Appendices

Appendix 1 List of monogenean species from the Old World siluriforms.

Fish species	Localities	Monogenean species	References
Ariidae:			
**Arius*			
A. arius	India	*Chauhanellus nengi*	Tripathi, 1957
	"	*Neocalceostoma elongatum*	Tripathi, 1957
A. caelatus	Penin. Malaysia	*Chauhanellus caelatus*	Lim, 1994
		Hamatopeduncularia malayanus	Lim, 1996a
		Neocalceostomoides simplex	Lim, 1995a
A. dussumieri	India	*Chauhanellus chauhani*	Venkatanarsaiah & Kulkarni, 1990
A. falcarius	China	*Hamatopeduncularia arii*	Bychowsky & Nagibina, 1969
	"	*H. elegan*	Bychowsky & Nagibina, 1969
	"	*H. simplex*	Bychowsky & Nagibina, 1969
	"	*Chauhanellus flexiosus*	Bychowsky & Nagibina, 1969
	India	*C. alatus*	Chauhan, 1945 (in Lim, 1996a)
A. graeffei	Australia	*Chauhanellus australis*	Young, 1967;
			Kearn & Whittington, 1994
	"	*C. youngi*	Kearn & Whittington, 1994
	"	*Hamatopeduncularia australis*	Young, 1967
	"	*H. brisbanensis*	Young, 1967;
			Kearn & Whittington, 1994
	"	*H. major*	Kearn & Whittington, 1994
	"	*H. pearsoni*	Kearn & Whittington, 1994
	"	*H. spiralis*	Kearn & Whittington, 1994
	"	*Neocalceostomoides brisbanensis*	Whittington & Kearn, 1995
A. jella	India	*Hamatopeduncularia indicus*	Siddiqui & Kulkarni, 1983
A. leiotetocephalus	China	*H. arii*	Bychowsky & Nagibina, 1969
A. macrocephalus	Kenya	*H. elegans*	Paperna, 1977
	"	*H. nagibinae*	Paperna, 1977
	"	*H. papernai*	Paperna, 1977
A. maculatus	Penin. Malaysia	*Chauhanellus auriculatum*	Lim, 1994
	"	*C. poculus*	Lim, 1994
	"	*C. pulutanus*	Lim, 1994
	"	*Hamatopeduncularia arii*	Lim, 1996a
	"	*H. elegans*	Lim, 1996a
	"	*H. isosimplex*	Lim, 1996a

Appendix 1 cont'd

Fish species	Localities	Monogenean species	References
Osteogeneiosus			
O. militaris	India	*Chauhanellus nengi*	Tripathi, 1957
	"	*Neocalceostoma elongatum*	Tripathi, 1957
	Penin. Malaysia	*Chauhanellus osteogeneiosi*	Lim, 1994
	"	*Hamatopeduncularia malaccensis*	Lim, 1996a
	"	*H. simplex*	Lim, 1996a
Bagridae:			
Bagrinae:			
Aorichthys			
A. aor	India	*Ancylodiscoides micracanthus*	Gussev, 1976
	"	*Thaparocleidus postorchidis*	Kulkarni, 1969c; Gussev, 1976; Lim, 1996b
	Pakistan	*T. aori*	Rizvi, 1971; Gussev, 1976; Lim, 1996b
	"	*T. mystusi*	Rizvi, 1971; Gussev, 1976; Lim, 1996b
A. seenghala	India	*Bifurcohaptor giganticus*	Jain, 1958; Gussev, 1978
(syn. *Mystus seenghala*)	"	*Hamatopeduncularia sohani*	Tewari & Agrawal, 1986b
	"	*Thaparocleidus seenghali*	Jain, 1961a; Gussev, 1976; Lim, 1996b
Bagrus			
B. docmac	Uganda	*Quadriacanthus bagrae*	Paperna, 1979
	Ghana	*Q. clariadis*	Paperna & Thurston, 1968
B. bayad	Uganda	*Q. bagrae*	Paperna, 1979
B. orientalis	Tanzania	*Q. bagrae*	Paperna, 1979
Hemibagrus			
H. elongatus	China	*Bychowskyella pseudobagri*	Li & Zhang, 1992
(syn. *Mystus elongatus*)			
H. guttatus	"	*B. pseudobagri*	Li & Zhang, 1992
(syn. *M. guttatus*)			
H. macropterus	"	*Ancylodiscoides hemibagri*	Zhang & Ji, 1981
(syn. *M. macropterus*)	"	*Bychowskyella pseudobagri*	Long, 1981

Appendix 1 cont'd

Fish species	Localities	Monogenean species	References
P. fulvidraco	China	*Bychowskyella pseudobagri*	Long, 1981
	"	*T. strelkowi*	Li & Zhang, 1992; Lim, 1996b
P. vachelli	"	*Ancylodiscoides curvitubus*	Zhang & Ji, 1981
	"	*A. asciicirrus*	Ma, Li & Wang, 1981
Pseudobagrus			
P. longirostris (syn. *Leiocassis longirostris*)	China	*Ancylodiscoides leiocassi*	Ma, Li & Wang, 1981
P. ussuriensis (syn. *Leiocassis ussuriensis*)	USSR	*Thaparocleidus rimskykorsakovi*	Gussev, 1985; Lim, 1996b
Ritinae:			
Rita			
R. rita	India	*Bychowskyella raipurensis*	Majumdar & Agarwal, 1988
	"	*Thaparocleidus ritius*	Jain, 1961a; Lim, 1996b
Claroteidae:			
Auchenoglanidinae:			
Auchenoglanis			
A. occidentalis	Ghana	*Bagrobdella auchenoglanii*	Paperna, 1969
	Uganda	*B. auchenoglanii*	Euzet & Le Brun, 1990
	"	*B. anthopenis*	Euzet & Le Brun, 1990
	"	*B. fraudulenta*	Euzet & Le Brun, 1990
Claroteinae:			
Chrysichthys			
C. nigrodigitatus	Ghana	*Protoancylodiscoides chrysichthys*	Paperna, 1969
Clariidae:			
Clarias			
C. batrachus	India	*Bychowskyella tchangi*	Gussev, 1976
	"	*Quadriacanthus kobiensis*	Gussev, 1976

Appendix 1 cont'd

Fish species	Localities	Monogenean species	References
C. gariepinus	Ghana	*Q. clariadis*	Paperna, 1969
	Uganda	*Q. allobychowskiella*	Paperna, 1979
	Thailand	*Q. bagrae*	Lerssutthichawal & Lim, 1997
C. mossambicus	Uganda	*Q. clariadis*	Paperna & Thurston, 1968
C. walkeri	Ghana	*Q. voltaensis*	Paperna, 1969
Heterobranchus			
H. isopterus	Ghana	*Q. clariadis*	Paperna, 1965; 1969
Heteropneustidae:			
Heteropneustes			
H. fossilis	India	*Bychowskyella fossilisi*	Majumdar & Agarwal, 1988
	"	*Gyrodactylus gussevi*	Dubey, Gupta & Agarwal, 1990
Mochokidae:			
Synodontis			
S. membranaceus	Ghana	*Ancyrocephalus synodonti*	Paperna, 1969
	Uganda	*A. synodonti*	Paperna & Thurston, 1968
Pangasiidae:			
Pangasianodon			
P. hypophthalmus	Penin. Malaysia	*Thaparocleidus caecus*	Lim, 1990b; Lim, 1996b
(syn. *Pangasius*	"	*T. siamensis*	Lim, 1990b; Lim, 1996b
sutchi)	China	*T. campylopterocirrus*	Zeng, 1988; Lim, 1996b
Pangasius			
P. pangasius	India	*T. pangasi*	Tripathi, 1957; Lim, 1996b
Plotosidae:			
**Plotosus*			
P. canius	Penin. Malaysia	*Anchylodiscus malayensis*	Lim, 1992c
	"	*A. liewi*	Lim, 1992c
Tandanus			
T. tandanus	Australia	*Anchylodiscus tandani*	Johnston & Tiegs, 1922 (in Lim, 1992c)
**Cnidoglanis*			
C. megastoma	Australia	*A. caballeroi*	Paperna, 1977

Appendix 1 cont'd

Fish species	Localities	Monogenean species	References
S. intermedius	Uganda	*S. acornis*	Paperna, 1979; Paperna & Thurston, 1968
	"	*S. quadricornis*	Paperna, 1979; Paperna & Thurston, 1968
S. mystus	Ghana	*Schilbetrema eutropii*	Paperna, 1969
	"	*S. hexacornis*	Paperna, 1969
	"	*S. spirocirra*	Paperna, 1969
	Togo	*S. eutropii*	Kritsky & Kulo, 1992a
	"	*S. hexacornis*	Kritsky & Kulo, 1992a
S. mystus	"	*S. spirocirra*	Kritsky & Kulo, 1992a
	"	*S. torula*	Kritsky & Kulo, 1992a
	"	*Schilbetrematoides pseudodactylogyrus*	Kritsky & Kulo, 1992b
Schilbe sp. (syn. *Eutropius* sp.)	Tanzania	*Schilbetrema tricera*	Paperna, 1973; Kritsky & Kulo, 1992a
Silonia			
S. silondia	India	*Bychowskyella cauveryi*	Tripathi, 1957; Gussev, 1976
	"	*Thaparocleidus multispiralis*	Jain, 1957b; Gussev, 1976; Lim, 1996b
Siluridae:			
Ompok			
O. hypophthalmus (syn. *Silurodes hypophthalmus*)	Penin. Malaysia	*Thaparocleidus convolvulus*	Lim, 1986a; Lim, 1996b
	"	*T. laisensis*	Lim, 1986a; Lim, 1996b
	"	*T. macrocleithrius*	Lim, 1986a; Lim, 1996b
	"	*T. microhaptorus*	Lim, 1986a; Lim, 1996b
	"	*T. tasekberai*	Lim, 1986a; Lim, 1996b
O. malabaricus (syn. *Callichrous malabaricus*)	India	*T. malabaricus*	Gussev, 1976; Lim, 1996b

Appendix 1 cont'd

Fish species	Localities	Monogenean species	References
O. pubda	"	*Bychowskyella asiatica*	Jain, 1959; Gussev, 1976
(syn. *Callichrous pubda*)	"	*Thaparocleidus devaraji*	Gussev, 1976; Lim, 1996b
	"	*T. octotylus*	Kulkarni, 1969c; Gussev, 1976; Lim, 1996b
Silurus			
S. asotus	China	*T. anguloformis*	Zhang & Pan, 1988; Lim, 1996b
(syn. *Parasiluru asotus*)	"	*T. clavicula*	Chen, 1988; Lim, 1996b
	"	*T. disparidentata*	Chen, 1988; Lim, 1996b
	"	*T. forcicula*	Chen, 1988; Lim, 1996b
	"	*T. megacephala*	Chen, 1988; Lim, 1996b
	"	*T. moriformis*	Chen, 1988; Lim, 1996b
	Japan	*T. hamatovagina*	Yamaguti, 1942; Gussev, 1985; Lim, 1996b
	"	*T. infundibulovagina*	Yamaguti, 1942; Gussev, 1985; Lim, 1996b
	"	*T. japonicus*	Yamaguti, 1963; Gussev, 1985; Lim, 1996b
	"	*T. lingmoeni*	Gussev & Strelkow,1960; Lim, 1996b
	USSR	*T. asoti*	Gussev, 1985; Lim, 1996b
	"	*T. botulovagina*	Gussev & Strelkow,1960; Lim, 1996b
	"	*T. cochleavagina*	Gussev & Strelkow,1960; Lim, 1996b
	"	*T. cornucirrus*	Gussev, 1985; Lim, 1996b
	"	*T. curvilamellis*	Gussev, 1985; Lim, 1996b
	"	*T. disjuctus*	Gussev, 1985; Lim, 1996b
	"	*T. dorsocirrus*	Gussev, 1985; Lim, 1996b
	"	*T. magnicirrus*	Gussev, 1985; Lim, 1996b
	"	*T. markewitschi*	Gussev, 1985; Lim, 1996b
	"	*T. mediacanthus*	Gussev, 1985; Lim, 1996b
	"	*T. mutabilis*	Gussev, 1985; Lim, 1996b
	"	*T. obscurus*	Gussev, 1985; Lim, 1996b
	"	*T. omegavagina*	Gussev, 1985; Lim, 1996b
	"	*T. sigmoidovagina*	Gussev, 1985; Lim, 1996b
	"	*T. varicus*	Gussev, 1985; Lim, 1996b

Appendix 1 cont'd

Fish species	Localities	Monogenean species	References
S. asotus	USSR	*Ancylodiscoides parasiluri*	Gussev, 1985
	"	*Gyrodactylus gussevi*	Gussev, 1985
S. glanis	"	*Thaparocleidus magnus*	Gussev, 1985; Lim, 1996b
	"	*T. siluri*	Gussev, 1985; Lim, 1996b
	"	*T. vistulensis*	Gussev, 1985; Lim, 1996b
S. soldatovi	"	*T. infundibulovagina*	Gussev, 1985; Lim, 1996b
	"	*T. longitubus*	Gussev & Strelkow, 1960; Lim, 1996b
	"	*T. macracanthus*	Gussev, 1985; Lim, 1996b
	"	*T. magnicirrus*	Gussev, 1985; Lim, 1996b
	"	*T. mediacanthus*	Gussev, 1985; Lim, 1996b
	"	*T. rarissimus*	Gussev, 1985; Lim, 1996b
	"	*T. soldatovi*	Gussev, 1985; Lim, 1996b
S. soldatovi	"	*Ancylodiscoides parasiluri*	Gussev, 1985
	"	*Gyrodactylus gussevi*	Gussev, 1985
Silurichthys			
S. hasselti	Penin. Malaysia	*Bychowskyella baueri*	Lim, 1991b
Wallago			
W. attu	India	*B. singhi*	Rajeswari & Kulkarni, 1983
	"	*B. wallagonia*	Jain, 1959; Gussev, 1976
	"	*Hamatopeduncularia lucknowensis*	Agrawal & Sharma, 1988
	"	*H. yogendrai*	Pandey & Mehta, 1986
	"	*Heteronchocleidus athari*	Pandey & Mehta, 1986
	"	*Mizelleus chauhani*	Agrawal & Sharma, 1989
	"	*M. hindanensis*	Tewari & Agrawal, 1986a
	"	*M. indicus*	Jain, 1957a; Kulkarni, 1969c; Gussev, 1976, Agrawal & Mishra, 1992
	"	*M. lucknowensis*	Agrawal & Sharma, 1996
	"	*M. wallagonius*	Singh, Kumari & Agrawal, 1992
	"	*Neocalceostoma chauhani*	Pandey & Mehta, 1986
	"	*Thaparocleidus chauhani*	Agrawal & Pandey, 1981; Lim, 1996b

Appendix 1 cont'd

Fish species	Localities	Monogenean species	References
W. attu	India	*T. dayali*	Pandey & Agrawal, 1988; Lim, 1996b
	"	*T. gomtius*	Jain, 1952a; Gussev, 1976; Lim, 1996b
	"	*T. guptai*	Pandey & Mehta, 1986
	"	*T. gussevi*	Dubey, Gupta & Agarwal, 1992a; Lim, 1996b
	"	*T. indicus*	Kulkarni, 1969a; Gussev, 1976; Lim, 1996b
	"	*T. jaini*	Agrawal, 1981
	"	*T. longicirrus*	Tripathi, 1957; Gussev, 1976; Venkatanarsaiah & Kulkarni, 1981; Lim, 1996b
	"	*T. ramalingami*	Pandey & Metha, 1986; Lim, 1996b
	"	*T. saharanpurensis*	Pandey & Agrawal, 1990
		T. sharmae	Singh & Sharma, 1992; Lim, 1996b
	"	*T. sohani*	Pandey & Mehta, 1986
	"	*T. sudhakari*	Gussev, 1976; Lim, 1996b
	"	*T. surendrai*	Pandey & Agrawal, 1990
	"	*T. wallagonius*	Jain, 1952b
	"	*T. yongendrai*	Agrawal, 1981
	Thailand	*Mizelleus siamensis*	Lim & Lerssutthichawal, 1996
	"	*Thaparocleidus kao*	Lim & Lerssutthichawal, 1996
	"	*T. indicus*	Lim & Lerssutthichawal, 1996
Sisoridae:			
Bagarius			
B. bagarius	India	*Bifurcohaptor gorakhnathai*	Kumar & Agarwal, 1982
	"	*B. son*	Tripathi, 1957
	"	*B. vishwanathai*	Agarwal & Kumar, 1977
	"	*Bychowskyella bagariusi*	Sharma, 1983; Sharma, 1989
Glyptothorax			
G. major	Penin. Malaysia	*Bychowskyella sisoris*	Lim, 1991b
G. sinense	China	*B. glyptothoraci*	Ma, Wang & Li, 1983

Appendix 2: Photographs of Thai freshwater siluriforms examined

I. Family Bagridae

Fig. F1 *Bagrichthys macropterus* (Bleeker, 1853)

Fig. F2 *Mystus bocourti* (Bleeker, 1864)

Fig. F3 *Mystus gulio* (Hamilton, 1822)

Fig. F4 *Mystus singaringan* (Bleeker, 1846)

Fig. F5 *Hemibagrus wyckii* (Bleeker, 1858)

Fig. F6 *Hemibagrus wyckoides* (Chaux & Fang, 1949)

Fig. F7 *Hemibagrus nemurus* (Val. in Cuv. & Val., 1839)

Fig. F8 *Pseudomystus siamensis* (Regan, 1913)

II Family Clariidae

Fig. F9 *Clarias batrachus* (Linnaeus, 1758)

Fig. F10 *Clarias macrocephalus* Gunther, 1864

Fig. F11 *Clarias nieuhofi* ((Val. in Cuv. & Val., 1840)

Fig. F12 *Clarias gariepinus* (Burchell, 1822)

Fig. F13 *Clarias cataractus* (Fowler, 1939)

Fig. F14 *Clarias meladerma* Bleeker, 1847

Fig. F15 *C. batrachus* compared with *C. macrocephalus*

Fig. F16 *Clarias hybrid* (crossbred between *C. macrocephalus* & *C. gariepinus*)

III Family Pangasiidae

Fig. F17 *Pangasius bocourti* Sauvage, 1880

Fig. F18 *Pangasius conchophilus* Roberts & Vidthayanon, 1991

Fig. F19 *Pangasius larnaudii* Bocourt, 1866

Fig. F20 *Pangasius sanitwongsei* Smith, 1931

Fig. F21 *Pangasius krempfi* Fang & Chaux, 1949

Fig. F22 *Pangasius macronema* Bleeker, 1851

Fig. F23 *Helicophagus waandersii* Bleeker, 1858

Fig. F24 *Pangasianodon gigas* Chevey, 1930

Fig. F25 *Pangasianodon hypophthalmus* (Sauvage, 1878)

Fig. F26 *Pteropangasius pleurotaenia* (Sauvage, 1878)

IV Family Schilbeidae

Fig. F27 *Laides hexanema* (Bleeker, 1852)

V Family Siluridae

Fig. F28 *Belodontichthys dinema* Bleeker, 1851

Fig. F29 *Wallago attu* (Bloch & Schneider, 1802)

Fig. F30 *Hemisilurus mekongensis* Bornbusch & Lundberg, 1989

Fig. F31 *Silurichthys* sp.

