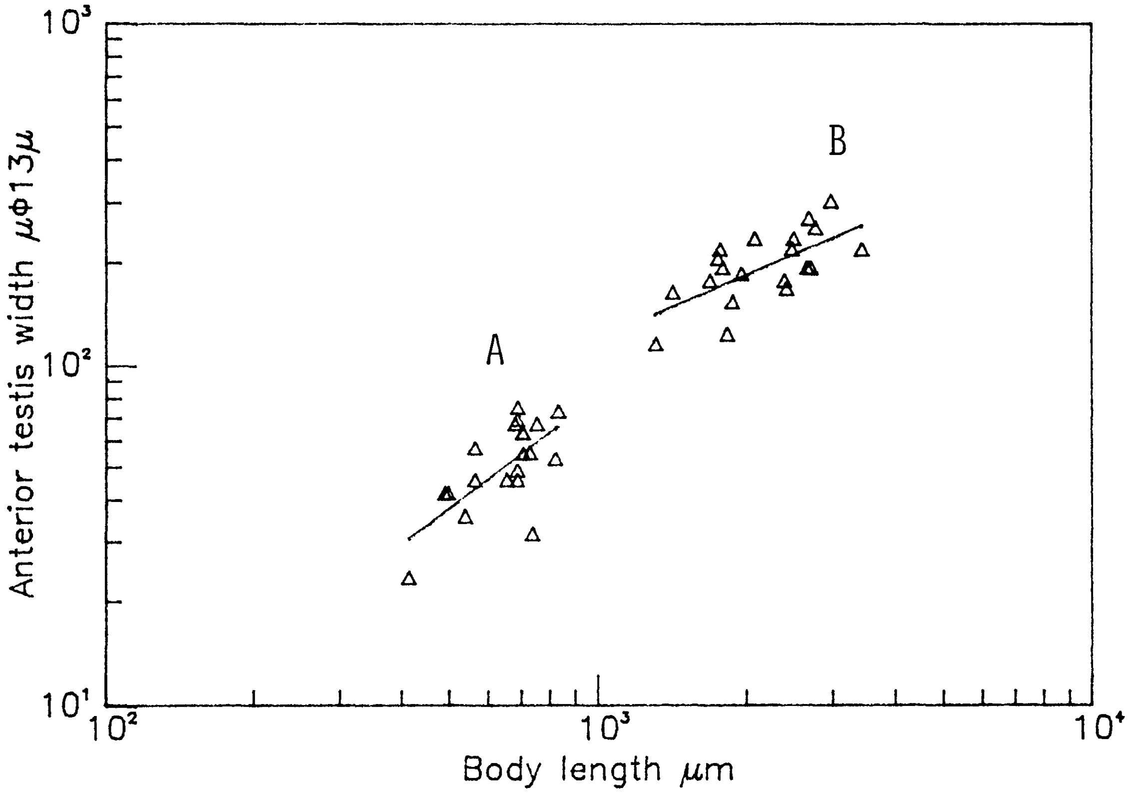


FIGURE 18

Figure 19. *Coitocaecum gymnophallum*.

Allometric growth of maximum posterior testis length in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

Y: $= 0.0657\ X^{1 \cdot 185}$ ($p < 0.005$)

B: $= 0.4956\ X^{0 \cdot 807}$ ($p < 0.0005$).

Note: allometric growth negative for A and B, but more strongly negative for B.

Figure 20. *Coitocaecum gymnophallum*.

Allometric growth of maximum posterior testis width in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: $Y = 0.0036\ X^{1 \cdot 483}$ ($p < 0.001$)

B: $Y = 1.1118\ X^{0 \cdot 684}$ ($p < 0.0005$).

Note: allometric growth negative for A and B, but more strongly negative for B.