Fig. F32 *Kryptopterus apogon* (Bleeker, 1851)

Fig. F33 *Kryptopterus bleekeri* Gunther, 1864

Fig. F34 *Kryptopterus cryptopterus* (Bleeker, 1851)

Fig. F35 *Kryptopterus bicirrhis* (Val. in Cuv. & Val., 1839)

Fig. F36 *Ompok bimaculatus* (Bloch, 1797)

VI Family Sisoridae

Fig. F37 *Bagarius yarrelli* Sykes, 1941

Fig. F38 *Bagarius bagarius* (Hamilton, 1822)

Fig. F39 *Glyptothorax major* (Boulenger, 1894)

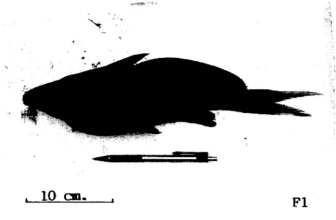
VII Family Heteropneustidae

Fig. F40 *Heteropneustes fossilis* (Bloch, 1797)

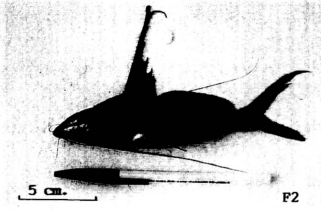
VIII Family Ariidae

Fig. F41 *Hemipimelodus borneensis* (Bleeker,

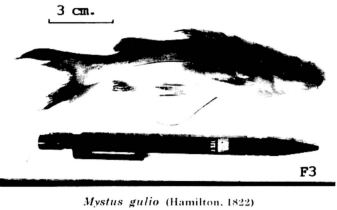
Family Bagridae



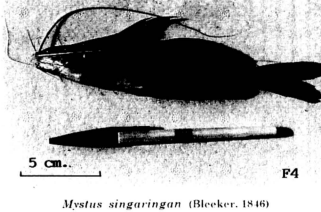
Bagrichthys macropterus (Bleeker, 1854)



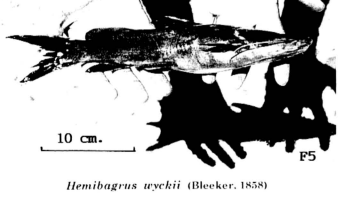
Mystus bocourti (Bleeker, 1864)



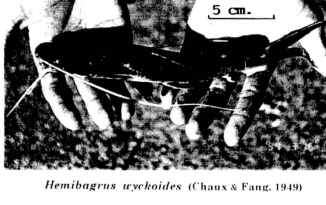
Mystus gulio (Hamilton, 1822)



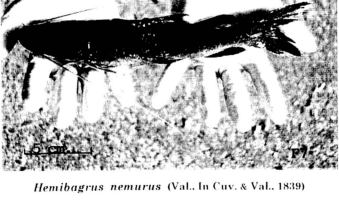
Mystus singaringan (Bleeker, 1846)



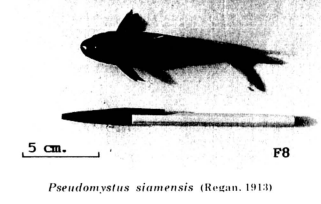
Hemibagrus wyckii (Bleeker, 1858)



Hemibagrus wyckoides (Chaux & Fang, 1949)

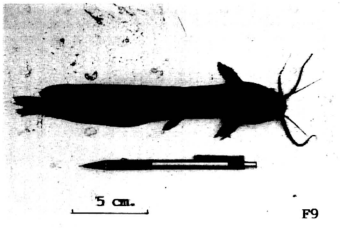


Hemibagrus nemurus (Val., In Cuv. & Val., 1839)



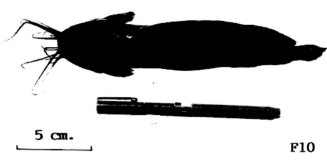
Pseudomystus siamensis (Regan, 1913)

Family Clariidae



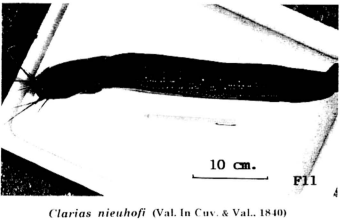
F9

Clarias batrachus (Linnaeus, 1758)



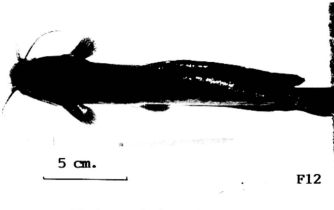
F10

Clarias macrocephalus Gunther, 1864



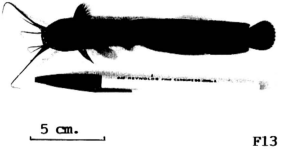
F11

Clarias nieuhofi (Val. In Cuv. & Val., 1840)



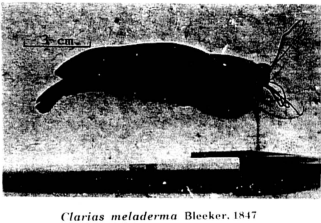
F12

Clarias gariepinus (Burchell, 1822)

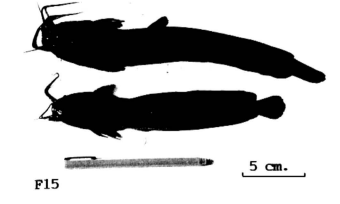


F13

Clarias cataractus (Fowler, 1939)



Clarias meladerma Bleeker, 1847



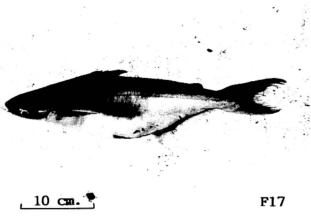
F15

C. batrachus (up) compared with
C. macrocephalus (below)

F16

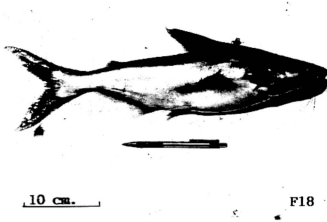
Clarias hybrid (crossbred between
C. macrocephalus & C. gariepinus)

Family Pangasiidae



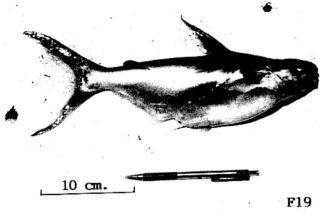
F17

Pangasius bocourti Sauvage, 1880



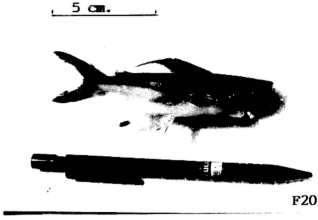
F18

Pangasius conchophilus Roberts & Vidthayanon, 1991



F19

Pangasius larnaudii Bocourt, 1866

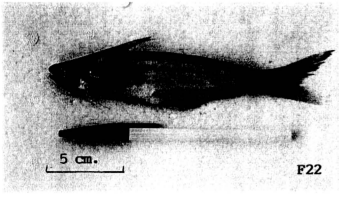


F20

Pangasius sanitwongsei Smith, 1931

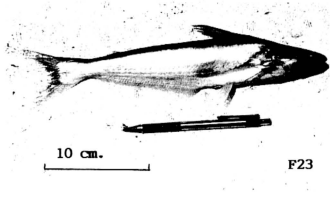
F21

Pangasius krempfi Fang & Chaux, 1949



F22

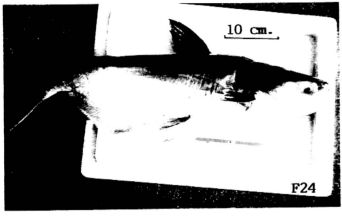
Pangasius macronema Bleeker, 1851



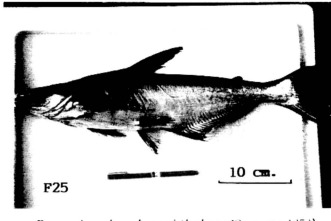
F23

Helicophagus waandersii Bleeker, 1858

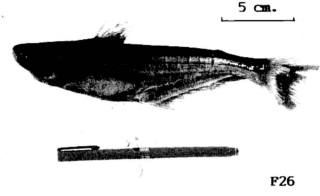
Family Pangasiidae



Pangasianodon gigas Chevey, 1930

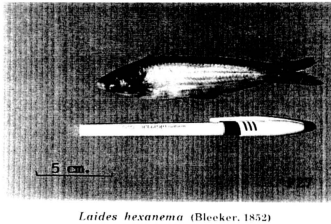


Pangasianodon hypophthalmus (Sauvage, 1878)



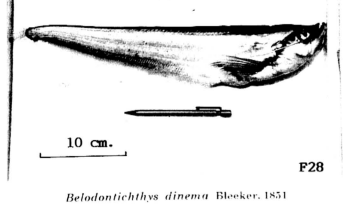
Pteropangasius pleurotaenia Sauvage, 1878

Family Schilbeidae

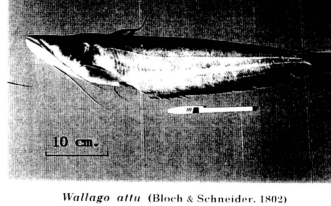


Laides hexanema (Bleeker, 1852)

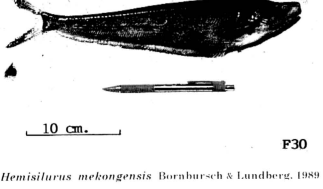
Family Siluridae



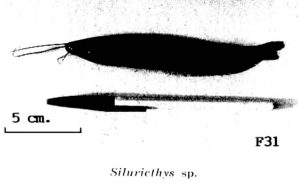
Belodontichthys dinema Bleeker, 1851



Wallago attu (Bloch & Schneider, 1802)

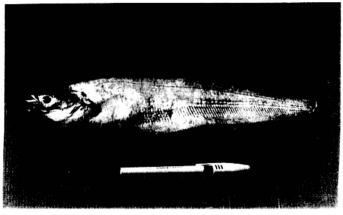


Hemisilurus mekongensis Bornbursch & Lundberg, 1989

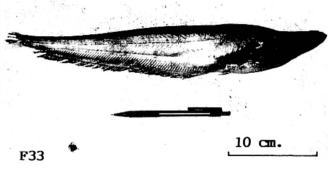


Silurichthys sp.

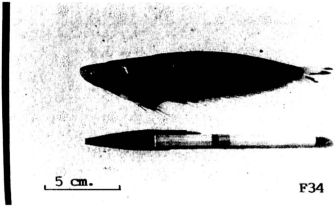
Family Siluridae



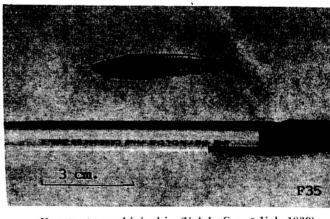
Kryptopterus apogon (Bleeker, 1851)



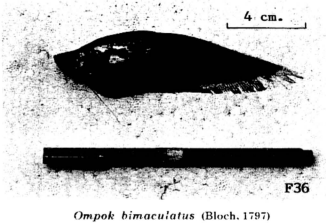
Kryptopterus bleekeri Gunther, 1864



Kryptopterus cryptopterus (Bleeker, 1851)

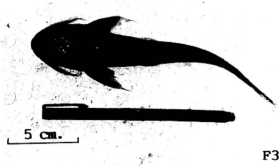


Kryptopterus bicirrhis (Val. In Cuv. & Val., 1839)



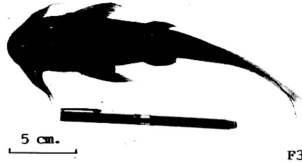
Ompok bimaculatus (Bloch, 1797)

Family Sisoridae



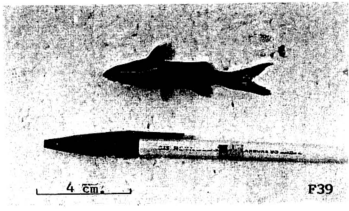
F37

Bagarius yarrelli Sykes, 1941



F38

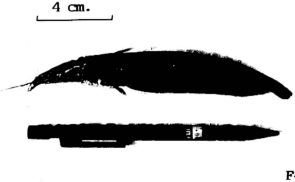
Bagarius bagarius (Hamilton, 1822)



F39

Glyptothorax major (Boulenger, 1894)

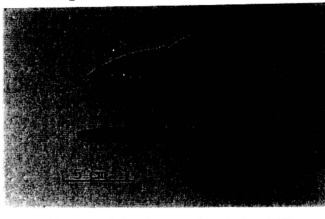
Family Heteropneustidae



F40

Heteropneustes fossilis (Bloch, 1797)

Family Ariidae



Hemipemelodus borneensis (Bleeker, 1851)

Appendix 3: Monogeneans of Thai freshwater siluriforms

Introduction

As already stated instead of just describing the monogenean species collected from the siluriforms, it is more informative to analyse and summarise the relationships of the monogeneans collected within the text, while the descriptions of the species which form the basis of this thesis will be given in the appendix.

In this study, a total of 83 species of monogeneans were obtained from 40 out of the 44 freshwater siluriform species examined. The 44 siluriform species examined belong to eight families. The 83 monogenean species belong to two subfamilies, Ancylodiscoidinae Gussev, 1961 and Ancyrocephalinae Bychowsky, 1937 of the family Ancyrocephalidae Bychowsky, 1937. The subfamily Ancylodiscoidinae contains 70 of the 83 species in three genera: *Bifurcohaptor* Jain, 1958, *Cornudiscoides* Kulkarni, 1969 and *Thaparocleidus* Jain, 1952 with two, 13 and 55 species, respectively. The other 13 species belong to four genera of the subfamily Ancyrocephalinae, *Bychowskyella* Achmerow, 1952, *Quadriacanthus* Paperna, 1961, *Hamatopeduncularia* Yamaguti, 1953 and *Mizelleus* Jain, 1957, with eight, two, two and one species, respectively.

Sixty-six of the 83 monogenean species obtained in this study are new to Science. Two of these 66 species have already been described: *Mizelleus siamensis* Lim & Lerssutthichawal, 1996 and *Thaparocleidus kao* Lim & Lerssutthichawal, 1996 from *Wallago attu* (see Lim & Lerssutthichawal, 1996) and included herein as Appendix 3.8 as they are part of this thesis.

The morphometric data of *Cornudiscoides germinus* Gussev, 1976 (see Appendix 3.2), *Quadriacanthus kobiensis* Ha, 1968 and *Q. bagrae* Paperna, 1979 (see Appendix 3.3) are included. Descriptions of the 16 previously known species are not given except when necessary (see Appendices 3.2 & 3.3). The illustrations of the hard parts of all the 83 monogenean species are provided to facilitate the coding and characterisation processes (Chapter 2; Section 2.4.2). The composite illustrations of the whole worms of 19 species are also given (Figs. A1- A102). The methods of collection, preservations and examinations are already given in Chapter 2 (Section 2.3.1) and will not be discussed here.

Table A1 Codes given to monogenean species in the cluster analysis and in the descriptions

No.	Monogenean species	No. as used in analysis	No. as in description	Fish host families	Fish host species
	Ancylodiscoidinae:				
1	*Bifurcohaptor baungi*	sp. 1	A3	Bagridae	*Hemibagrus nemurus* (Hn)
2	*Bifurcohaptor* n. sp. 1	sp. 2	A11, A12		*H. nemurus*
3	*Cornudiscoides malayensis*	sp. 1	A4		*H. nemurus*
4	*Cornudiscoides selangoricus*	sp. 2	A5		*H. nemurus*
5	*Cornudiscoides sundanensis*	sp. 3	A6		*H. nemurus*
6	*Cornudiscoides anchoratus*	sp. 11	A7		*Mystus singaringan* (Ms)
7	*Cornudiscoides bagri*	sp. 12	A8		*M. singaringan*
8	*Cornudiscoides facicirrus*	sp. 13	A9		*M. singaringan*
9	*Cornudiscoides germinus*	sp. 6	A10		*M. atrifaciatus* (Ma)
10	*Cornudiscoides* n. sp. 1	sp. 4	A13, A14		*H. wyckoides* (Hy)
11	*Cornudiscoides* n. sp. 2	sp. 5	A15		*H. wyckoides*
12	*Cornudiscoides* n. sp. 3	sp. 7	A16		*M. bocourti* (Mb)
13	*Cornudiscoides* n. sp. 4	sp. 8	A17, A18		*M. gulio* (Mg)
14	*Cornudiscoides* n. sp. 5	sp. 9	A19		*M. gulio, M. wolffii* (Mw)
15	*Cornudiscoides* n. sp. 6	sp. 10	A20		*M. mysticetus* (Mm)
16	*Thaparocleidus* n. sp. 1	sp. 1	A21		*Batasio tengara* (Bt)
17	*Thaparocleidus* n. sp. 2	sp. 2	A22		*H. nemurus*
18	*Thaparocleidus* n. sp. 3	sp. 3	A23		*H. nemurus*
19	*Thaparocleidus* n. sp. 4	sp. 4	A24		*H. nemurus*
20	*Thaparocleidus* n. sp. 5	sp. 6	A25		*H. nemurus*
21	*Thaparocleidus* n. sp. 6	sp. 5	A26		*H. wyckoides*
22	*Thaparocleidus* n. sp. 7	sp. 7	A27		*H. wyckoides*
23	*Thaparocleidus* n. sp. 8	sp. 8	A28, A29		*H. wyckoides*
24	*Thaparocleidus* n. sp. 9	sp. 9	A30, A31		*H. wyckoides*
25	*Thaparocleidus* n. sp. 10	sp. 10	A32		*M. atrifasciatus*
26	*Thaparocleidus* n. sp. 11	sp. 11	A33		*M. bocourti*
27	*Thaparocleidus* n. sp. 12	sp. 12	A34		*M. mysticetus*
28	*Thaparocleidus* n. sp. 13	sp. 13	A35, A36		*M. mysticetus*
29	*Thaparocleidus* n. sp. 14	sp. 14	A37		*M. singaringan*
30	*Thaparocleidus* n. sp. 15	sp. 15	A38, A39		*Pseudomystus siamensis* (Ps)

Table A1 cont'd

No.	Monogenean species	No. as used in analysis	No. as in description	Fish host family	Fish host species
31	*Thaparocleidus caecus*	sp. 16	A51	Pangasiidae	*Pangasianodon hypophthalmus*(Ph) *Helicophagus waandersii* (Hw), *Pangasius conchophilus* (Pc), *Pangasius krempfi* (Pk), *Pangasius larnaudii* (Pl), *Pteropangasius pleurotaenia*(Pp)
32	*Thaparocleidus siamensis*	sp. 19	A52		*P. hypophthalmus*
33	*Thaparocleidus* n. sp. 16	sp. 17	A53, A54		*H. waandersii, P. conchophilus*
34	*Thaparocleidus* n. sp. 17	sp. 18	A55, A56		*H. waandersii, P. krempfi,* *Pangasius bocourti* (Pb)
35	*Thaparocleidus* n. sp. 18	sp. 20	A53, A54		*P. bocourti*
36	*Thaparocleidus* n. sp. 19	sp. 21	A58		*P. conchophilus*
37	*Thaparocleidus* n. sp. 20	sp. 22	A59, A60		
38	*Thaparocleidus* n. sp. 21	sp. 23	A61, A62		*P. krempfi*
39	*Thaparocleidus* n. sp. 22	sp. 24	A63, A64		*P. larnaudii*
40	*Thaparocleidus* n. sp. 23	sp. 25	A65, A66		*P. larnaudii*
41	*Thaparocleidus* n. sp. 24	sp. 26	A67		*P. larnaudii*
42	*Thaparocleidus* n. sp. 25	sp. 27	A68		*P. larnaudii*
43	*Thaparocleidus* n. sp. 26	sp. 28	A69		*P. sanitwongse* iPs), *P. larnaudii*
44	*Thaparocleidus* n. sp. 27	sp. 29	A70		*Pangasius macronema* (Pm), *P. pleurotaenia*
45	*Thaparocleidus* n. sp. 28	sp. 30	A71		*P. macronema, P. pleurotaenia*
46	*Thaparocleidus* n. sp. 29	sp. 31	A72		*P. macronema, P. pleurotaenia*
47	*Thaparocleidus* n. sp. 30	sp. 32	A73		*P. macronema*
48	*Thaparocleidus* n. sp. 31	sp. 33	A74		*P. pleurotaenia*
49	*Thaparocleidus* n. sp. 32	sp. 34	A75		*P. pleurotaenia*
50	*Thaparocleidus* n. sp. 33	sp. 35	A76	Schilbeidae	*Laides hexanema* (Lh)
51	*Thaparocleidus* n. sp. 34	sp. 36	A77		*L. hexanema*
52	*Thaparocleidus indicus*	sp. 53	A79	Siluridae	*W. attu*
53	*Thaparocleidus kao*	sp. 54	A80		*W. attu*
54	*Thaparocleidus* n. sp. 35	sp. 37	A81, A82		*Belodontichthys dinema* (Bd)
55	*Thaparocleidus* n. sp. 36	sp. 38	A83, A84		*B. dinema*
56	*Thaparocleidus* n. sp. 37	sp. 39	A85		*Hemisilurus mekongensis* (Hm)
57	*Thaparocleidus* n. sp. 38	sp. 40	A86		*H. mekongensis*

Table A1 cont'd

No.	Monogenean species	No. as used in analysis	No. as in description	Fish host families	Fish host species
58	*Thaparocleidus* n. sp. 39	sp. 41	A87	Siluridae	*Kryptopterus apogon* (Ka), *K. bleekeri* (Kl)
59	*Thaparocleidus* n. sp. 40	sp. 42	A88		*K. apogon, K. bleekeri*
60	*Thaparocleidus* n. sp. 41	sp. 43	A89		*K. bicirrhis* (Kb)
61	*Thaparocleidus* n. sp. 42	sp. 44	A90		*K. cryptopterus* (Kc), *K.bicirrhis*
62	*Thaparocleidus* n. sp. 43	sp. 45	A91		*K. cryptoptersus*
63	*Thaparocleidus* n. sp. 44	sp. 46	A92		*K. bleekeri, K. cryptoptersus*
64	*Thaparocleidus* n. sp. 45	sp. 47	A93		*K. bleekeri*
65	*Thaparocleidus* n. sp. 46	sp. 48	A94		*Ompok bimaculatus* (Ob)
66	*Thaparocleidus* n. sp. 47	sp. 49	A95		*O. bimaculatus*
67	*Thaparocleidus* n. sp. 48	sp. 50	A96, A97		*O. bimaculatus*
68	*Thaparocleidus* n. sp. 49	sp. 51	A98, A99		*O. bimaculatus*
69	*Thaparocleidus* n. sp. 50	sp. 52	A100		*Silurichthys* sp. (Ss)
70	*Thaparocleidus* n. sp. 51	sp. 55	A102	Sisoridae	*Bagarius bagarius* (Bb)
	Ancyrocephalinae:				
1	*Hamatopeduncularia longicopulatrix*	sp. 1	A1	Ariidae	*Hemipimelodus borneensis* (Hb)
2	*Hamatopeduncularia* n. sp. 1	sp. 2	A2		*H. borneensis*
3	*Bychowskyella tchangi*	sp. 1	A40	Heteropneustidae	*Heteropneustes fossilis* (Hf)
				Clariidae	*Clarias batrachus* (Cb)
					C. macrocephalus (Cm)
4	*Bychowskyella teysmanni*	sp. 3	A41		*C. meladerma* (Ce)
5	*Bychowskyella* n. sp. 1	sp. 2	A45		*C. batrachus*
6	*Bychowskyella* n. sp. 2	sp. 4	A46		*C. meladerma*
7	*Bychowskyella* n. sp. 3	sp. 5	A47, A48		*C. nieuhofi* (Cn)
8	*Bychowskyella* n. sp. 4	sp. 6	A49		*C. nieuhofi*
9	*Bychowskyella* n. sp. 5	sp. 7	A50		*C. nieuhofi*
10	*Quadriacanthus kobiensis*	sp. 1	A42, A43		*C. batrachus, C. cataractus*(Cc) *C. macrocephalus, C. meladerma*
11	*Quadriacanthus bagrae*	sp. 2	A44		*C. gariepinus* (Cg), *Clarias* hybrid (Ch)
12	*Mizelleus siamensis*	sp. 1	A78	Siluridae	*Wallago attu* (Wa)
13	*Bychowskyella* n. sp. 6	sp. 8	A101	Sisoridae	*Glyptothorax major* (Gm)

Appendix 3.1: Monogeneans of Ariidae

Introduction

Hemipimelodus Bleeker, 1858 is the only true freshwater ariid genus in Thailand. There are four species of *Hemipimelodus*; *Hemipimelodus borneensis* (Bleeker, 1851), *Hemipimelodus bicolor* Fowler, 1935, *Hemipimelodus intermedius* Vinciguerra, 1880 and *Hemipimelodus siamensis* Sauvage, 1987 in Thailand (see Kottelat, 1989). However in this study only *H. borneensis* (Bleeker, 1851) was collected and examined for monogeneans.

Currently the Ariidae are hosts to 20 species of *Hamatopeduncularia*, 21 species of *Chauhanellus* Bychowsky & Nagibina, 1969, one species of *Neocalceostoma* Tripathi, 1957 and five species of *Neocalceostomoides* Kritsky, Mizelle & Bilqees, 1978 (see Kearn & Whittington, 1994; Lim, 1994, 1995a, 1996a; Whittington & Kearn, 1995). *Hamatopeduncularia* and *Chauhanellus* were recorded on the ariids from the Indian Ocean to the Pacific Ocean (Africa, India, Southeast Asia, China and Australia), while *Neocalceostoma* and *Neocalceostomoides* were thus far recorded from the ariids of India, Peninsular Malaysia and Australia (see Lim, 1994, 1995a, 1996a; Whittington & Kearn, 1995).

Hamatopeduncularia and *Chauhanellus* have been reported from the freshwater as well as marine ariids in Australia (Kearn & Whittington, 1994). The Australian freshwater ariids are, however, not true freshwater ariid species.

Results

Two species of *Hamatopeduncularia* Yamaguti, 1953 (*Hamatopeduncularia longicopulatrix* Lim, 1996 and a new species) were found on *Hemipimelodus borneensis* (Bleeker, 1851).

1. *Hamatopeduncularia longicopulatrix* Lim, 1996 (Fig. A1)

Type host: *Arius venosus* (Valenciennes, 1840)
Type locality: Perak, Peninsular Malaysia
Present host: *Hemipimelodus borneensis* (Bleeker, 1851) (5 individuals examined, one infected)
Locality: Jatujak fish market, Bangkok
No. of monogenean specimens collected and studied: 2

Remark: *Hamatopeduncularia longicopulatrix* Lim, 1996 was first described from the brackish water ariid, *Arius venosus* from Matang, Perak in Peninsular Malaysia.

2. *Hamatopeduncularia* n. sp. 1 (Fig. A2)

Type host: *Hemipimelodus borneensis* (Bleeker, 1851) (5 individuals examined, 4 infected)
Type locality: Jatujak fish market, Bangkok
No. of monogenean specimens collected and studied: 12
No. of monogenean specimens measured: 7

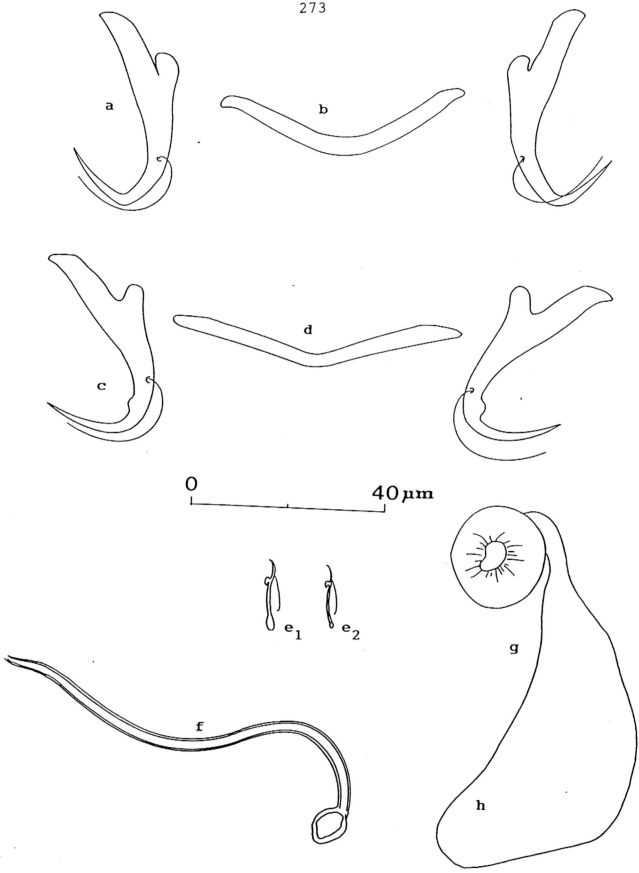


Fig. A1. Hard parts of *Hamatopeduncularia longicopulatrix* Lim, 1996: a, dorsal anchor; b, dorsal bar; c, ventral anchor; d, ventral bar, e_1, marginal hook; e_2, hook near ventral anchor; f, copulatory tube; g, vaginal opening; h, seminal receptacle. Scale-bar in micrometres

Appendix 3.2: Monogeneans of Bagridae

Introduction

There are 25 species of bagrids belonging to eight genera in Thailand; *Aorichthys* Wu, 1939 (one species), *Bagrichthys* Bleeker, 1858 (two species), *Bagroides* Bleeker, 1851 (one species), *Batasio* Blyth, 1860 (one species), *Hemibagrus* Bleeker, 1862, (five species), *Mystus* Scopoli (11 species), *Leiocassis* Bleeker, 1858 (one species) and *Pseudomystus* Jayaram, 1968 (three species) (see Smith, 1945; Mo, 1991; Roberts, 1992a, 1994).

In this study, only 12 species of bagrids were examined. The 12 species examined were *Bagrichthys macropterus* (Bleeker, 1853), *Batasio tengara* (Hamilton-Buchanan, 1822), *Hemibagrus nemurus* (Val. in Cuv. & Val., 1839), *Hemibagrus wyckii* (Bleeker, 1858), *Hemibagrus wyckoides* (Chaux & Fang, 1949), *Mystus atrifasciatus* Fowler, 1937, *Mystus bocourti* (Bleeker, 1864), *Mystus gulio* (Hamilton, 1822), *Mystus mysticetus* Roberts, 1992, *Mystus singaringan* (Bleeker, 1846), *Mystus wolffii* (Bleeker, 1851) and *Pseudomystus siamensis* (Regan, 1913). Except for *H. wyckii* and *B. macropterus*, the other ten bagrid species were found to be infected with monogeneans.

Presently, 37 species of monogeneans have been recorded from 16 bagrid species (six genera) in the Oriental region. The 37 monogenean species include 14 species of *Cornudiscoides* Kulkarni, 1969, nine species of *Thaparocleidus* Jain, 1952, five species of *Ancylodiscoides* Yamaguti, 1937, four species of *Bifurcohaptor* Jain, 1958, three species of *Bychowskyella* Achmerow, 1952, one species of *Hamatopeduncularia* Yamaguti, 1953 and one species of *Gyrodactylus* Nordman, 1832 (Table A2).

Only five monogenean species were recorded from three bagrid species in the Palearctic region; one species of *Pseudancylodiscoides* Yamaguti, 1963, three species of *Thaparocleidus* and one species of *Bychowskyella* (Table A2).

The African *Bagrus*, on the other hand, was found to possess two species of *Quadriacanthus* Paperna, 1961 (Table A2). *Bagrobdella* Paperna, 1969 and *Protoancylodiscoides* Paperna, 1969 were recorded from *Auchenoglanis* species and *Chrysichthys* species, respectively (see Paperna, 1969; Euzet & Le Brun, 1990 & see Appendix 1). However, *Auchenoglanis* and *Chrysichthys* which were formerly in the family Bagridae were recently reassigned by Mo (1991) into the family Claroteidae. If these reassignments are accepted then the two monogenean genera (*Bagrobdella* and *Protoancylodiscoides*) have to be removed from the list of monogeneans infecting the Bagridae. In this study Mo's classification is accepted, hence the two genera are not included in Table A2.

Results

In this study 30 monogenean species belonging to three genera of Ancylodiscoidinae were obtained from ten of the 12 bagrid species examined. The three monogenean genera are *Bifurcohaptor* Jain, 1958, *Cornudiscoides* Kulkarni, 1969 and *Thaparocleidus* Jain, 1952, with two, 13 and 15 species, respectively.

3. *Cornudiscoides selangoricus* Lim, 1987 (Fig. A5)

Type host: *Hemibagrus nemurus* (Val. in Cuv. & Val., 1839)
Type locality: Selangor, Peninsular Malaysia
Present host: *Hemibagrus nemurus* (42 individuals examined, 15 infected from sites 1, 4, 8, 10 & 11)
Localities: Cha-uad district, Nakornsithammarat (site 1); Nakornsithammarat Campus (RIT), Nakornsithammarat (site 2); Trang River, Trang (site 3); Muang district, Pattanee (site 4); Srinakarin Reservoir, Kanchanaburi (site 5); Kanchanaburi Freshwater Fishery Development Center, Kanchanaburi (site 6); Ayudthaya Campus (RIT) (site 7), Chao-praya River, Chinat (site 8); Ping River, Tak (site 9); Mun River, Ubonratchathanee (site 10); Ubonratana Reservoir, Khon-kean (site 11)
No. of monogenean specimens collected and studied: 36

Remark: *Cornudiscoides selangoricus* was first described from Malaysian *Hemibagrus nemurus* (see Lim, 1987b) and presently recorded on *H. nemurus* in Thailand.

4. *Cornudiscoides sundanensis* Lim, 1987 (Fig. A6)

Type host: *Hemibagrus nemurus* (Val. in Cuv. & Val., 1839)
Type locality: Pahang, Peninsular Malaysia
Present host: *Hemibagrus nemurus* (42 individuals examined, 14 infected from sites 1, 4, 8, 10 & 11)
Localities: Cha-uad district, Nakornsithammarat (site 1); Nakornsithammarat Campus (RIT), Nakornsithammarat (site 2); Trang River, Trang (site 3); Muang district, Pattanee (site 4); Srinakarin Reservoir, Kanchanaburi (site 5); Kanchanaburi Freshwater Fishery Development Center, Kanchanaburi (site 6); Ayudthaya Campus (RIT) (site 7), Chao-praya River, Chinat (site 8); Ping River, Tak (site 9); Mun River, Ubonratchathanee (site 10); Ubonratana Reservoir, Khon-kean (site 11)
No. of monogenean specimens collected and studied: 51

Remark: *Cornudiscoides sundanensis* Lim, 1987 was first described from *Hemibagrus nemurus* in Peninsular Malaysia (Lim, 1987b). This species was also found on Thai *H. nemurus* in this study.

5. *Cornudiscoides anchoratus* Lim, 1987 (Fig. A7)

Type host: *Mystus nigriceps* (Val. in Cuv. & Val., 1839)
Type locality: Pahang, Peninsular Malaysia
Present host: *Mystus singaringan* (Bleeker, 1846) (9 individuals examined, 8 infected from sites 1, 2, 3, 4 & 5)
Localities: Ubonratana Reservoir, Khon-kean (site 1); Chao-praya River, Chinat (site 2); Muang district, Pattanee (site 3), Mun River, Ubonratchathanee (site 4), Khog-kram subdistrict, Nakornsithammarat (site 5)

Body size 336 (320-620) x 84 (67-112). Four eye spots, posterior pair larger. Haptor size 67 (62-84) x 117 (84-156). Dorsal anchors: inner length 40 (38-41); outer length 34 (33-34); inner root 12 (11-13); stumpy outer root; recurved point 26 (24-27). Knee-shaped patches, size 10 (10-11) x 4 (4-5). Ventral anchors: sickle shaped inner length 18 (17-19); outer length 20 (19-20); inner root 5 (5-6); outer root 4 (4-5); long open point, with recurved in the ends 20 (19-21). Dorsal bar broad V-shaped widening at both ends, size 26 (25-28) x 3 (3-4). Ventral bar paired, tapering and curving at the distal part, size 36 (34-37) x 4 (4-5). Seven pairs of marginal hooks, 2 types: 6 pairs larval type, length 12 (12-13); one modified long pair near ventral anchors, length 26 (26-28).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long, thin blind seminal vesicle. Copulatory organ consists of S-shaped copulatory tube, length along the tube 30 (28-33) and clipper-like accessory piece, size 17 (16-22) x 6 (5-6). Vaginal opening sinistral, lightly sclerotised.

Remark: The present species is similar to *Cornudiscoides jaini* (Gussev, 1963) Gussev, 1976 from *Mystus keletius*, *Cornudiscoides proximus* Gussev, 1976 and *C. germinus* Gussev, 1976 from *M. vittatus* in the morphologies of anchors and connective bars. However comparing the morphometric data of the present species with the morphometric data of these three known species, this present species is identified as *C. germinus* although the points of the ventral anchors of the present specimens are more recurved compared to the original description of *C. germinus*.

9. *Bifurcohaptor* n. sp. 1 (Figs. A11 & A12)

Type host: *Hemibagrus nemurus* (Val. in Cuv. & Val., 1839) (42 individuals examined, 2 infected from sites 1 & 4)

Localities: Trang River, Trang (type locality) (site 1); Cha-uad district, Nakornsithammarat (site 2); Nakornsithammarat Campus (RIT), Nakornsithammarat (site 3); Muang district, Pattanee (site 4); Srinakarin Reservoir, Kanchanaburi (site 5); Kanchanaburi Freshwater fishery Development Center, Kanchanaburi (site 6); Ayudthaya Campus (RIT) (site 7), Chao-praya River, Chinat (site 8); Ping River, Tak (site 9); Mun River, Ubonratchathanee (site 10); Ubonratana Reservoir, Khon-kean (site 11)

No. of monogenean specimens collected and studied: 6

No. of monogenean specimens measured: 4

Body size 861 (714-1008) x 130 (109-150). Four eye spots. Haptor bifurcated, size 210 (205-215) x 168 (162-174). *Bifurcohaptor*-type dorsal anchors: along each of bifurcated haptor, total length 150 (146-156), short recurved point 34 (32-36). Patches, rectangular, size 15 (14-36) x 4. Ventral anchors: situate on each side of haptor, inner length 27 (24-30); outer length 27 (24-30); inner root 13 (12-14); outer root 2; recurved point 22 (20-24). Dorsal bar solid square, ventral side concave, size 16 (15-16) x 40 (39-41). Ventral bars paired, situates along the dorsal anchors, size 68 (66-70) x 2 (1-2). Seven pairs of marginal hooks, same shape, length 18 (17-19).