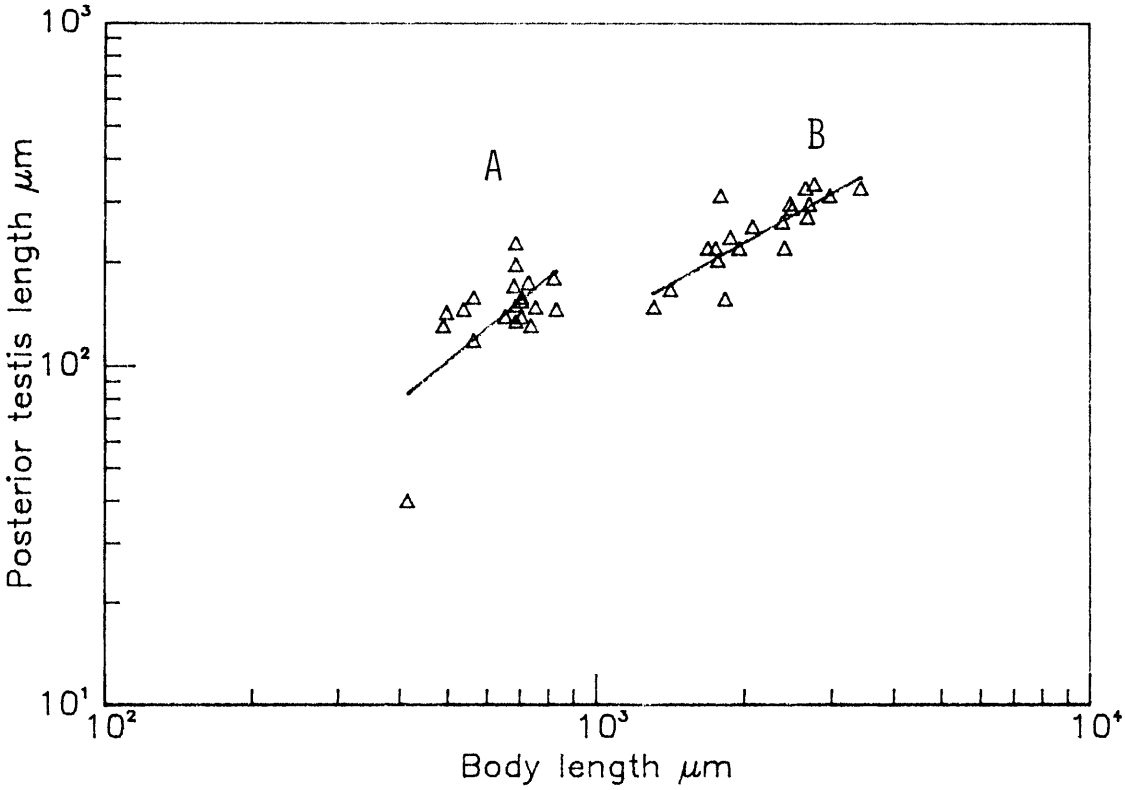


FIGURE 19

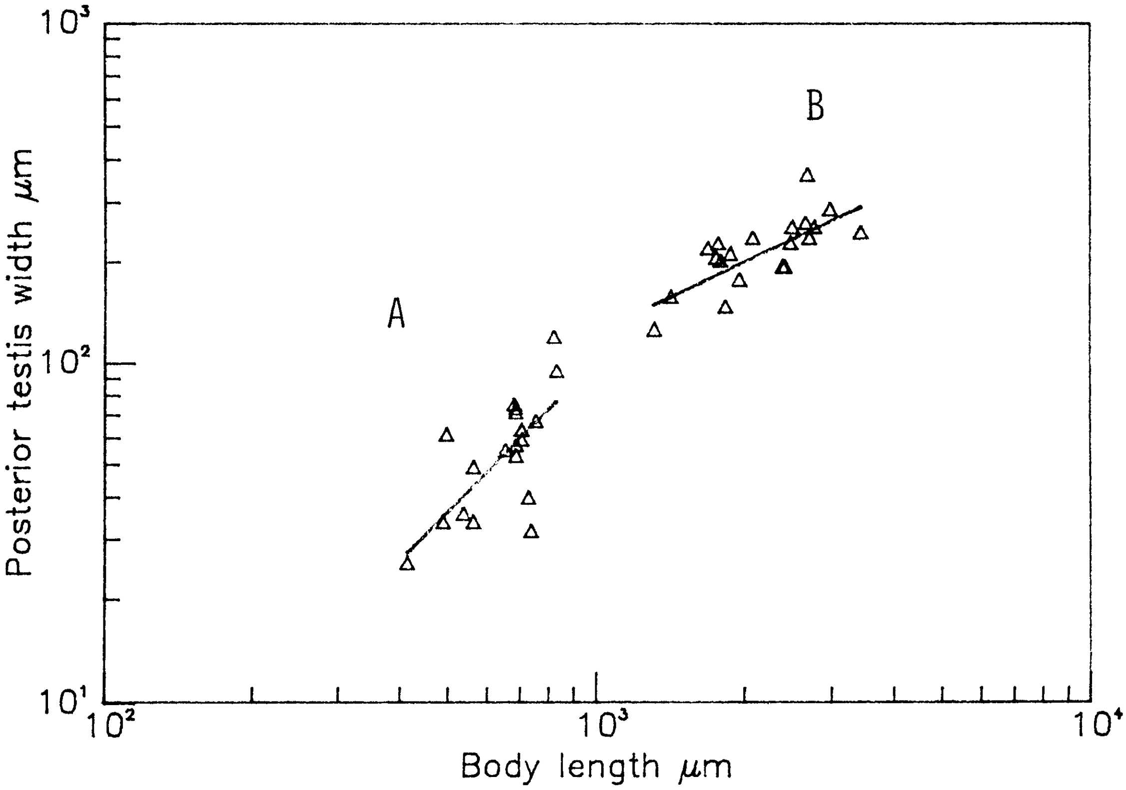


FIGURE 20

Figure 21. *Coitocaecum gymnophallum.*

Maximum egg length in worms of different lengths in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: regression not significant ($F < 1.42$)

B: regression not significant ($F < 4.45$).

Note: no regression lines drawn for A and B, since there are no significant slopes.

Figure 22. *Coitocaecum gymnophallum.*

Maximum egg width in worms of different lengths in specimens from fish fixed in cold 10% formalin (A) and in specimens collected alive and fixed in hot 10% formalin (B).