11. *Cornudiscoides* n. sp. 2 (Fig. A15)

Type host: *Hemibagrus wyckoides* (Chaux & Fang, 1949) (12 individuals examined, 3 infected from sites 1 & 5)
Localities: Mun River, Ubonratchathanee (type locality) (site 1), Me-kong River, Ubonratchathanee (site 2); Ubonratana Reservoir, Khon-kean (site 3); Ping River, Tak (site 4); Srinakarin Reservoir, Kanchanaburi (site 5); Rajjaprabha Reservoir, Surat-thani (site 6)
No. of monogenean specimens collected and studied: 24
No. of monogenean specimens measured: 8

Body size 700 (546-883) x 98 (67-126). Four eye spots, posterior pair larger. Haptor size 122 (84-210) x 202 (168-252). Dorsal anchors: inner length 41 (40-44); outer length 32 (30-36); inner root 10 (8-11); stumpy outer root; recurved point 25 (24-26). Patches with spinous tip, size 16 (16-18) x 6 (6-7). Ventral anchors: inner length 20 (20-21); outer length 19 (18-20); inner length 10 (8-12); outer root 4 (2-4); recurved point 15 (14-16). Dorsal bar bone-shaped, size 35 (32-38) x 4 (3-4). Ventral bar curved paired, size 38 (36-40) x 2 (1-2), connected with long, thin ligament. Seven pairs of marginal hooks, 2 types: 6 pairs, larval type, length 12 (11-12); one modified long pair near ventral anchors, length 57 (56-58).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of long straight copulatory tube, length 42 (40-44) and flat, plate-like accessory piece, size 12 (12-16) x 5 (4-6). Vaginal opening sinistral, connected to round seminal receptacle with long vaginal tube, length 24 (20-29).

Differential diagnosis: The present species is similar to *Cornudiscoides* n. sp. 1, in the morphology of sclerotised parts of the haptor except in terms of size. The present species possesses a long modified marginal hook which is twice the length of the corresponding marginal hook in *Cornudiscoides* n. sp. 1 and the dorsal anchor of the present species is smaller than that of *Cornudiscoides* n. sp. 1. The present species is also different from *Cornudiscoides* n. sp. 1 in having a flat, plate-like accessory piece, while that of *Cornudiscoides* n. sp.1 is grooved pipe-like. This species is also different from the other known *Cornudiscoides* species in the morphology of copulatory organ. It is thus a new species and identified as *Cornudiscoides* n. sp. 2.

12. *Cornudiscoides* n. sp. 3 (Fig. A16)

Type host: *Mystus bocourti* (Bleeker, 1864) (5 individuals examined, 3 infected from sites 1 & 2)
Localities: Pink River, Tak (type locality) (site 1); Chao-praya River, Chinat (site 2)
No. of monogenean specimens collected and studied: 14
No. of monogenean specimens measured: 6

Body size 670 (590-758) x 101 (84-118). Four eye spots, posterior pair larger. Haptor size 101 (76-158) x 168 (134-186). Dorsal anchors: inner length

present species is dumbbell-shaped, while that of *C. anchoratus* is spindle-shaped. Accessory piece of the present species is grooved pipe-like, while that of *C. anchoratus* is clipper-like. This species is also different from the other known *Cornudiscoides* species in the morphology of dorsal bar. It is thus a new species and identified as *Cornudiscoides* n. sp. 4 in this study.

14. *Cornudiscoides* n. sp. 5 (Fig. A19)

Type host: *Mystus gulio* (Hamilton, 1822) (3 individuals examined, 3 infected, 14 monogeneans collected from site 1)
Other hosts: *Mystus wolffi* (Bleeker, 1851) (3 examined, 3 infected, 64 monogeneans collected from sites 1, 2 & 3)
Localities: Cha-uad district, Nakornsithammarat (type locality) (site 1), Chao-praya River, Chinat (site 2), Rajjaprabha Reservoir, Surat-thani (site 3)
No. of monogenean specimens collected and studied: 78
No. of monogenean specimens measured: 7

Body size 759 (588-117) x 117 (92-109). Four eye spots, posterior pair larger. Haptor size 131 (93-210) x 160 (59-135). Dorsal anchors: inner length 49 (46-50); outer length 42 (38-44); inner root; 9 (8-10); stumpy outer root; recurved point 28 (26-30). Patches knee-shaped, size 16 (14-18) x 5 (4-6). Ventral anchors: inner length 24 (22-26); outer length 22 (20-22); inner root 12 (10-12); outer root 2; recurved point 23 (22-24). Dorsal bar slightly V-shaped, size 32 (28-34) x 4. Ventral bars paired, widening at mainpart, with spine at the middle of inner side, size of one side 43 (40-46) x 6 (5-6). Seven pairs of marginal hooks, 2 types: 6 pairs, larval type, length 12 (12-14); one modified long pair near ventral anchors, length 37 (34-38).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long, thin blind seminal vesicle. Copulatory organ consists of undulated copulatory tube, length 38 (32-42) and tubular or grooved accessory piece, size 33 (30-34) x 3. Vaginal opening sinistral, sclerotised funnel-like, connected to seminal receptacle with long twisted vaginal tube.

Differential diagnosis: The present species is different from the other known *Cornudiscoides* species in having curved ventral bar with spine at the middle of inner side, a sinuous copulatory tube and a long vaginal tube. It is thus a new species and identified as *Cornudiscoides* n. sp. 5 in this study.

15. *Cornudiscoides* n. sp. 6 (Fig. A20)

Type host: *Mystus mysticetus* Roberts, 1992 (one individual examined, one infected)
Type locality: NIFI Aquarium, Bangkok
No. of monogenean specimens collected and studied: 100
No. of monogenean specimens measured: 6

Body size 586 (487-672) x 106 (67-162). Four eye spots, posterior pair larger. Haptor size 123 (76-168) x 163 (126-168). Dorsal anchors: inner length 39 (36-44); outer length 28 (26-30); long inner root 13 (10-16), stumpy outer root;

to its small body size. Hence this species is considered a new species and identified as *Thaparocleidus* n. sp. 1 in this thesis.

17. *Thaparocleidus* n. sp. 2 (Fig. A22)

Type host: *Hemibagrus nemurus* (Val. in Cuv. & Val., 1839) (43 individuals examined, 24 infected from sites 1, 2, 4, 5, 6, 8, 9 & 10)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Cha-uad district, Nakornsithammarat (site 2); Nakornsithammarat Campus (RIT), Nakornsithammarat (site 3); Muang district, Pattanee (site 4); Srinakarin Reservoir, Kanchanaburi (site 5); Kanchanaburi Freshwater Fishery Development Center, Kanchanaburi (site 6); Ayudthaya Campus (RIT) (site 7), Chao-praya River, Chinat (site 8); Ping River, Tak (site 9); Ubonratana Reservoir, Khon-kean (site 10); Trang River, Trang (site 11).
No. of monogenean specimens collected and studied: 121
No. of monogenean specimens measured: 8

Body size 450 (352-630) x 75 (67-109). Four eye spots. Haptor size 59 (50-67) x 84 (67-101). Dorsal anchors: without root, total length 48 (46-49); short recurved point 12 (11-13). Patches knee-shaped, size 20 (19-22) x 6 (5-7). Ventral anchors: inner length 22 (21-24); outer length 18 (18-19); inner root 8 (7-8); outer root 2; recurved point 22 (20-22). Dorsal bar straight with knob-like at both ends, size 4 (4-5) x 38 (36-38). Ventral bar V-shaped, size of one side 26 (26-28) x 4 (3-4). Seven pairs of marginal hooks, same shape, length 16 (15-16).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long, thin blind seminal vesicle. Copulatory organ consists of long, curved copulatory tube and grooved stick-like accessory piece, size 18 (18-20) x 4 (4-5). Vaginal opening not observed.

Differential diagnosis: The present species is different from the other two new *Thaparocleidus* species from *Hemibagrus nemurus* in the morphologies of dorsal anchors and patches. The dorsal anchors of the present species is without roots and have short gently recurved point with large knee-shaped patches. This species is also different from other known *Thaparocleidus* species in the morphologies of dorsal anchors and patches. This species is thus considered a new species and named *Thaparocleidus* n. sp. 2.

18. *Thaparocleidus* n. sp.. 3 (Fig. A23)

Type host: *Hemibagrus nemurus* (Val. in Cuv. & Val., 1839) (43 individuals examined, 24 infected from sites 1, 2, 3, 4, 5, 6, 8, 9, & 10)
Localities: Trang River, Trang (type locality) (site 1); Cha-uad district, Nakornsithammarat (site 2); Nakornsithammarat Campus (RIT), Nakornsithammarat (site 3); Muang district, Pattanee (site 4); Srinakarin Reservoir, Kanchanaburi (site 5); Kanchanaburi Freshwater Fishery Development Center, Kanchanaburi (site 6); Ayudthaya Campus (RIT) (site 7), Chao-praya River, Chinat (site 8); Ping River, Tak (site 9); Mun River, Ubonratchathanee (site 10); Ubonratana Reservoir, Khon-kean (site 11)

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long, thin blind seminal vesicle. Copulatory organ consists of curved copulatory tube, length 45 (41-50) with flower-like initial part, diameter 4 and curved, grooved accessory piece, size 30 (28-34) x 4 (4-5). Vaginal opening not observed.

Differential diagnosis: The present species is the most abundant monogenean species on Thai *Hemibagrus nemurus* (see Table 4.1). The present species differs from the other two new species of *Thaparocleidus* from the same host species in having paired ventral bars and a curved copulatory tube with flower-like initial part. This species is also different from the other known *Thaparocleidus* species in the morphologies of ventral bar and copulatory organ. The present species is considered a new species and identified as *Thaparocleidus* n. sp. 4.

20. *Thaparocleidus* n. sp. 5 (Fig. A25)

Type host: *Hemibagrus wyckoides* (Chaux & Fang, 1949) (12 individuals examined, 10 infected from sites 1,2,3 & 4)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanee (site 2); Ping River, Tak (site 3); Srinakarin Reservoir, Kanchanaburi (site 4); Ubonratana Reservoir, Khon-kean (site 5); Rajjaprabha Reservoir, Surat-thani (site 6)
No. of monogenean specimens collected and studied: 159
No. of monogenean specimens measured: 12

Body size 462 (336-554) x 81 (67-92). Four eye spots, posterior pair larger. Haptor size 77 (67-101) x 103 (67-151). Dorsal anchors: inner length 35 (34-36); outer length 30 (28-32); inner root 6 (4-8); stumpy outer root; recurved point 16 (14-18). Patches, size 11 (10-12) x 4 (3-4). Ventral anchors: inner length 19 (19-20); outer length 18 (16-19); inner root 2 (2-4); outer root 2 (2-4); recurved point 12 (12-14). Dorsal bar slightly V-shaped, size 25 (24-27) x 3 (2-4). Ventral bar V-shaped, size of one side 25 (23-28) x 2. Seven pairs of marginal hooks, 2 types, same length 12 (11-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long, thin, blind seminal vesicle. Copulatory organ consists of short curved copulatory tube, length 20 (18-24) and small clipper-like accessory piece, size 10 (8-12) x 8 (6-8). Prostatic reservoir small, enters separately into initial part of copulatory tube. Vaginal opening sinistral, funnel-like.

Differential diagnosis: The haptoral armaments of the present species is similar to that of *Thaparocleidus pusillus* (Gussev, 1976) Lim, 1996 from *Mystus vittatus* (see Gussev, 1976), but the morphology of copulatory organ of these two species are different. The present species possesses a short curved copulatory tube and a small clipper-like accessory piece, but *T. pusillus* possesses a long curved copulatory tube with S-shaped plate-like accessory piece. This species is also different from other known *Thaparocleidus* species in the morphology of copulatory organ. It is thus a new species and is identified as *Thaparocleidus* n. sp. 5.

21. *Thaparocleidus* n. sp. 6 (Fig. A26)

Type host: *Hemibagrus wyckoides* (Chaux & Fang, 1949) (12 individuals examined, 5 infected from sites 1, 2, 3 & 4)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanee (site 2); Ping River, Tak (site 3); Srinakarin Reservoir, Kanchanaburi (site 4); Ubonratana Reservoir, Khon-kean (site 5); Rajjaprabha Reservoir, Surat-thani (site 6)
No. of monogenean specimens collected and studied: 18
No. of monogenean specimens measured: 8

Body size 675 (563-756) x 98 (84-118). Four eye spots, posterior pair larger. Haptor size 111 (56-168) x 168 (134-210). Dorsal anchors: inner length 37 (35-38); outer length 31 (30-34); inner root 8 (6-8); stumpy outer root; recurved point 18 (18-20). Triangular patches, size 15 (12-16) x 2. Ventral anchors: inner length 20 (20-21); outer length 20 (20-21); inner root 4; outer root 3 (2-4); recurved point 14 (12-15). Dorsal bar broad V-shaped, size 29 (28-31) x 5 (4-6). Ventral bar V-shaped, size of one side 20 (20-22) x 3 (2-4). Seven pairs of marginal hooks, 2 types, same length 12 (10-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of spring-like copulatory tube (3 coils) and grooved accessory piece, size 12 (22-24) x 5 (4-6). Vaginal opening midbody slightly to right side, connected to ovoid seminal receptacle with long vaginal tube, length 26 (23-28).

Differential diagnosis: The present species is different from the previously described *Thaparocleidus* species from the Bagridae in having a coiled copulatory tube (3 coils). Although coiled copulatory tube (2-3 coils) is observed in *Thaparocleidus malabaricus* Gussev, 1976 from *Ompok malabaricus* (Siluridae) in India (see Gussev, 1976), but the two species differ in their accessory piece and ventral bar. The present species possesses a curved grooved-like accessory piece of copulatory organ and V-shaped ventral bar, while *T. malabaricus* has a clipper-like accessory piece and paired ventral bars. The present species also differs from *Thaparocleidus kao* Lim & Lersutthichawal, 1996 from *Wallago attu* (Siluridae) in the morphology of accessory piece (see Lim & Lerssutthichawal, 1996: Appendix 3.8). The present species is thus a new species and identified as *Thaparocleidus* n. sp. 6 in this study.

22. *Thaparocleidus* n. sp. 7 (Fig. A27)

Type host: *Hemibagrus wyckoides* (Chaux & Fang, 1949) (12 individuals examined, 8 infected from sites 1,2,3 & 4)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanee (site 2); Ping River, Tak (site 3); Srinakarin Reservoir, Kanchanaburi (site 4); Ubonratana Reservoir, Khon-kean (site 5); Rajjaprabha Reservoir, Surat-thani (site 6)
No. of monogenean specimens collected and studied: 91
No. of monogenean specimens measured: 10

Body size 606 (378-756) x 90 (76-118). Four eye spots, posterior pairs larger. Haptor size 92 (59-151) x 145 (84-210). Dorsal anchors: inner length 35 (32-36); outer length 26 (24-28); inner root 10 (8-10); stumpy outer root; recurved point 17 (16-18). Small triangular patches, size 5 (4-6) x 2 (2-3). Ventral anchors: inner length 20 (19-21); outer length 18 (18-19); inner root 4 (3-4); outer root 2; recurved point 14 (13-14). Dorsal bar slightly V-shaped, size 27 (25-30) x 4 (3-4). Ventral bar V-shaped, size of one side 22 (20-24) x 3 (2-4). Seven pairs of marginal hooks, 2 types, same length 12 (10-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long, thin, blind seminal vesicle. Copulatory organ consists of flat, coiled copulotory tube (2 coils) and small stick-like accessory piece, size 13 (12-14) x 2. Vaginal opening midbody slightly to right side, connected to ovoid seminal receptacle with long vaginal tube, length 77 (64-106).

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 6 in having similar morphology of haptoral armaments, but differs from it in having a flat, coiled copulatoy tube (with 2 coils) and a small stick-like accessory piece. *Thaparocleidus* n. sp. 6 on the other hand possesses a spring-like copulatory tube (with 3 coils) and a grooved accessory piece. This species is considered a new species and identified as *Thaparocleidus* n. sp. 7.

23. *Thaparocleidus* n. sp. 8 (Figs. A28 & A29)

Type host: *Hemibagrus wyckoides* (Chaux & Fang, 1949) (12 individuals examined, 8 infected from sites 1, 2, 3 & 4)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanee (site 2); Ping River, Tak (site 3); Srinakarin Reservoir, Kanchanaburi (site 4); Ubonratana Reservoir, Khon-kean (site 5); Rajjaprabha Reservoir, Surat-thani (site 6)
No. of monogenean specimens collected and studied: 115
No. of monogenean specimens measured: 10

Body size 738 (630-840) x 101 (76-126). Four eye spots, posterior pair larger. Haptor size 98 (84-126) x 129 (101-168). Dorsal anchors: inner length 40 (38-42); outer length 35 (33-38); inner root 7 (6-8); stumpy outer root; recurved point 21 (18-22). Boot-like patches, size 12 (10-13) x 4 (4-5). Ventral anchors: inner length 22 (20-24); outer length 7 (16-18); inner root 8 (8-10); outer root 2 (2-3); recurved point 16 12-18). Dorsal bar slightly V-shaped, size 33 (32-34) x 4 (3-5). Ventral bar V-shaped, size of one side 27 (26-30) x 2 (2-3). Seven pairs of marginal hooks, 2 types, length 12 (11-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long, thin, blind seminal vesicle. Copulatory organ consists of long folded copulatory tube (2 folds) and clipper-like accessory piece, size 16 (10-20) x 10 (8-14). Prostatic reservoir ovoid, enters separately into initial part of copulatory tube. Vaginal opening sinistral, globulate, connected to ovoid seminal receptacle with long vaginal tube, length 64 (60-72).

Differential diagnosis: The present species is different from the other four new *Thaparocleidus* species from *Hemibagrus wyckoides* in having a dorsal anchor with short inner root, boot-like patch and long curved (folded) copulatory tube. This species is also different from the previously described *Thaparocleidus* species in having a long curve(folded) copulatory tube. The present species, hence is considered a new species and identified as *Thaparocleidus* n. sp. 8.

24. *Thaparocleidus* n. sp. 9 (Fig. A30 & A31)

Type host: *Hemibagrus wyckoides* (Chaux & Fang, 1949) (12 individuals examined, 10 infected from sites 1, 2, 3 & 4)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanee (site 2); Ping River, Tak (site 3); Srinakarin Reservoir, Kanchanaburi (site 4); Ubonratana Reservoir, Khon-kean (site 5); Rajjaprabha Reservoir, Surat-thani (site 6)
No. of monogenean specimens collected and studied: 101
No. of monogenean specimens measured: 10

Body size 774 (378-1016) x 96 (67-126). Four eye spots, posterior pair larger. Haptor size 114 (84-168) x 122 (101-16051). Dorsal anchors: with inconspicuous roots, total length 68 60-76), distal shaft sinuous, short recurved point 8 (6-10). Long curved patch, size 27 (22-32) x 6 (4-8). Ventral anchors: inner length 26 (25-27); outer length (20-24); inner root 9 (8-10); outer root 4 (4-6); recurved point 17 (16-20). Dorsal bar broad V-shaped, broader at both ends, size 38 (34-40) x 7 (6-8). Ventral bar V-shaped, size of one side 37 (32-42) x 4. Seven pairs of marginal hooks, 2 types, same length 12 (10-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long, thin, blind seminal vesicle. Copulaory organ consists of curved copulotory tube, length 62 (54-74) and clipper-like accessory piece, size 29 (22-37) x 11 (8-14). Sclerotised vaginal opening sinistral, funnel-like, diameter 4, connected to seminal receptacle with long vaginal tube; length 63 (62-64).