A: regression not significant ($F < 1.42$)

B: regression not significant ($F < 4.45$).

Note: no regression lines drawn for A and B, since there are no significant slopes.

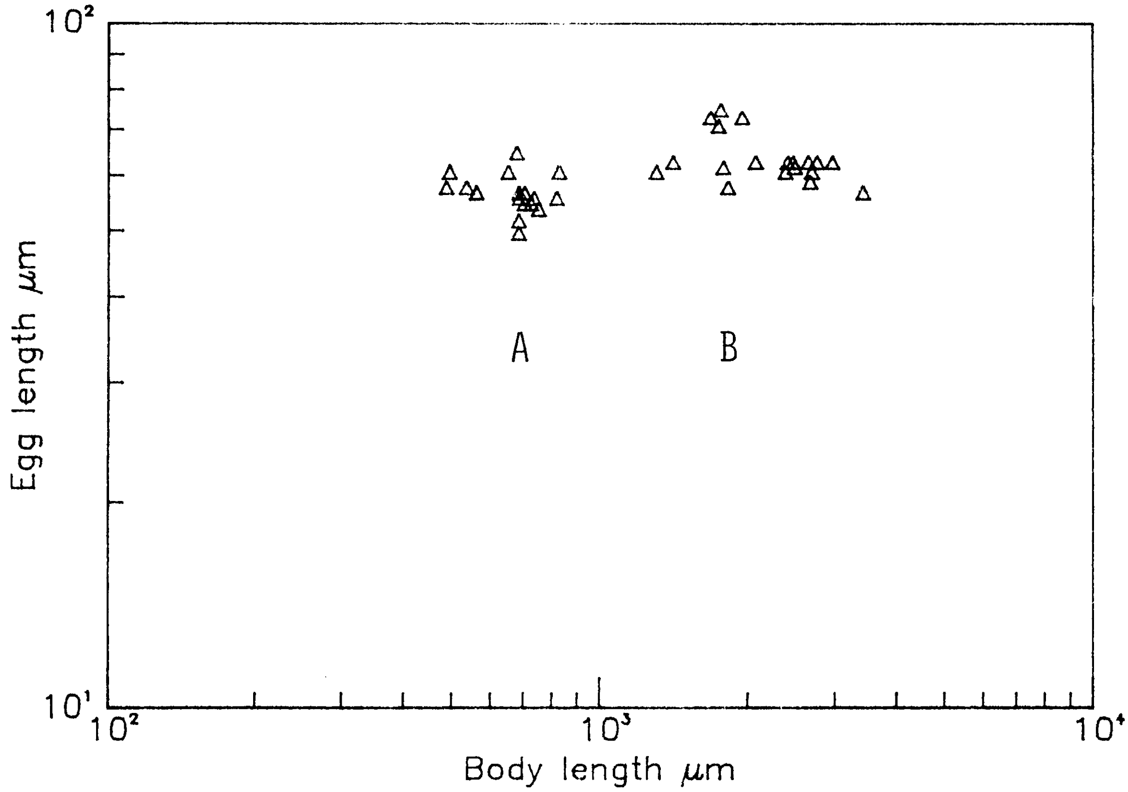


FIGURE 21

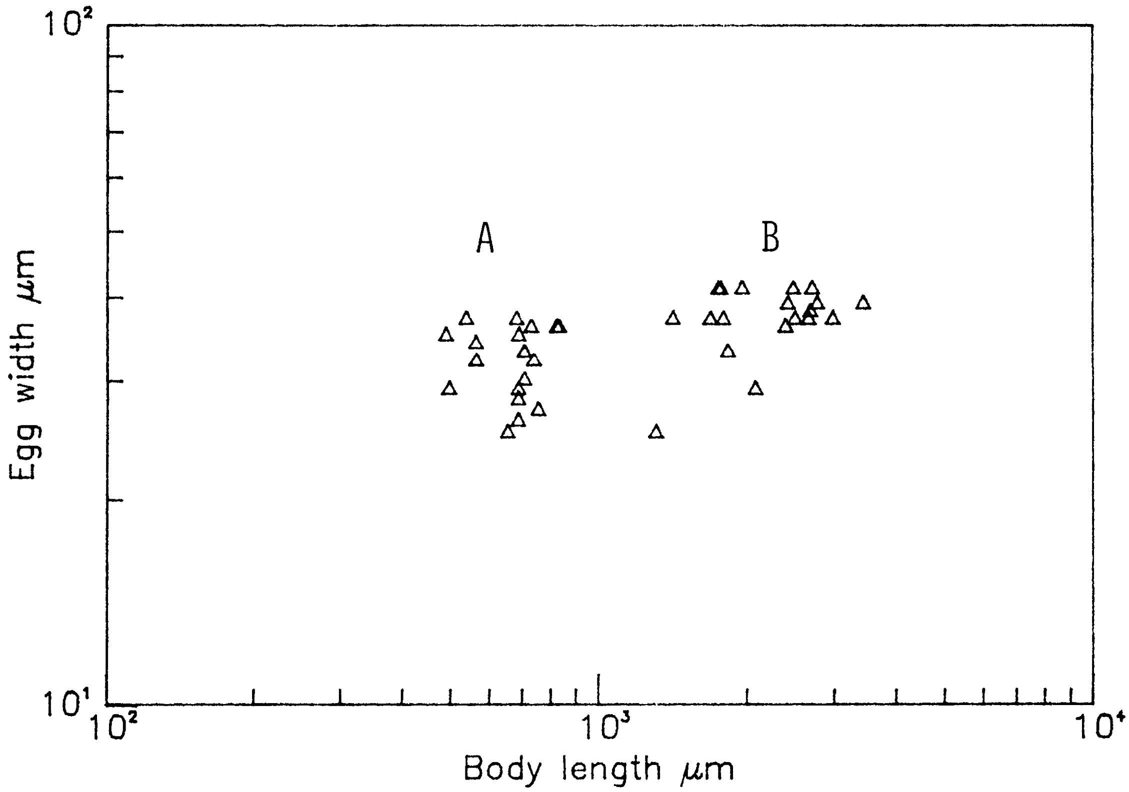


FIGURE 22

CHAPTER 5

DISCUSSION

5.1 Species Diversity

In 449 fish examined in this study, a total of 32 species of endoparasites has been found, consisting of 11 digenetic trematodes, 5 cestodes, 12 nematodes and 4 acanthocephalans.

Recently, Byrnes (1985) conducted a comprehensive study on the ectoparasites of four Australian species of *Acanthopagrus*. He reported a total of 48 species of ectoparasites. Most, i.e. 32 species were found on 320 specimens of *Acanthopagrus australis* from 8 localities along the coast of Queensland, New South Wales and Victoria, i.e. from Lucinda, Queensland to near Mallacoota Inlet, Victoria. Earlier, Roubal (1981) studied the ectoparasite fauna of *A. australis* in the Coffs Harbour region, where my study was also made, and which is approximately in the middle of the range of the species. He recorded twenty species of ectoparasites. It is obvious that species richness both of ecto- and endoparasites of *A. australis* is similar and very great. However, it has to be considered that 9 of the endoparasitic species are larval forms, whereas all the ectoparasites of *A. australis*, both in Roubal's and Byrnes' studies, were adults. If adults only are compared, species richness of ectoparasites is 37 species (data from Roubal and Byrnes combined) and 20 species (Roubal's records only) compared with 23 endoparasites. This is an interesting finding, since surveys in northern cold-temperate seas have always demonstrated a far greater species diversity of endoparasites than of ectoparasites. For example, the data in Polyansky (1961) show that in the Barents Sea, only 7 of 19 parasite species were ectoparasites, and in the Black Sea, 6 out of 14 species.