Differential diagnosis: The present species is different from the other known *Thaparocleidus* species from the bagrid hosts in having dorsal anchor with inconspicuous roots and sinuous shaft in the dorsal anchor. This species is considered a new species and named *Thaparocleidus* n. sp. 8.

25. *Thaparocleidus* n. sp. 10 (Fig. A32)

Type host: *Mystus atrifasciatus* Fowler, 1937 (4 individuals examined, 3 infected from sites 1 & 2)
Localities: Mun River, Ubonratchathanee (type locality) (site 1), Ubonratana Reservoir, Khon-kean (site 2)
No. of monogenean specimens collected and studied: 23
No. of monogenean specimens measured: 6

Body size 378 (336-420) x 59 (50-67). Four eye spots. Haptor size 53 (42-59) x 61 (58-67). Dorsal anchors: inner length 30 (31-34); outer length 24 (22-27); inner root 8 (8-9); stumpy outer root; recurved point 12 (12-13). Small triangular patches, size 8 (7-10) x 3. Ventral anchors: inner length 17 (16-18); outer length 16 (15-17; inner root 4 (3-5); outer root 2; recurved point 8 (8-9). Dorsal bar slightly V-shaped, size 22 (21-23) x 2 (2-3). Ventral bar V-shaped, size of one side 25 (24-26) x 2. Seven pairs of marginal hooks, same length 11 (11-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of coiled copulatory tube (2-3 coils) and long grooved accessory piece, size 21 (19-24) x 2. Vaginal opening sinistral, connected to small round seminal receptacle with long curved vaginal tube.

Differential diagnosis: The present species is similar to *Thaparocleidus pusillus* (Gussev, 1976) Lim, 1996 from Indian *Mystus vittatus* in having similar types of haptoral armaments and vaginal armaments, but differs from it in the morphology of copulatory tube. The present species possesses a coiled copulatory tube (2-3 coils), while *T. pusillus* possesses a long curved copulatory tube. Although coiled copulatory tube is observed in two *Thaparocleidus* species from *H. wyckoides* in this study (see Figs. A26 & A27), but they are different in the morphologies of accessory piece and vaginal armament. This species also differs from other known *Thaparocleidus* species in the morphologies of copulatory tube and vaginal opening. It is thus a new species and identified as *Thaparocleidus* n. sp. 10 here.

26. *Thaparocleidus* n. sp. 11 (Fig. A33)

Type host: *Mystus bocourti* (Bleeker, 1864) (5 individuals examined, 4 infected from sites 1, 2 & 3)
Localities: Chao-praya River, Chinat (type locality) (site 1); Ping River, Tak (site 2); Khao-Leam Reservoir, Kanchanaburi (site 3)
No. of monogenean specimens collected and studied: 8
No. of monogenean specimens measured: 5

Body size 575 (542-656) x 98 (84-118). Four eye spots, posterior pair larger. Haptor size 111 (56-168) x 168 (134-210). Dorsal anchors: inner length 24 (23-25); outer length 19 (18-21); inner root 7 (6-7); stumpy outer root; recurved point 12 (12-13). Small boot-like patches, size 4 (4-5) x 2. Ventral anchors: inner length 14 (14-15); outer length 13 (13-14); inner root 5 (4-5); outer root 2 (2-3); recurved point 10 (10-11). Dorsal bar broad V-shaped, size 18 (17-20) x 3 (3-5). Ventral bar V-shaped, size of one side 20 (20-22) x 2 (2-3). Seven pairs of marginal hooks, same length 10 (9-10).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long, thin blind seminal vesicle. Copulatory organ consists of curved copulotory tube, length along the tube 42 (39-44) and long clipper-like accessory piece, size 14 (13-16) x 7 (6-8). Vaginal armament not observed.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp.1 from *Batasio tengara* in having similar types of haptoral armaments and copulatory tube, but differs from it in the morphology of accessory piece. The present species has a long clipper-like accessory piece, while that of *Thaparocleidus* n. sp.1 is large, rounded clipper-like. This species is also different from the other known *Thaparocleidus* species in the morphology of accessory piece of copulatory organ. It is thus a new species and identified as *Thaparocleidus* n. sp. 11.

27. *Thaparocleidus* n. sp. 12 (Fig. A34)

Type host: *Mystus mysticetus* Roberts, 1992 (one individual examined, one infected)
Type locality: NIFI Aquarium, Bangkok
No. of monogenean specimens collected and studied: 8
No. of monogenean specimens measured: 5

Body size 502 (420-554) x 96 (84-126). Four eye spots. Haptor size 102 (76-151) x 115 (101-126). Dorsal anchors: inner length 32 (30-32); outer length 25 (20-26); inner root 9 (8-10); stumpy outer root; recurved point 16 (14-16). Patches bifurcated, size 11 (10-12) x 4 (3-4). Ventral anchors: inner length 16 (15-16); outer length 14 (14-15); inner root 4 (4-5); outer root 2 (1-2); recurved point 9 (8-10). Dorsal bar slightly V-shaped, size 25 (22-26) x 4 (4-5). Ventral bars paired, connected with long thin ligament, size of one side 19 (16-20) x 2 (1-2). Seven pairs of marginal hooks, same shape, length 11 (11-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of long curved copulatory tube, length 59 (54-68), widening at initial part, diameter 4 and clipper-like accessory piece, size 15 (14-18) x 4. Vaginal opening dextral, globulate, diameter (7-8), connected to round seminal receptacle with long vaginal tube, length, 42 (40-43).

Differential diagnosis: The present species is different from the previously known *Thaparocleidus* species from the bagrids in having paired ventral bars connected with long thin ligament and patch with bifurcated tip. This species is considered a new species and identified as *Thaparocleidus* n. sp. 12 here.

28. *Thaparocleidus* n. sp. 13 (Figs. A35 & A36)

Type host: *Mystus mysticetus* Roberts, 1992 (one individual examined, one infected)
Type locality: NIFI Aquarium, Bangkok
No. of monogenean specimens collected and studied: 100
No. of monogenean specimens measured: 10

Body size 403 (302-504) x 103 (84-134). Four eye spots. Haptor size 74 (50-84) x 105 (76-168). Dorsal anchors: inner length 26 (24- 27); outer length 21 (20-22); inner root 8 (6-8); stumpy outer root; recurved point 12 (10-12). Small triangular patches, size 8 (6-10) x 3. Ventral anchors: inner length 16 (14- 17); outer length 14 (13-15); inner root 3 (3-4); outer root 2 (1-2); recurved point 8

(8-10). Dorsal bar slightly V-shaped, size 20 (18-22) x 3 (2-4). Ventral bar V-shaped, size of one side 21 (18-22) x 2 (1-2). Seven pairs of marginal hooks, same shape, length 12 (11-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of coiled copulatory tube (2 coils), length along the tube 57 (52-68), widening at initial part, diameter 2 and clipper-like accessory piece, size 15 (14-16) x 6. Vaginal opening dextral, funnel-like, diameter 2 (2-3) connected to round seminal receptacle with vaginal tube, length, 22 (19-23).

Differential diagnosis: The present species is similar to *Thaparocleidus parvulus* (Gussev, 1976) Lim, 1996 in having similar morphology of haptoral armaments, but differs from it in having a coiled copulatory tube (2 coils) and a clipper-like accessory piece. While *T. pusillus* possesses a long curved copulatory tube (1 turn) and S-shape accessory piece (see Gussev, 1976). This species also differs from the other known *Thaparocleidus* species in the morphology of copulatory organ. The present species, hence considered a new species and is named *Thaparocleidus* sp. n. 13.

29. *Thaparocleidus* n. sp. 14 (Fig. A37)

Type host: *Mystus singaringan* (Bleeker, 1846) (9 individuals examined, 5 infected from sites 1, 2, 4 & 5)
Localities: Khog-kram subdistrict, Nakornsithammarat (type locality) (site 1); Mun River, Ubonratchathanee (site 2); Muang district, Pattanee (site 3); Chao-praya River, Chinat (site 4); Ubonratana Reservoir, Khon-kean (site 5)
No. of monogenean specimens collected and studied: 35
No. of monogenean specimens measured: 6

Body size 403 (396-462) x 101 (84-109). Four eye spots. Haptor size 67 (59-92) x 84 (67-101). Dorsal anchors: inner length 24 (23-25); outer length 20 (20-21); inner root 6 (5-6); stumpy outer root; recurved point 12 (11-12). Small triangular patch, size 6 (6-7) x 2 (2-3). Ventral anchors: inner length 16 (16-18); outer length 14 (14-15); inner root 4 (3-4); outer root 2 (1-2); recurved point 6 (5-6). Dorsal bar slightly V-shaped, size 18 (17-20) x 3 (3-4). Ventral bar V-shaped, size of one side 20 (18-20) x 2 (1-2). Seven pairs of marginal hooks, same shape, length 10 (10-11).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of long curved copulatory tube, length 54 (48-58) and small grooved accessory piece, size 14 (12-16) x 4 (3-4). Vaginal opening not observed.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 1 and *Thaparocleidus* n. sp. 13 in having similar morphology of haptoral armaments but differs from them in the morphology of accessory piece of copulatory organ. The present species possesses a small grooved accessory piece, while that of *Thaparocleidus* n. sp. 1 is large round clipper-like and that of *Thaparocleidus* n. sp. 13 is clipper-like. The present species is also different from the other known

Thaparocleidus species in the morphology of copulatory organ. This species is considered a new species and identified as *Thaparocleidus* n. sp. 14.

30. *Thaparocleidus* n. sp. 15 (Figs. A38 & A39)

Type host: *Pseudomystus siamensis* (Regan, 1913) (9 individuals examined, 8 infected from sites 1 & 2)
Localities: Khog-kram subdistrict, Nakornsithammarat (type locality) (site 1); Cha-uad district, Nakornsithammarat (site 2)
No. of monogenean specimens collected and studied: 58
No. of monogenean specimens measured: 10

Body size 1005 (630-1176) x 147 (126-160). Four eye spots, Haptor size 116 (92-126) x 149 (126-176). Dorsal anchors: inner length 44 (38-48); outer length 35 (32-38); inner root 13 (12-14); stumpy outer root; recurved point 20 (22-24). Patches triangular with spinous tip, size 12 (10-12) x 6 (6-7). Ventral anchors: fenestrated at mainpart, inner length 24 (22-24); outer length 20 (18-22); inner root 8 (6-8); outer root 2 and recurved point 14 (12-16). Dorsal bar slightly V-shaped, size 28 (26-30) x 4 (4-5). Ventral bar broad V-shaped, size of one side 24 (21- 24) x 2 (2-3). Seven pairs of marginal hooks, 2 types, same length 12 (11-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of curved copulatory tube, length along the tube 64 (56-70), diameter of the initial part 6 (5-7) and sinuous accessory piece, size 27 (22-32) x 3 (2-4). Vaginal opening funnel-like, midbody. Trilobed structure of female reproductive system is present as described by Lim (1990b) for *Thaparocleidus caecus* (Mizelle & Kritsky, 1969) Lim, 1996 on the pangasiids.

Differential diagnosis: The present species is different from all the other *Thaparocleidus* species from the Bagridae in having fenestrated ventral anchor and patch with a spinous tip. Also observed is trilobed structure of female reproductive system. These characteristics are mainly observed in *Thaparocleidus* species from Pangasiidae (for example *T. caecus*) (see Appendix 3.4: Monogeneans of Pangasiidae). However, the present species is different from the *Thaparocleidus* species of Pangasiidae in the detailed copulatory organ. Hence, it is considered a new species and identified as *Thaparocleidus* n. sp. 15.

Discussion

In this study three monogeneans genera (*Bifurcohaptor*, *Cornudiscoides* and *Thaparocleidus*) were found on the Thai bagrid species. The three genera are also present on the bagrids of India and Malaysia (see Gussev, 1976; Lim, 1987b; Lim & Furtado, 1983). *Bifurcohaptor* and *Cornudiscoides* are so far only found on Bagridae of the Oriental region, in India (Gussev, 1976) and Peninsular Malaysia (Lim, 1987b) and now in Thailand (present study). *Thaparocleidus* could be found on most of the freshwater catfish of the Oriental region as well as on the catfish of the Amur-Chinese region (see Lim, 1996b).

Besides these three monogenean genera, *Ancylodiscoides* and *Bychowskyella* were recorded on the bagrids in India and the Palaearctic region, while *Pseudancylodiscoides* was found only on the bagrids in the Palaearctic region (see Table A2), but not on the bagrids in Southeast Asia. *Hamatopeduncularia* (one species) recorded on the bagrids in India is probably a misidentification.

***Bifurcohaptor* Jain, 1958**

To date there are only seven species of *Bifurcohaptor* of which three are from the Sisoridae of India (see Appendix 3.7: Monogeneans of Sisoridae) and four are from the Bagridae of Peninsular Malaysia and India. The four species of *Bifurcohaptor* from the Bagridae are *Bifurcohaptor baungi* from *Hemibagrus nemurus* in Malaysia, *B. giganticus* Jain, 1958 from *Aorichthys seenghala*, *B. lanki* Gussev, 1976 from *Mystus keletius* and *B. indicus* Jain, 1958 from *M. vittatus* (see Lim & Furtado, 1983; Gussev, 1976; Table 4.5: Chapter 4). In Thailand *Bifurcohaptor baungi* and one new species of *Bifurcohaptor* species were found on *H. nemurus*, but none on the six species of *Mystus* examined. However there are five species of *Mystus* still not examined (see Introduction).

***Cornudiscoides* Kulkarni, 1969**

To date there are 14 *Cornudiscoides* species on five species of *Mystus* and one species of *Hemibagrus* from the Indian subcontinent and Peninsular Malaysia (see Table 4.6: Chapter 4). Of these 14 *Cornudiscoides* species, six species were from two bagrid species in Peninsular Malaysia: *Cornudiscoides malayensis*, *C. selangoricus* and *C. sundanensis* from *Hemibagrus nemurus*; *C. anchoratus*, *C. bagri* and *C. facicirrus* from *Mystus nigriceps* (see Lim, 1987b). The other eight species were from three *Mystus* species from Indian subcontinent: *C. germinus*, *C. proximus*, *C. raipurensis* and *C. vittati* from *M. vittatus* (see Gussev, 1976; Dubey, Gupta & Agrawal, 1992b), *C. heterotylus*, *C. microtylus* and *C. megalorchis* from *M. tengara* (see Kulkarni, 1969b) and *C. jaini* from *M. keletius* (see Gussev, 1963) Thus far there is no record of *Cornudiscoides* from *Hemibagrus* species in the Amur-Chinese region.

In this study 13 *Cornudiscoides* species (of which six are new) were obtained from five species of Bagridae belonging to the genera *Hemibagrus* and *Mystus*. The six new species increases the total number of *Cornudiscoides* to 20. These 20 species of *Cornudiscoides* are from one species of *Hemibagrus* and 11 *Mystus* species of India, Malaysia and Thailand (Table A2). Morphologically, the *Cornudiscoides* species from *Hemibagrus* and *Mystus* are similar in having paired ventral bars and a pair of very long modified marginal hooks.

***Thaparocleidus* Jain, 1952**

Hitherto, there are ten species of *Thaparocleidus* from six species of Bagridae from the Indian subcontinent and the Palearctic region: three species are found on *Aorichthys aor*, one species from *A. seenghala*, two species from *Mystus vittatus*, one species from *M. gulio* and *M. tengara* from India; two species from *Pelteobagrus fulvidraco* and one species from *Pseudobagrus ussuriensis* in Russia

(Table A2). *Thaparocleidus* species are also found on Malaysian and Thai *H. nemurus* (see Lim, 1987a; present data).

Thaparocleidus species are common on Thai bagrids, viz., *Batasio*, *Hemibagrus*, *Mystus* and *Pseudomystus*. A total of 15 new species of *Thaparocleidus* are collected from the Thai bagrids in this study.

Four of these 15 new *Thaparocleidus* species are different from the other 12 species in having a coiled copulatory tube (2-3 coils). These four species are *Thaparocleidus* n. sp. 6 and *Thaparocleidus* n. sp.7 from *H. wyckoides*; *Thaparocleidus* n. sp. 10 from *M. atrifasciatus*; and *Thaparocleidus* n. sp. 13 from *M. mysticetus* (see Figs. A26, A27, A32, A36).

Thaparocleidus n. sp. 15 is morphologically different from the present 14 new *Thaparocleidus* species in having ventral anchor with fenestrated mainpart and patch with spinous tip (Fig. A39). These characteristics are observed in some *Thaparocleidus* species from the Pangasiidae, as exemplified by *Thaparocleidus caecus* (see appendix 3.4).

Morphologically the *Thaparocleidus* species and *Cornudiscoides* species of Thai striped catfish *M. atrifasciatus* and *M. mysticetus* are similar to *Thaparocleidus* species and *Cornudiscoides* species of Indian striped catfish *M. vittatus*.