Dollfus (1953) listed 29 ectoparasites of a total 71 or 72 parasite species for *Gadus morhua* in northern seas, and Arthur and Arai (1980) recorded 10 ectoparasitic and 22 endoparasitic species for *Clupea harengus pallasi* in North America. Similarly, Paperna's (1975) data for mullet parasites in different regions indicate that there are more endoparasitic than ectoparasitic species in cold-temperate regions, and that diversity of ectoparasites is somewhat greater in the warmest locality, i.e. in the Gulf of Mexico.

5.2 Host Specificity

Host specificity is the restriction of parasites to certain host species (e.g. Croll, 1960; Hargis, 1957; Dogiel, 1964; Noble and Noble, 1976, Rohde, 1980). It is well known that many ectoparasites have the greatest host specificity (Shulman, 1961). For instance, Monogenea tend to have a high host specificity (e.g. Rohde, 1978, 1979, 1984a, 1984b) and the parasites which search for their host actively (ecto-parasites in general), tend to be more specific than those which enter their host passively (endoparasites in general) (Bychovsky, 1957 in Shulman, 1961).

Shulman (1961) also stated that the parasites infesting the gut are rarely confined to one host species. Although only one other survey of endoparasitic helminths of coastal marine fishes has been made in northern New South Wales, i.e. that of Hooper (1983) of flat-head (Family Platycephalidae), comparison of my data with studies at different localities confirmsthis conclusion. Of 8 species of Digenea recorded by me (excluding the three which could be identified to genus level only), only four have been found on *Acanthopagrus australis* only. These include two species which are probably new and of which only a single specimen was found, and a third new species as well (Table 5.1).

It is not unlikely that further studies will show additional host species for them.

Among the cestodes, not a single species, and among the nematodes, only six new or probably new species have been recorded from *A. australis* only. As pointed out with regard to Digenea, further surveys in northern New South Wales and elsewhere may well show additional host species. Among the species of Acanthocephala, only one is known from *A. australis* only.