Table A2 Monogeneans of the bagids (PM: Peninsular Malaysia)

Fish host species	Monogenean species	Localities	References
Aorichthys aor	*Ancylodiscoides micracanthus*	India	Kulkarni, 1969b
	Thaparocleidus acri	Pakistan	Rizvi, 1971; Gussev, 1976; Lim, 1996b
	T. mystusi	"	Rizvi, 1971; Gussev, 1976; Lim, 1996b
	T. postorchidis	India	Gussev, 1976; Kulkarni, 1969 Lim, 1996b
A. seenghala	*T. seenghali*	"	Jain, 1961a; Lim, 1996b
	Bifurcohaptor giganticus	"	Jain, 1958; Gussev, 1978
	Hametopeduncularia sohani	"	Tewari & Agrawal, 1986b
Bagrus docmac	*Quadriacanthus bagrae*	Uganda	Paperna, 1979
	Q. clariadis	Ghana	Paperna & Thurston, 1968
B. bayad	*Q. bagrae*	Uganda	Paperna, 1979
B. orientalis	*Q. bagrae*	Tanzania	Paperna, 1979
Batasio tengara	*Thaparocleidus* n.sp.1	Thailand	present study
Hemibagrus elongatus	*Bychowskyella pseudobagri*	China	Li & Zhang, 1992
H. guttatus	*H. pseudobagri*	"	Li & Zhang, 1992
H. macropterus	*B. pseudobagri*	"	Long, 1981
	A. hemibagri	"	Zhang & Ji, 1981; Lim, 1996b
H. nemurus	*Bifurcohaptor baungi*	PM	Lim & Furtado, 1983
		Thailand	present study
	Cornudiscoides malayensis	PM	Lim, 1987b
		Thailand	present study
	C. selangoricus	PM	Lim, 1987b
		Thailand	present study
	C. sundanensis	PM	Lim, 1987b
		Thailand	present study
	Thaparocleidus n.sp.1	"	present study
	Thaparocleidus n.sp.2	"	present study
	Thaparocleidus n.sp.3	"	present study

Table A2 cont'd

Fish host species	Monogenean species	Localities	References
H. wyckoides	*Cornudiscoides* n.sp.1	Thailand	present study
	Cornudiscoides n.sp.2	"	present study
	Thaparocleidus n.sp.5	"	present study
	Thaparocleidus n.sp.6	"	present study
	Thaparocleidus n.sp.7	"	present study
	Thaparocleidus n.sp.8	"	present study
	Thaparocleidus n.sp.9	"	present study
Mystus	*C. germinus*	"	present study
atrifasciatus	*Thaparocleidus* n.sp.10	"	present study
M. bocourti	*Cornudiscoides* n.sp.3	"	present study
	Thaparocleidus n.sp.11	"	present study
M. gulio	*T. tengra*	India	Tripathi, 1957; Lim, 1996b
	C. jaini	"	Gussev, 1963
	Cornudiscoides n.sp. 4	Thailand	present study
	Cornudiscoides n.sp. 5	"	present study
M. keletius	*Bifurcohaptor lanki*	Sri Lanka	Gussev, 1976
M. mysticetus	*Cornudiscoides* n.sp.6	Thailand	present study
	Thaparocleidus n.sp.12	"	present study
	Thaparocleidus n.sp.13	"	present study
M. nigriceps	*C. anchoratus*	PM	Lim, 1987b
	C. bagri	"	Lim, 1987b
	C. facicirrus	"	Lim, 1987b
M. singaringan	*C. anchoratus*	Thailand	present study
	C. bagri	"	present study
	C. facicirrus	"	present study
	Thaparocleidus n.sp.14	"	present study
M. tengara	*Bychowskyella kangpurensis*	India	Gupta & Sachdeva, 1986
	C. heterotylus	"	Kulkarni, 1969b
	C. megalorchis	"	Kulkarni, 1969b
	C. microtylus	"	Kulkarni, 1969b
	T. tengra	"	Tripathi, 1957; Lim, 1996b

Table A2 cont'd

Fish host species	Monogenean species	Localities	References
M. vittatus	*Bifurcohaptor indicus*	India	Jain, 1958; Kulkarni, 1969b; Gussev, 1976
	C. germinus	"	Gussev, 1976
	C. proximus	"	Gussev, 1976
	C. raipurensis	"	Dubey, Gupta & Agrawal, 1992b
	C. vittati	"	Dubey, Gupta & Agrawal, 1992b
	Thaparocleidus parvulus	"	Gussev, 1976; Lim, 1996b
	T. pusillus	"	Gussev, 1976; Lim, 1996b
M. wolffii	*Cornudiscoides* n.sp.5	Thailand	present study
Pelteobagrus brashnikowi	*Bychowskyella pseudobagri*	China	Long, 1981
		USSR	Gussev, 1985
P. fulvidraco	*B. pseudobagri*	China	Long, 1981
		USSR	Achmerow, 1952 (in Gussev,1985)
	Pseudancylodiscoides gigi	"	Gussev, 1985
	T. poljanskyi	"	Gussev, 1985; Lim, 1996b
	T. strelkowi	"	Gussev, 1985; Lim, 1996b
		China	Li & Zhang, 1992; Lim, 1996b
P. vachelli	*A. curvitubus*	"	Zhang & Ji, 1981; Lim, 1996b
	A. asciicirrus	"	Ma, Li & Wang, 1981
Pseudobagrus longirostris	*A. leiocassi*	"	Ma, Li & Wang, 1981
P. ussuriensis	*T. rimskykorsakovi*	USSR	Gussev, 1985; Lim, 1996b
Pseudomystus siamensis	*Thaparocleidus* n.sp.15	Thailand	present study
Rita rita	*Bychowskyella raipurensis*	India	Majumdar & Agarwal, 1988
	T. ritius	"	Jain, 1961a; Lim,1996b

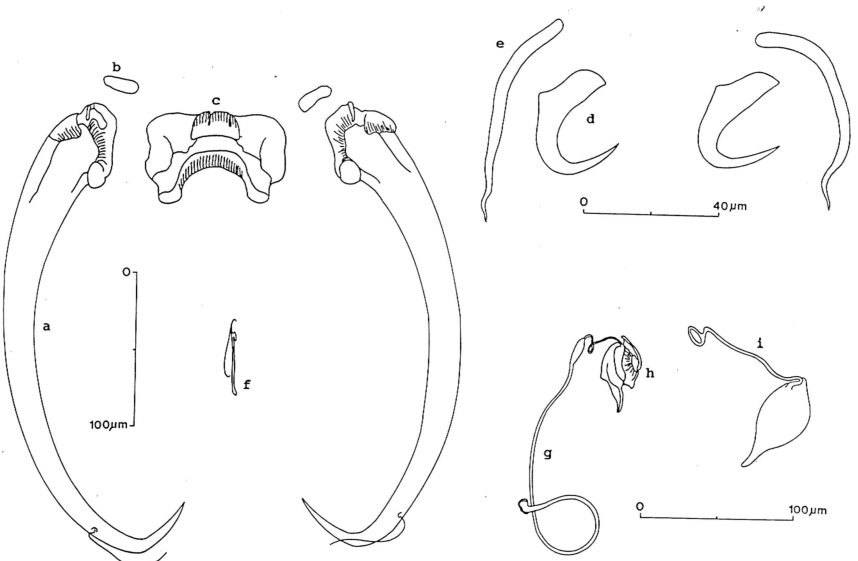


Fig. A3. Hard parts of *Bifurcohaptor baungi* Lim & Furtado, 1983: a, dorsal anchor; b, patch; c, dorsal bar;

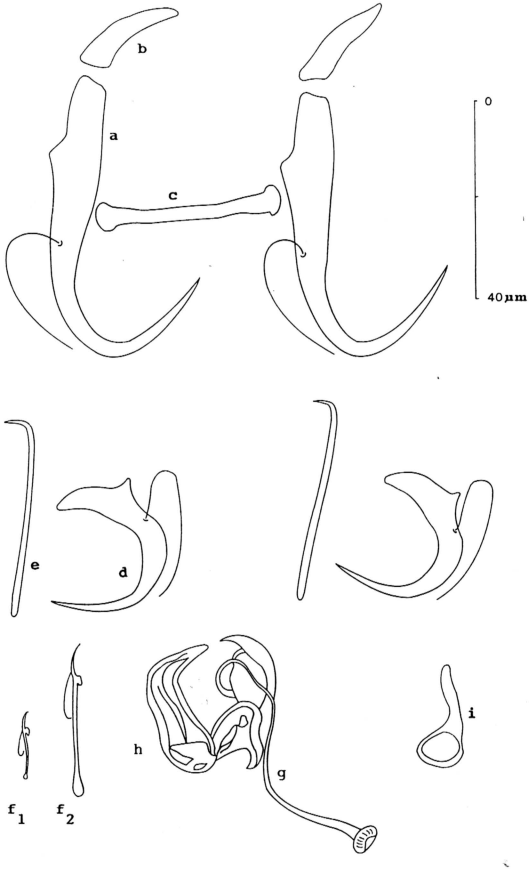


Fig. A4. Hard parts of *Cornudiscoides malayensis* Lim, 1987: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2, hook near ventral anchor; g, copulatory tube; h, accessory piece; i, vaginal opening. Scale-bar in micrometres

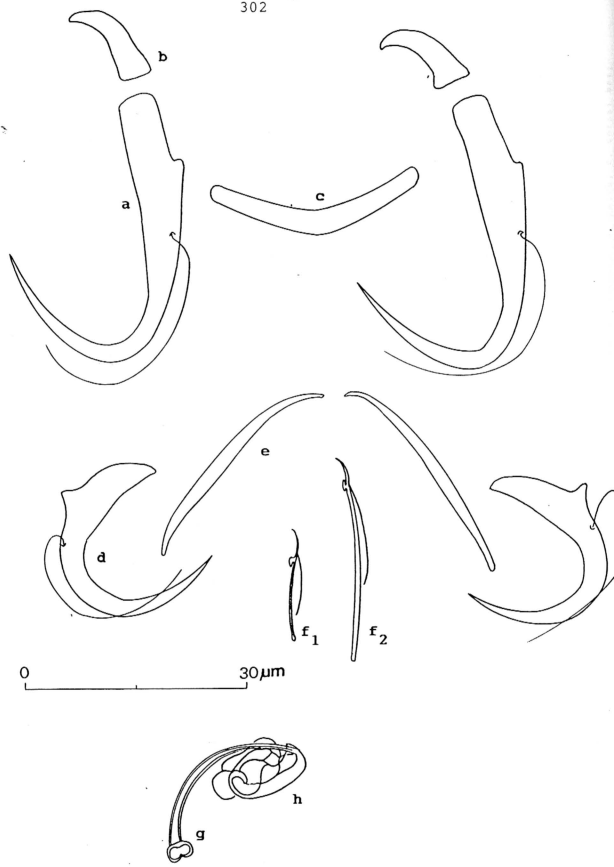


Fig. A5. Hard parts of *Cornudiscoides selangoricus* Lim, 1987: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2, hook near ventral anchor; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

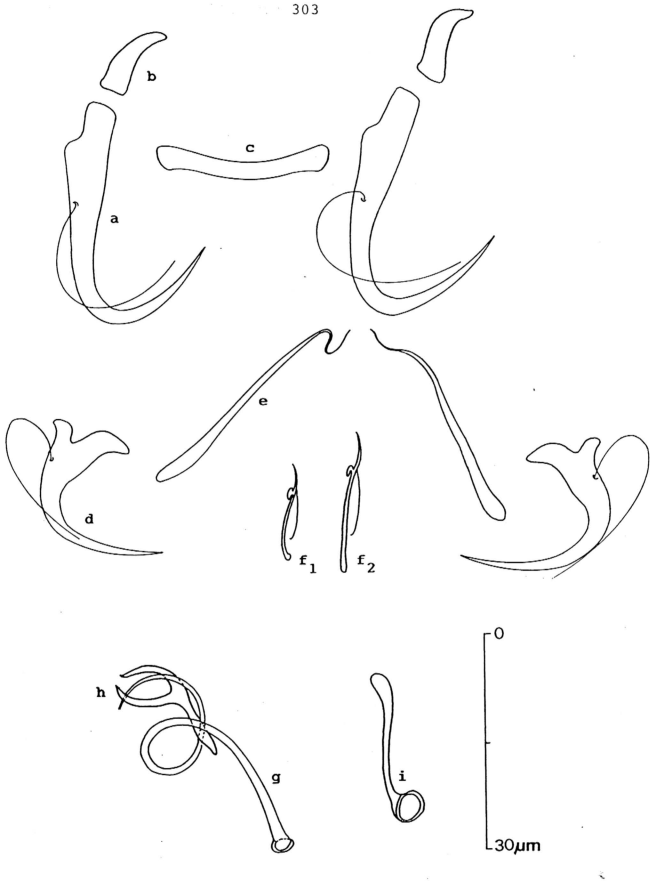


Fig. A6. Hard parts of *Cornudiscoides sundanensis* Lim, 1987: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2, hook near ventral anchor; g, copulatory tube; h, accessory piece; i, vaginal opening. Scale-bar in micrometres

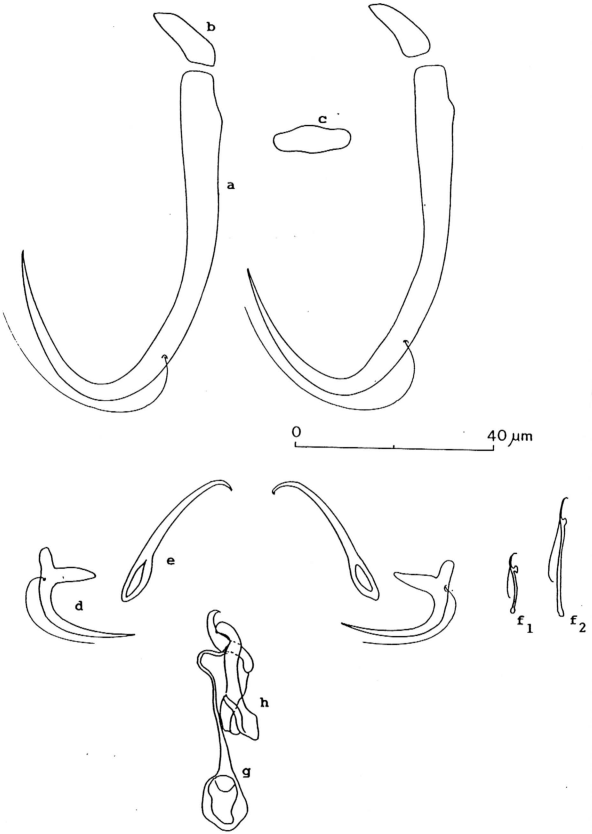


Fig. A7. Hard parts of *Cornudiscoides anchoratus* Lim, 1987: a, dorsal anchor; patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; hook near ventral anchor; g, copulatory tube; h, accessory piece. Scale-bar micrometres

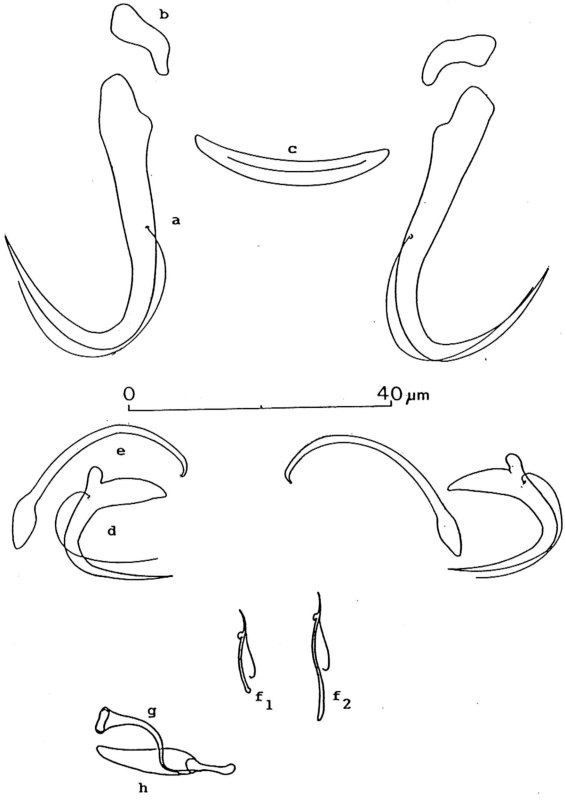


Fig. A8. Hard parts of *Cornudiscoides bagri* Lim, 1987: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e ventral bar; f_1, marginal hook; f_2, hook near ventral anchor; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

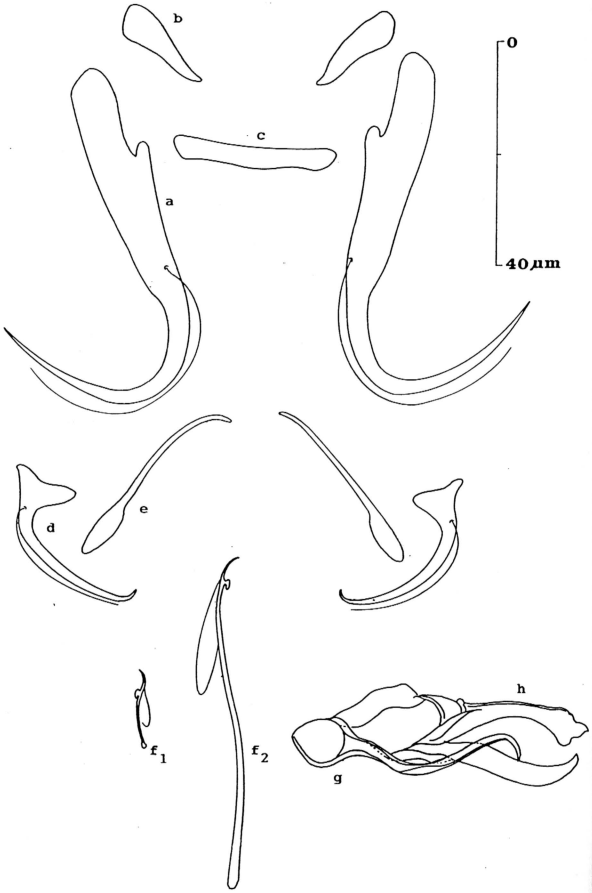
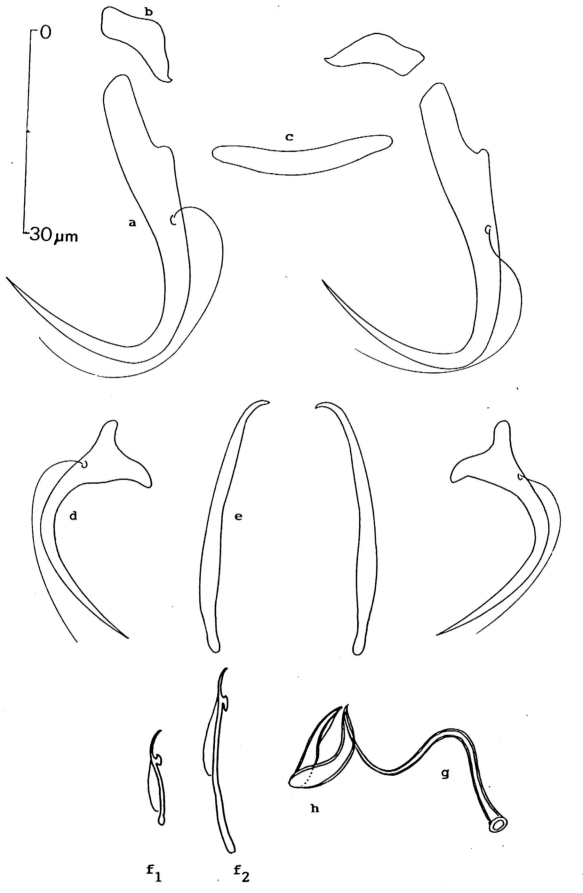


Fig. A9. Hard parts of *Cornudiscoides facicirrus* Lim, 1987: a, dorsal anchor; b patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2 hook near ventral anchor; g, copulatory tube; h, accessory piece. Scale-bar micrometres



A10. Hard parts of *Cornudiscoides germinus* Gussev, 1976: a, dorsal anchor; atch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2, near ventral anchor; g, copulatory tube; h, accessory piece. Scale-bar in ometres

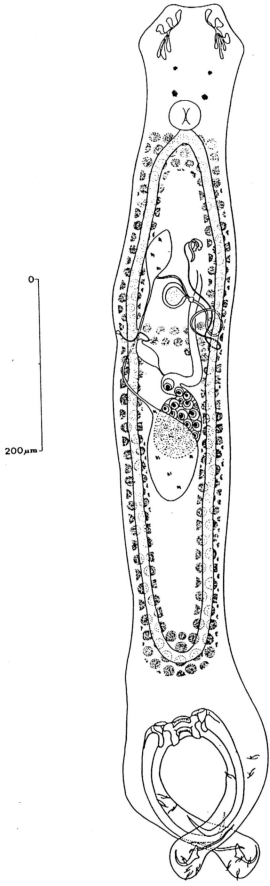


Fig. A11. Composite illustration of *Bifurcohaptor* n. sp. 1 (dorsal view). Scale bar in micrometres