In contrast, ectoparasite Monogenea, and to a lesser degree Copepoda of Australian sparids, are much more host specific. According to Roubal, *et al.*, 1983), only one of eight Monogenea species found on *A. australis* in northern New South Wales is also known from *A. schlegeli* (in Japan), and none of them has been recovered from the two other sparids in the same area, i.e. *Chrysophrys auratus* (see Roubal *et al.* 1983) and *Rhabdosargus sarba* (Rohde, personal communication). Accord-ding to Byrnes (1985), of the 14 species of Monogenea parasitic on four species of *Acanthopagrus* all around Australia, one was restricted to one species of the genus, seven to two species, three to three species and three to four species. None is known from other host genera. According to the same author, of the 24 species of Copepoda on Australian *Acanthopagrus*, eight species occur on one host species, five on two, six on three and five on four. However, 4 copepods are known from other fish genera.

Of the copepod species recorded from *Acanthopagrus* only, six are species described for the first time by Byrnes and future studies may show them on different host genera as well.

Table 5.1 Number of host species and genera of endoparasitic helminths found in this study, based on literature records.

Parasite species	No. of host species	No. of host genera
<u>DIGENEA</u>		
Coitocaecium gymnophallum	1	1
Dactylostomum gracile	2	2
Opecoelus lobatus	6	6
O. sphaericus	8	8
Austrocreadium sp. **	3	3
Monorchis sp. *	12	10
Uterovesiculurus yamagutii	2	2
Erilepturus acanthopagri n. sp.	1	1
Lecithocladium sp. *	> 54	> 41
Sterrhurus sp. *	> 40	> 36
Derogenoides sp. **	3	3
<u>CESTODE</u> (larvae) *		
Nippotaenia sp.	4	4
Gymnorhynchus sp. Type 1 Form 1		
Gymnorhynchus sp. Type 1 Form 2	5	5
Gymnorhynchus sp. Type 2		
Proteocephalus sp.	> 200	> 105
<u>NEMATODE</u>		
Terranova sp. (larva) Type 1 (Cannon, 1977) *	25	25
Terranova sp. (larva) Type 2 (Cannon, 1977)*	43	41
Contracaecum sp. (larva) *	> 150	> 150
Hysterothylacium sp. (larva) Type 1 *		
Spirocamallanus sp. **	> 50	> 28
Cucullanus acanthopagri n. sp.	1	1
Indocucullanus sp. **	6	6
Cucullanellus acanthopagri n. sp.	1	1
Neocucullanelus australis n. sp.	1	1
Echinocephalus uncinatus	20	14
Philometra sp.**	> 79	> 70
Philometroides roubali n. sp.	1	1

Cont'd

Table 5.1 (Cont'd)

Parasite species	No. of host species	No. of host genera
ACANTHOCEPHALA		
Longicollum pagrosomi	11	10
L. australis n. sp.	1	1
Neoechinorhynchus sp.**	41 including intermediate hosts	41
Hexaspiron sp. **	2	2

Note: * number of hosts of the genus

** number of hosts of the genus, but probably a new species to date recorded from *Acanthopagrus australis* only.

Sources: Yamaguti (1959, 1961, 1963, 1971a, 1971b); Ahmad (1980); Chandler (1935); Cannon (1977); Deardorff and Overstreet (1981a, 1981b, 1982); Hooper (1983); Gupta and Garg (1976); Fusco and Overstreet (1978); Fusco and Brooks (1978); Noble and King (1960); Khan and Yaseen (1969); Bilqees (1980); Arya and Johnson (1975); Khan (1969); Zaidi and Khan (1975); Ali and Kalyankar (1966) and this study.

5.3 Zoogeographical Affinity

Few studies have been made on endoparasitic helminths of fish in Australia (e.g. Hooper, 1983, Jetté, 1977). Hence it is impossible to compare the endoparasite fauna of coastal fish in northern New South Wales with that of other Australian regions.

Table 5.2 shows that among the species of Digenea, in addition to the new species described by me, two species, i.e. *Coitocaecum gymnophallum* and *Dactylostomum gracile*, have been found in Australia only; of the other species, two, *Opecoelus lobatus* and *O. sphaericus*,have also been found in other regions of the Pacific, i.e. in Japan, Hawaii, China, Vladivostok and Pacific Panama. The hemiurid *Uterovesiculurus yamagutii* is also known from the Indian Ocean, i.e. the Bay of Bengal.

Among other helminths, in addition to the five new species, only two species, the acanthocephalan *Longicollum pagrosomi* and the nematode *Echinocephalus uncinatus* were identified to species level. The acanthocephalan is also known from Japan, and the nematode from many localities, in the Indo-Pacific and Atlantic Oceans, and from the Aral Sea and the Mediterranean. The limited data available appear to indicate that at least part of the endoparasitic fauna of northern New South Wales is not unique, showing affinities with other parts of the Indo-Pacific Ocean.

Table 5.2 Localities from which endoparasitic helminths found in this study have been recorded to date.

Parasite species	Localities
DIGENEA	
Coitocaecum gymnophallum	Queensland and NSW
Dactylostomum gracile	Victoria and NSW
Opecoelus lobatus	Japan; Hawaii; NSW
O. sphaericus	Japan; Panama Pacific; Putiatin Isl.; China; NSW
Austrocreadium sp. **	Argentina; NSW
Monorchis sp. *	Triest; Mediterranean; Black Sea; Egypt; Florida; Pakistan; NSW
Uterovesiculurus yamagutii	Bay of Bengal; NSW
Erilepturus acanthopagri n. sp.	NSW
Lecithocladium sp. *	Mediterranean; Black Sea; Atlantic; Baltic; Pacific; Japan; Putiatin Is.; New Zealand; New Caledonia; Phillipines; Pakistan; India; Florida; Naples; NSW etc.
Sterrhurus sp. *	Mediterranean; Black Sea; Ise Bay; Japan; Macassar; Caribbean Sea; Florida; Queensland; Hawaii, Oregon; NSW
Derogenoides sp. **	Plymouth (USA); Black Sea; NSW
CESTODE (larvae) *	
Nippotaenia sp.	Japan; NSW
Gymnorhynchus sp. Type 1 Form 1	
Gymnorhynchus sp. Type 1 Form 2	Naples; Atlantic/Galveston Bay; NSW
Gymnorhynchus sp. Type 2	
Proteocephalus sp.	Europe; Italy; France; Lake Michigan; N. America; Canada; Texas; Sudan; Sierra Leone; California; Hudson Bay; L. Tanganyika; Woods Hole; Schall-Sea; L. Geneva; Estland; L. Lucerne; USA; Paraguay; Egypt; Patavii; Brazil; Argentina; Cuba; L. George New York;

(Cont'd)

Table 5.2 (Cont'd)

Parasite species	Localities
Proteocephalus sp. cont'd)	Switzerland; Greifswald; Ohio; Japan; Ireland; Washington; India; Russia; Oregon; L. Superior; Illinois; L. Erie; Nile and NSW
NEMATODE	
Terranova sp. (larva) Type 1 (Cannon, 1977)*) sp. (larva) Type 2 (Cannon, 1977)*)	Antarctic; N. America; Japan; Queensland; NSW; Cameroon; Australia; Russia; India; W. Africa; Atlantic; Gulf of Mexico
Contracaecum sp. (larva)*) *Hysterothylacium* sp. (larva) Type 1*)	Atlantic (Europe and America); Baltic; Canada; Kamchatka; San Juan Isl. White Sea; Asiatic Sea; China; Borneo; Ceylon; Japan; Sea of Okhotsk; N. America; Florida; Caribbean Sea; Texas; Trieste; N.E. Brazil; Padua; Mediterranean; Pacific; Australia; East North Sea; NSW; New England; Hawaii; Kerguelen; Macquarie Isl.; Russia; E. Persia; Aral Sea; S.W. Africa and NSW
Spirocamallanus sp. **	NSW; Mississippi; Florida; Columbia; Andaman; Nicobar; E. Pakistan; California
Cucullanus acanthopagri n. sp.	NSW
Indocucullanus sp. **	NSW: India; Pakistan
Cucullanellus acanthopagri n. sp.	NSW
Neocucullanellus australis n. sp.	NSW
Echinocephalus incinatus	Padua; Trieste; Ceylon; Woods Hole; Australia; Los Angeles; W. Africa; Peru; NSW
Philometra sp. **	Naples; Europe; N. America; Japan; Brazil; Bergens; Padua; Belgian Congo; Trieste; Korea; Spain; Aral Sea; Nancy; Russia; Australia; Adriatic Sea
Philometroides roubali n. sp.	NSW; Queensland; Pakistan; Japan

(cont'd)

Table 5.2 (Cont'd)

Parasite species	Localities
ACANTHOCEPHALA	
Longicollum pagrosomi	Japan; Queensland; NSW
L. australis n. sp.	NSW
Neoechinorhynchus sp. **	Europe, N. America; India; Amur; Indian Tibet; Kashmir; NSW
Hexaspiron sp. **	Nigeria; NSW

Note: * number of hosts of the genus

** number of hosts of the genus, but probably a new species to date recorded from *Acanthopagrus australis*.

Sources: (as in Table 5.1)

5.4 Seasonal Fluctuations of Parasite Infection

Examination of bimonthly intensities and prevalences of infection with five common parasites, i.e. *Coitocaecum gymnophallum*, two species of *Opecoelus*, *Dactylostomum gracile* and *Erilepturus acanthopagri*, showed no distinct seasonal fluctuations. However, sample sizes are small and it cannot be excluded that larger sample sizes may show slight seasonal fluctuations. Absence of distinct fluctuations may be due to the indistinct temperature changes in coastal waters of northern New South Wales (see Table 5.3). Hooper (1983) noted that the diversity of parasites in *Platycephalus bassensis* in the same area was highest in summer samples, but since more female fish were examined in summer and since fish were scarce during autumn, the fluctuations were not considered to be significant. Rohde and Sandland (1973) and Rohde (1981) reported that there were no seasonal fluctuations in any of the 17 digenetic trematodes and the aspidogastrean *Lobatostoma manteri* in two snail species, *Planaxis sulcatus* and *Cerithium moniliferum*, over a two year period on the Great Barrier Reef, where water temperatures are even more constant. Altogether, data on seasonal fluctuations in warm (tropical-subtropical) waters are inadequate (Rohde, 1982).