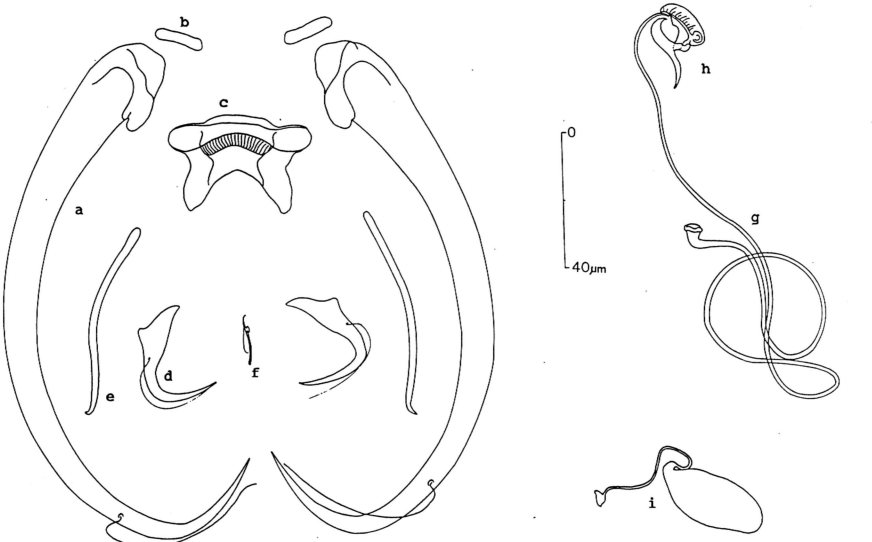


Fig. A12. Hard parts of *Bifurcohaptor* n. sp. 1: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece; i, vaginal system with seminal receptacle. Scale-bar in micrometres

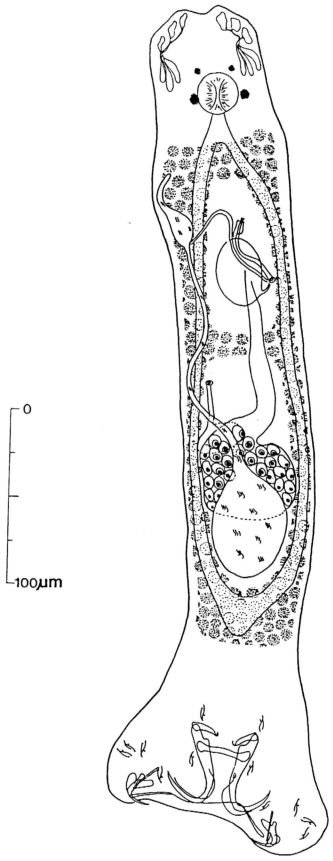


Fig. A13. Composite illustration of *Cornudiscoides* n. sp. 1 (dorsal view). Sca

bar in micrometres

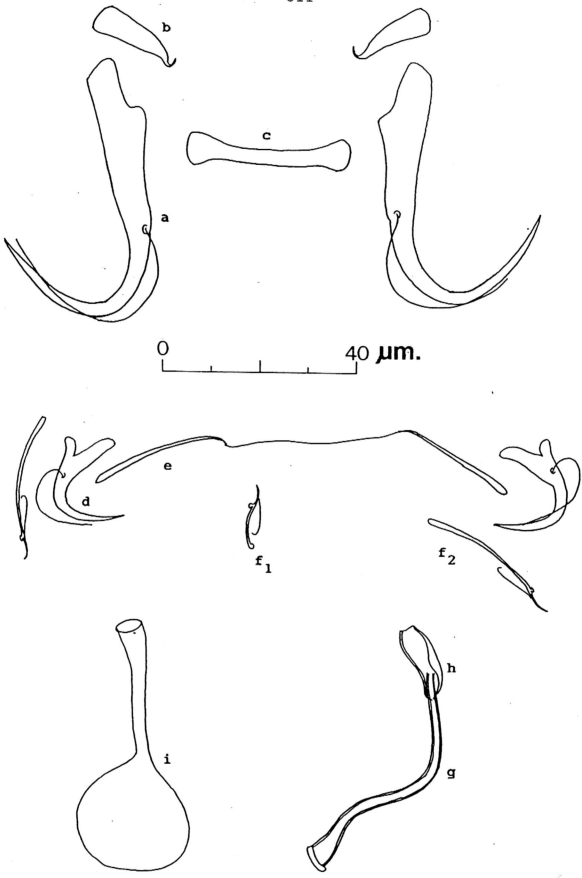


Fig. A14. Hard parts of *Cornudiscoides* n. sp. 1: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2, hook near ventral anchor; g, copulatory tube; h, accessory piece; i, vaginal system with seminal receptacle. Scale-bar in micrometres

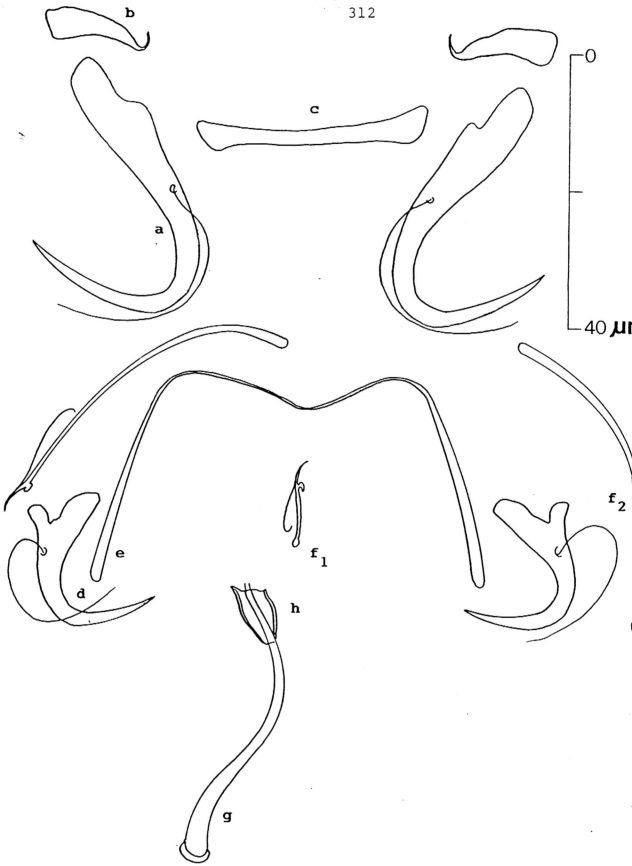


Fig. A15. Hard parts of *Cornudiscoides* n. sp. 2: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2, hook near ventral anchor; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

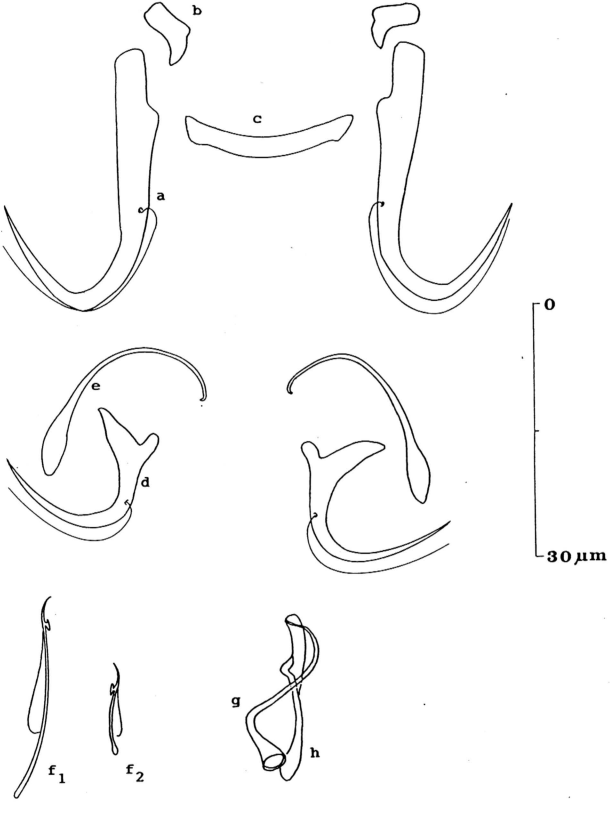


Fig. A16. Hard parts of *Cornudiscoides* n. sp. 3: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2, hook near ventral anchor; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

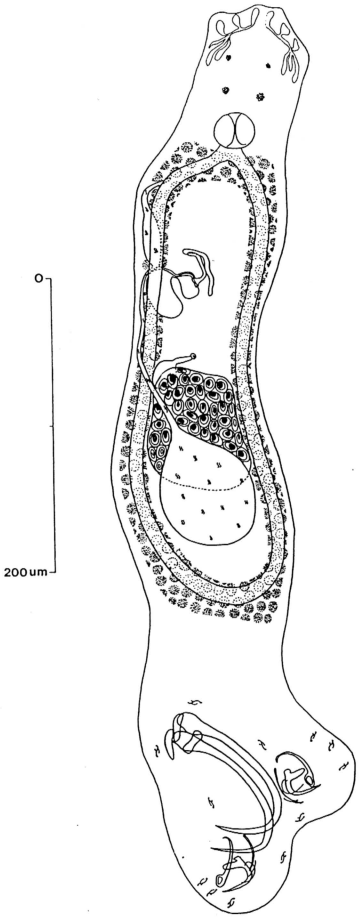


Fig. A17. Composite illustration and hard parts of *Cornudiscoides n.* sp. 4 (dors
view). Scale-bar in micrometres

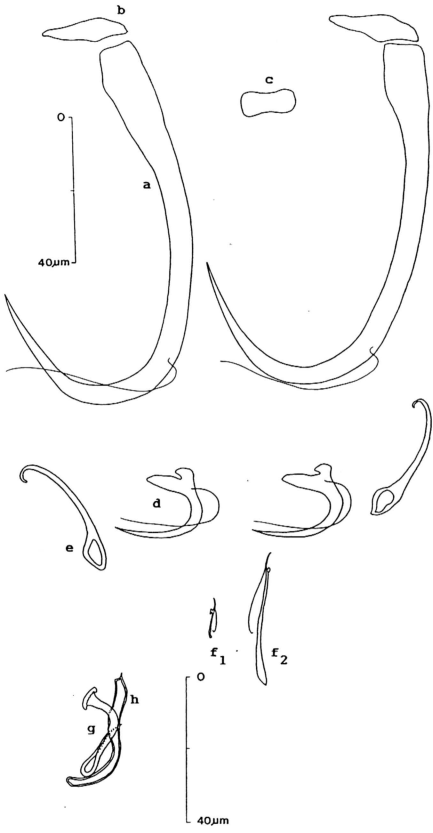


Fig. A18. Hard parts of *Cornudiscoides* n. sp. 4: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2, hook near ventral anchor; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

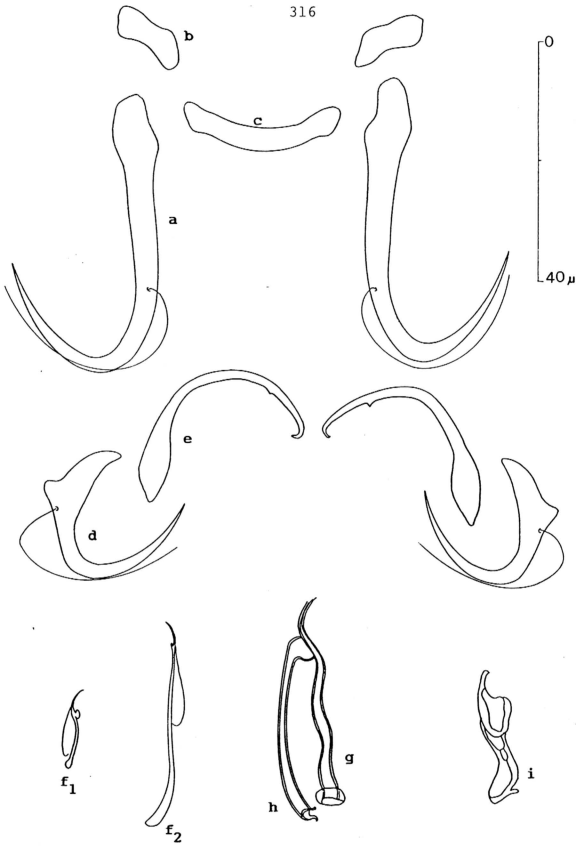


Fig. A19. Hard parts of *Cornudiscoides* n. sp.5: a, dorsal anchor; b, patch dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2, hook ventral anchor; g, copulatory tube; h, accessory piece; i, vaginal open Scale-bar in micrometres

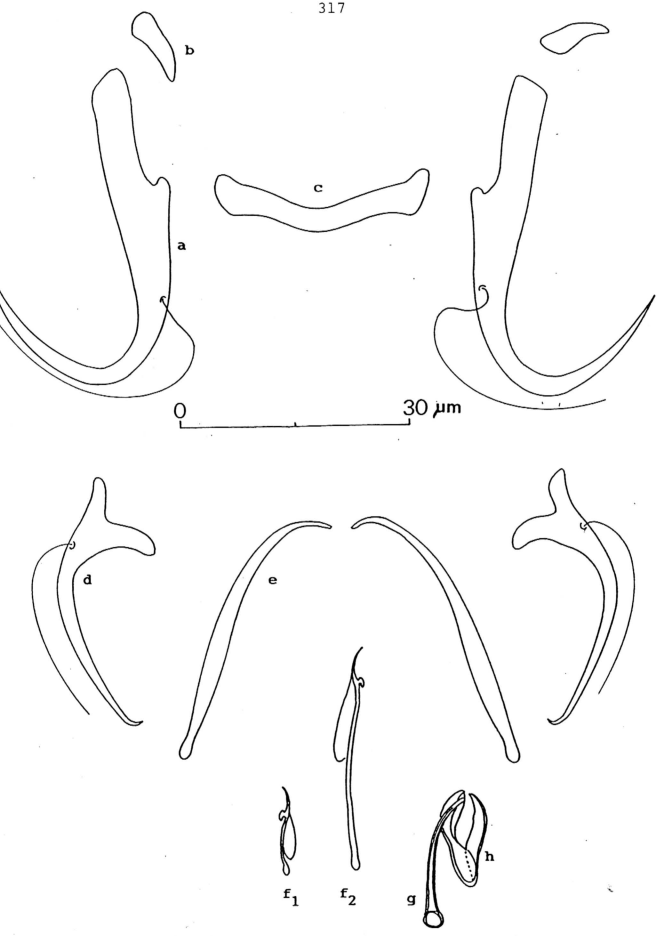


Fig. A20. Hard parts of *Cornudiscoides* n. sp. 6: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, marginal hook; f_2, hook near ventral anchor; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

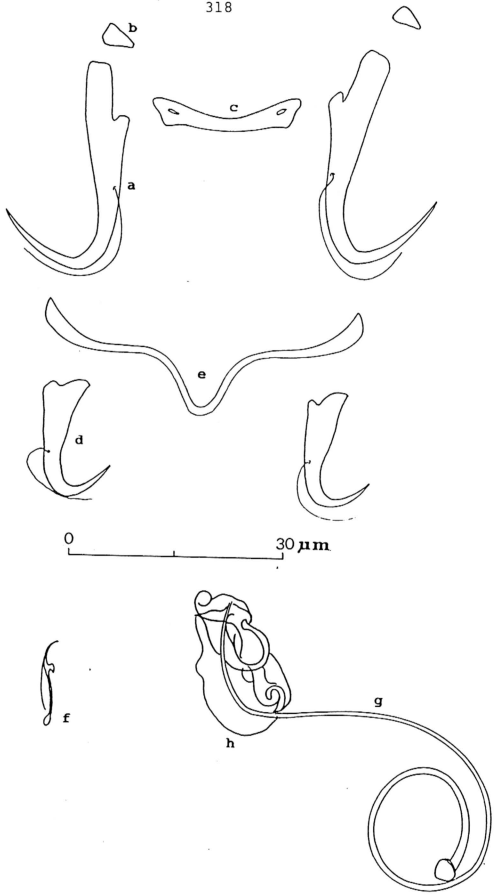


Fig. A21. Hard parts of *Thaparocleidus* n. sp. 1: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

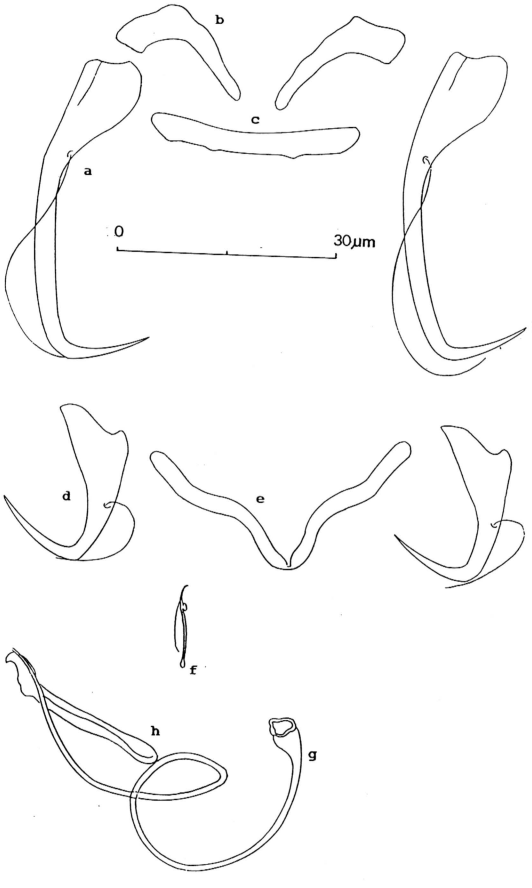


Fig. A22. Hard parts of *Thaparocleidus* n. sp. 2: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

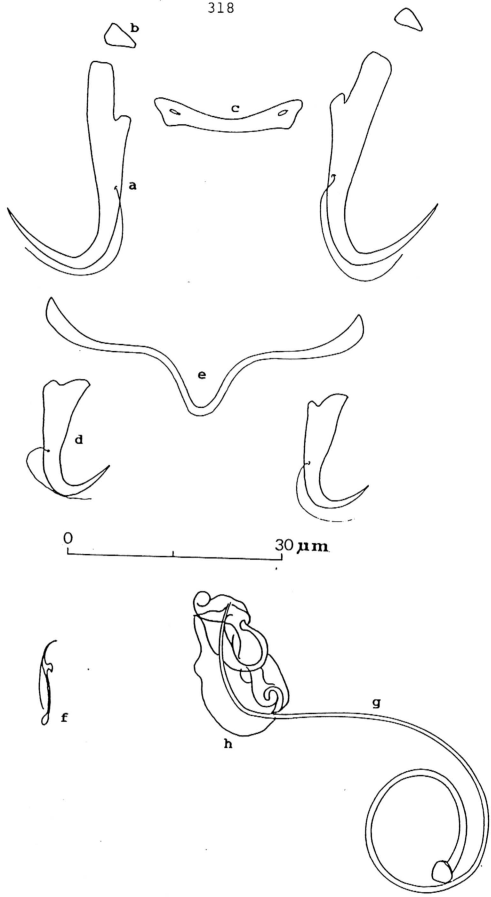


Fig. A21. Hard parts of *Thaparocleidus* n. sp. 1: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