The data in Kennedy (1975) on seasonal fluctuations of some endoparasites of freshwater fish in colder regions show that some species are seasonal, for example *Podocotyle* sp. in flounders in the River Ythan (MacKenzie and Gibson, 1970); *Ptoteocephalus fluviatilis* in small mouth bass (Fischer, 1967); *P. amblioplitis* in the viscera of small mouth bass (Fischer and Freeman, 1969); *P. filicollis* in stickle-backs in Scotland (Hopkins, 1959) and *Caryophyllaeus laticeps* in the River Avon (Kennedy, 1969). Furthermore, according to Möller (1974, 1975 in Rohde, 1984a), most endoparasites of flounder, *Platichthys flesus*, and all the species of *Gadus morhua* in the Bay of Kiel showed seasonal fluctuations; and according to Moravec (1982), there were seasonal fluctuations of *Nioechinorhynchus rutili* infecting *Cyprinus carpio* in Czechoslovakia. Meskal (1967) reported seasonal fluctuations of *Hemiurus communis* and *Derogenes varicus* in the cod, *Gadus callarias* in Bergin, Norway; Tedla and Fernando (1969) reported seasonal fluctuations of parasites of yellow perch, *Perca flavescens* in the Bay of Quinte, Lake Ontario, and Rawson (1973) noted some seasonal fluctuations of the parasites of striped mullet, *Mugil cephalus* L., and mummichogs, *Fundulus heteroclitus* (L.) in Georgia, U.S.A. Nevertheless, although seasonal fluctuations of parasite infection in cold-temperate freshwater and marine environments can be considered to be common, they are not universal (see e.g. Rohde 1982, 1984a, b). For example, Hopkins (1959, in Kennedy, 1975) showed that *Proteocephalus filicollis* in sticklebacks in Yorkshire is not seasonal, whereas in Scotland, according to the same author it is seasonal. Katkansky *et al.* (1967, in Rohde, 1982) did not find seasonal fluctuations of the copepod parasitic in mussels, *Mytilicola intestinalis* on the North American coast; and similarly Noble *et al.* (1963) did not find seasonal fluctuations in four parasite species infecting the estuarine fish, *Gillichthys mirabilis* in North America, in contrast with the distinct seasonal changes in water temperatures and salinities at that locality.

Table 5.3 Monthly mean surface sea temperature, recorded at the Solitary Islands by CSIRO Station near Coffs Harbour. Data shown are combined readings for 1960-1962 and 1969-1972 inclusive (data from Crooks, 1963 and Veron *et al.*, 1974 in Hooper, 1980).

°C	MONTH											
	J	F	M	A	M	J	J	A	S	O	N	D
Mean	24.6	25.5	24.6	23.8	23.0	20.8	20.2	19.5	19.9	21.5	21.5	23.5
High	26.8	26.4	26.7	24.6	24.0	22.0	22.6	21.0	21.0	22.8	22.2	26.0
Range Low	20.0	25.2	22.5	22.2	21.8	18.0	18.8	18.0	18.5	20.6	20.3	21.6

5.5 Allometric Growth

Allometric growth of various organs of *Coitocaecum gymnophallum* and of other trematode species is compared in Table 5.4. Only the suckers and pharynx show negative allometric growth in all species. Rohde (1966) noted that three of his species, i.e. *Platynostomum fastomum*, *Zonorchis* sp. and *Mesocoelium* sp. have a strong positive allometric growth of their hindbodies. This was also found in other species by other authors, except in *Metadena globusa* recovered from *Lutjanus analis* (see Fischthal, Fish and Vaught, 1980) which has an isometric growth of the hindbody.

The comparison of body width using the data from Fischthal (1978a), Fischthal (1978b), Fischthal, Fish and Vaught (1980) and this study shows a range from negative to isometric (unity), whereas the gonads show an allometric growth ranging from negative to positive.

My findings show again that body proportions change with growth, i.e. that differences in body proportions can be used for taxonomic studies only if the size of the specimens is taken into consideration. My findings further show that the way of fixation greatly influences body proportions and allometric quotients. Hence, trematodes should be fixed in the same way if taxonomic comparisons are made on the basis of differences in body proportions.

Table 5.4 Negative (-), positive (+) allometric growth and isometric (±) growth of trematode organs. (?) not examined. Forebody = preacetabular body; hindbody = postacetabular body.

Species of trematode	Body width	Forebody length	Hindbody length	Posttesticular body length	Oral sucker diameter	Acetabulum diameter	Pharynx diameter	Testes diameter	Ovary diameter	Source
Anchitrema sanguineum	?	-	+	?	-	-	-	-	-	
Platynosomum fastosum	?	-	+	?	-	-	-	?	?	
Zonorchis sp.	?	-	+	?	-	-	-	?	?	
Mesocoelium sp	?	-	+	?	-	-	-	?	?	
Diaschistorchis multitesticularis	?	?	?	?	-	-	-	?	?	
Maxbraunium baeri	?	?	?	?	-	-	-	?	?	
Odeningotrema hypergenitalis	?	?	?	?	-	-	-	?	?	
Novetrema nycticebi	?	?	?	?	-	-	-	?	?	Rohde, 1966
Renschetrema malayi	?	?	?	?	-	-	-	?	?	
Kaurma intermedia	?	?	?	?	-	-	-	?	?	
Parorientodiscus magnus	?	?	?	?	-	-	-	?	?	
Opistorchis viverini	?	?	?	?	-	-	-	?	?	
Polystomoides malayi	?	?	?	?	-	-	-	?	?	
P. renschi	?	?	?	?	-	-	-	?	?	
Multitestis rotundus	±	±	+	±	-	-	-	±	+	
Stenopera equilata	-	-	+	±	-	-	-	±	±	Fischthal, 1978a
Leurodera decora	±	±	+	±	-	-	-	±	±	
Prosorhynchus pacificus	-	-	+	-	-	-	-	±	+	
Apocreadium mexicanum	±	-	+	±	-	-	-	+	+	
Pseudocreadium lamelliforme	±	±	+	±	-	-	-	±	+	Fischthal, 1978b
Paracryptogonimus americanus	-	-	+	±	-	-	-	+	±	
Metadena globusa										
from *Lutjanus analis*	-	+	±	+	-	-	-	-	-	
from *L. synagris*	±	-	+	+	-	-	-	-	-	Fischthal, Fish and Vaught, 1980
from *Ocyurus chrysurus*	-	±	+	+	-	-	-	-	±	
Coitocaecum gymnophallum	-	?	?	?	-	-	-	-	-	This study

CHAPTER 6
CONCLUSIONS

Examination for endoparasites of 449 specimens of the black bream, *Acanthopagrus australis* in northern New South Wales revealed the presence of 11 digenetic trematodes (including one new species and two species which are probably new), five larval cestodes, four larval and eight adult nematodes (including three new species and three species which are probably new) and four acanthocephalans (including one new species and one species which is probably new). This compares with 20 species of ectoparasites on the same host species in the same area, i.e. eight Monogenea and 12 Copepoda (Roubal, 1981). In northern seas where comprehensive surveys have been made, the number of endoparasitic species was always far greater than that of ectoparasitic species (e.g. Osmanov, 1940 in the Black Sea, 42 Digenea, 21 Cestoda, 14 Nematoda, 5 Acanthocephala, 6 Monogenea, 4 Copepoda and 2 Isopoda; Shulman and Shulman-Albova, 1953: in the White Sea, 30 Digenea, 13 Cestoda, 9 Nematoda, 6 Acanthocephala, 10 Monogenea and 6 Copepoda; Campbell, Haedrich and Munroe, 1980 in deep-sea benthic fishes off the New York Bight, 43 Digenea, 9 Monogenea and 8 Copepoda). Further studies are necessary to demonstrate whether an increased proportion of ectoparasitic species in warmer seas is the rule. The fact that in my study single specimens were found for several species, indicates that more comprehensive studies will show more species. Additional specimens for some species will then permit establishment of several new species.

A further line of future research could be a study of the endoparasites of other species of *Acanthopagrus* from all around Australia, similar to the study of ectoparasites by Byrnes (1985).

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DEPOSITION NUMBERS

Specimens deposited in the Australian Museum, Sydney.

Parasites	Collection numbers
DIGENETIC TREMATODES:	
Coitocaecum gymnophallum Nicoll, 1915	See text.
Dactylostomum gracile Woolcock, 1935	
Opecoelus lobatus Ozaki, 1925	
O. sphaericus Ozaki, 1925	
Austrocreadium sp.	
Monorchis sp. (Monticelli, 1893) Looss, 1902	
Uterovesiculurus yamagutii Ahmad, 1980	
Erilepturus acanthopagri n. sp.	
Lecithocladium sp. Lühe, 1901	
Sterrhurus sp. Looss, 1907 (Yamaguti, 1970)	
Derogenoides sp.	
CESTODES:	
Nippotaenia sp. Yamaguti, 1939 (larva)	
Gymnorhynchus sp. Rudolphi (1819) Larva Type 1, Form 1	
Gymnorhynchus sp. Rudolphi (1819) Larva Type 2	
Proteocephalus sp. Weinland, 1858 (larva)	
NEMATODES:	
Terranova sp. Type 1, Larva, Cannon, 1977	
Terranova sp. Type 2, Larva, Cannon, 1977	
Contracaecum sp. (larva)	
Hysterothylacium sp. Ward and Magath, 1917 syn. *Thynnascaris* sp. Type 1, Larva, Cannon, 1977	

Cont'd

Parasites	Collection numbers
Spirocamallanus sp.	
Cucullanus acanthopagri n. sp.	
Indocucullanus sp.	
Cucullanellus acanthopagri n. sp.	
Neocucullanellus australis n. sp.	
Echinocephalus uncinatus Molin, 1858	
Philometra sp.	
Philometroides roubali n. sp.	
ACANTHOCEPHALANS:	
Longicollum pagrosomi Yamaguti, 1935	
L. australis n. sp.	
Neoechinorhynchus sp.	
Hexaspiron sp.	