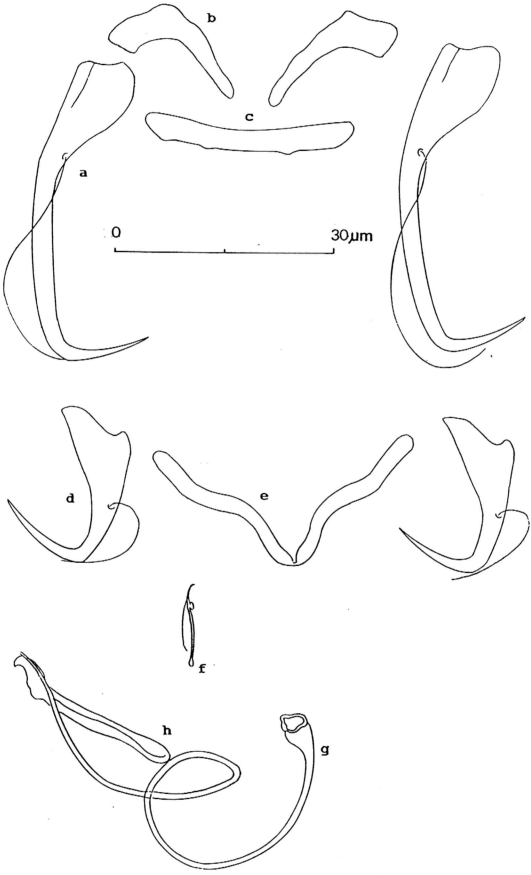


Fig. A22. Hard parts of *Thaparocleidus* n. sp. 2: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

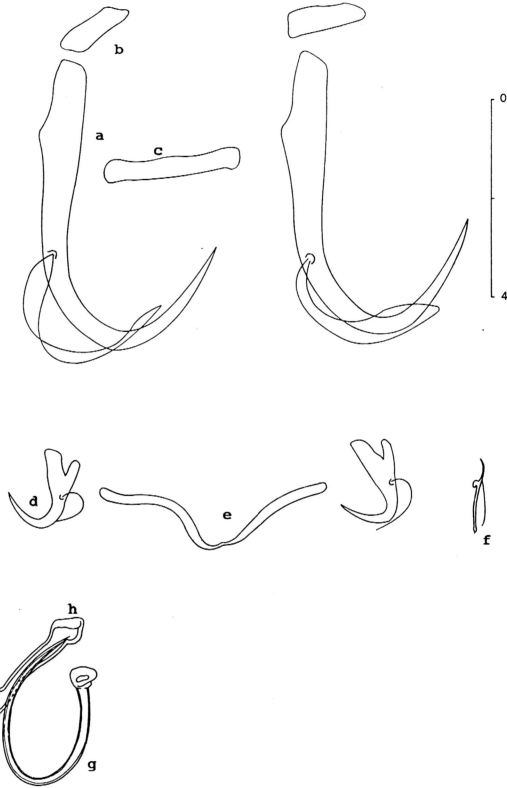


Fig. A23. Hard parts of *Thaparocleidus* n. sp. 3: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

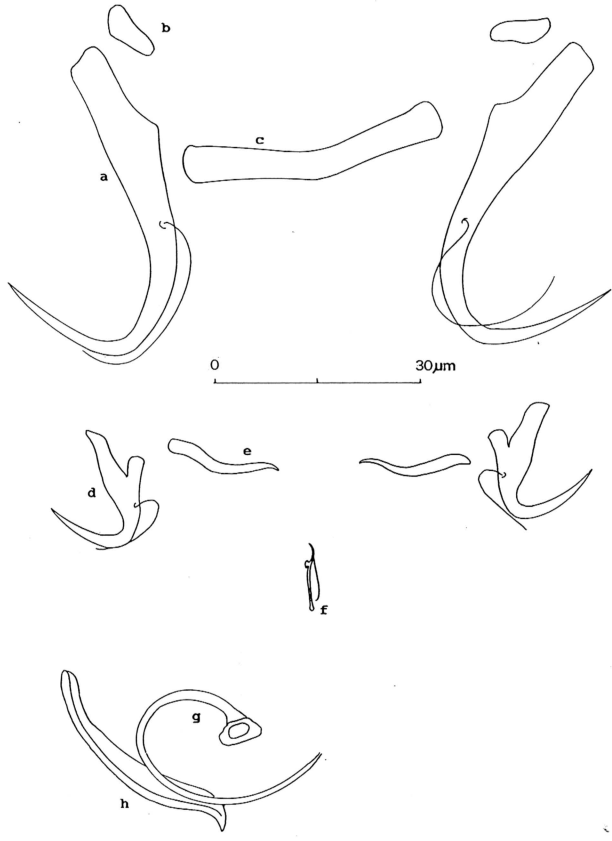


Fig. A24. Hard parts of *Thaparocleidus* n. sp. 4: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

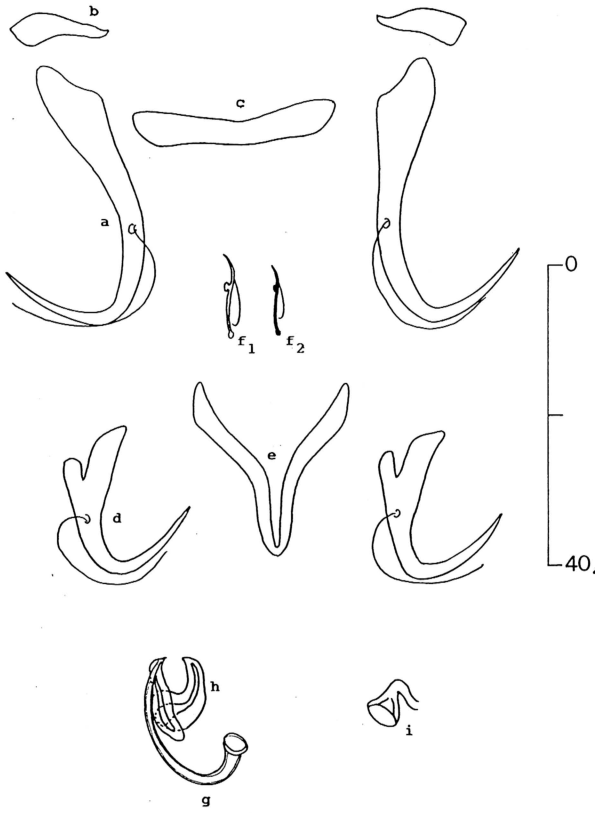


Fig. A25. Hard parts of *Thaparocleidus* n. sp. 5: a, dorsal anchor; b, patch; dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; copulatory tube; i, vaginal opening. Scale-bar in micrometres

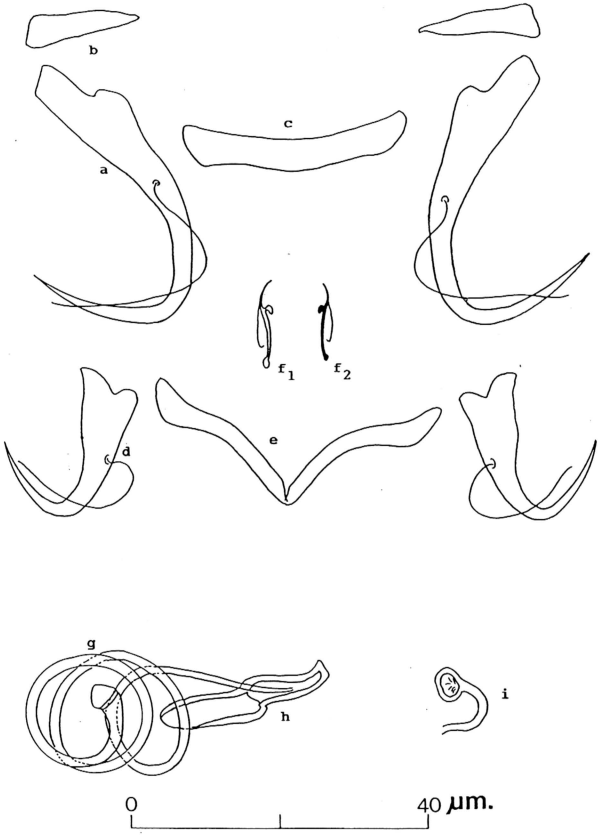


Fig. A26. Hard parts of *Thaparocleidus* n. sp. 6: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal opening. Scale-bar in micrometres

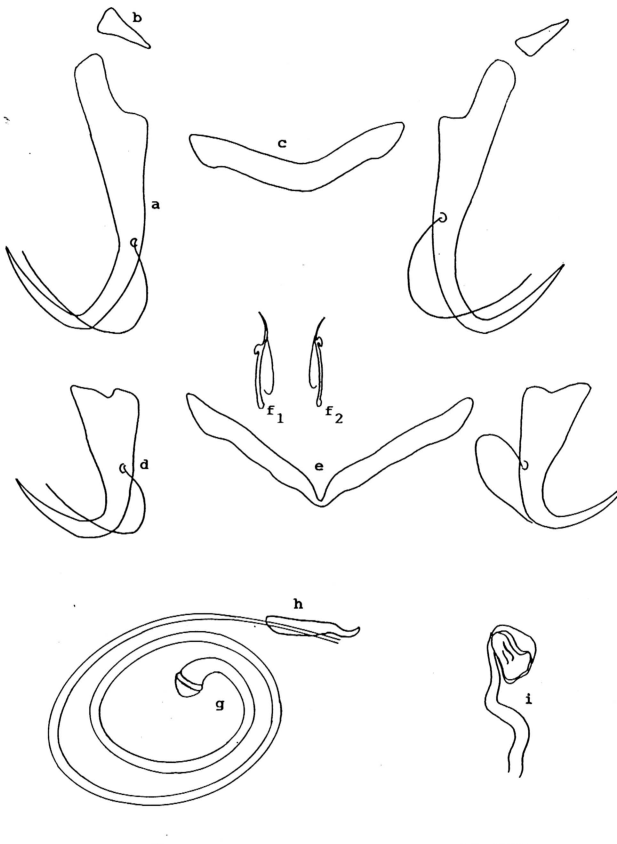


Fig. A27. Hard parts of *Thaparocleidus* n. sp. 7: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal opening. Scale-bar in micrometres

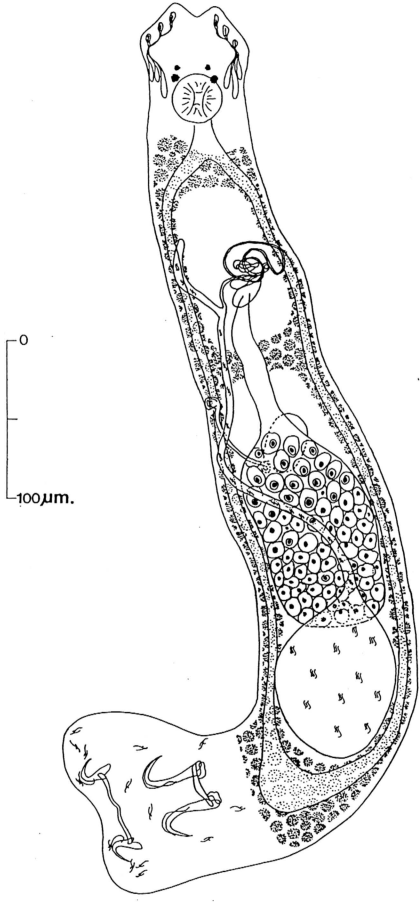


Fig. A28. Composite illustration of *Thaparocleidus* n. sp. 8 (dorsal view). Scale-bar in micrometres

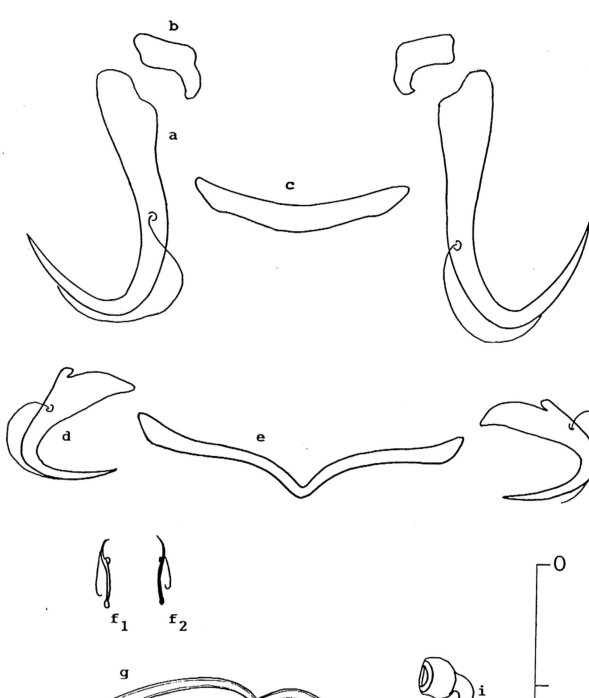


Fig. A29. Hard parts of *Thaparocleidus* n. sp. 8: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal opening. Scale-bar in micrometres

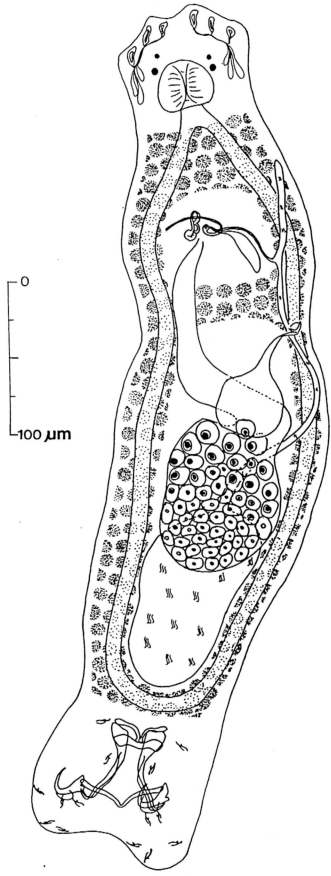


Fig. A30. Composite illustration of *Thaparocleidus* n. sp. 9 (ventral view). Scale-bar in micrometres

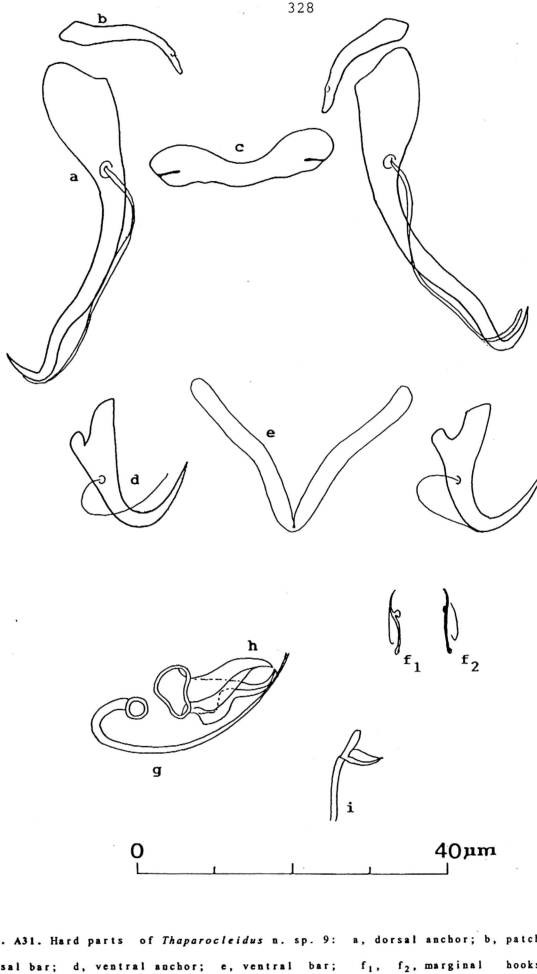


Fig. A31. Hard parts of *Thaparocleidus* n. sp. 9: a, dorsal anchor; b, patch; dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; copulatory tube; h, accessory piece; i, vaginal opening. Scale-bar in micromet

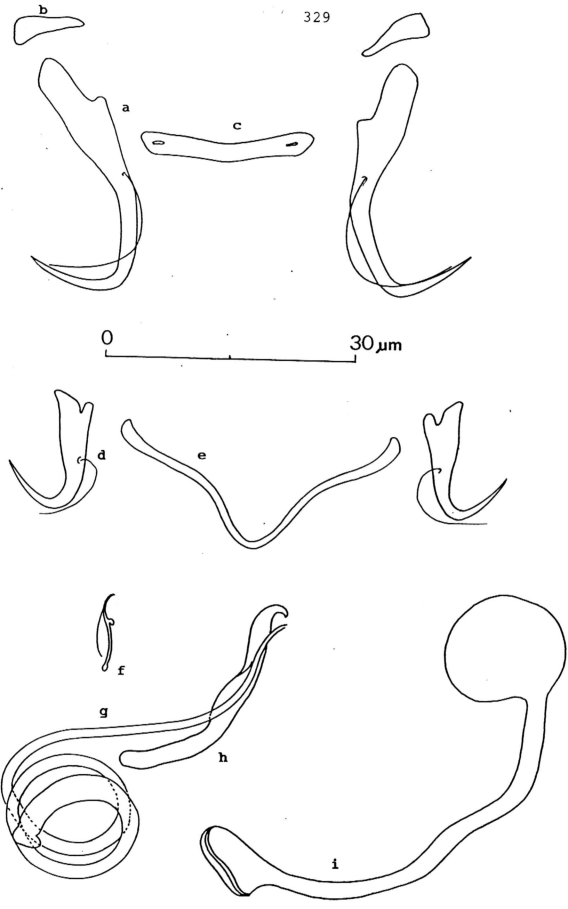


Fig. A32. Hard parts of *Thaparocleidus* n. sp. 10: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece; i, vaginal system with seminal receptacle. Scale-bar in micrometres

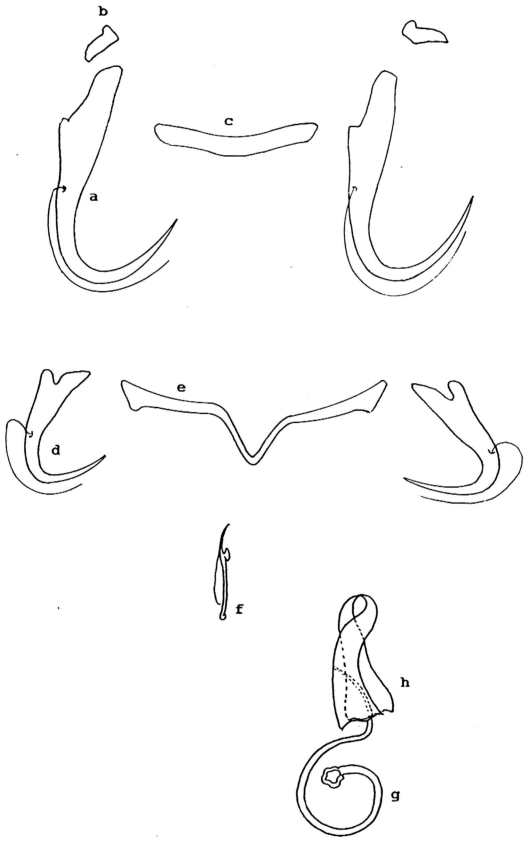


Fig. A33. Hard parts of *Thaparocleidus* n. sp. 11: a, dorsal anchor; b, patch; dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulat tube; h, accessory piece. Scale-bar in micrometres

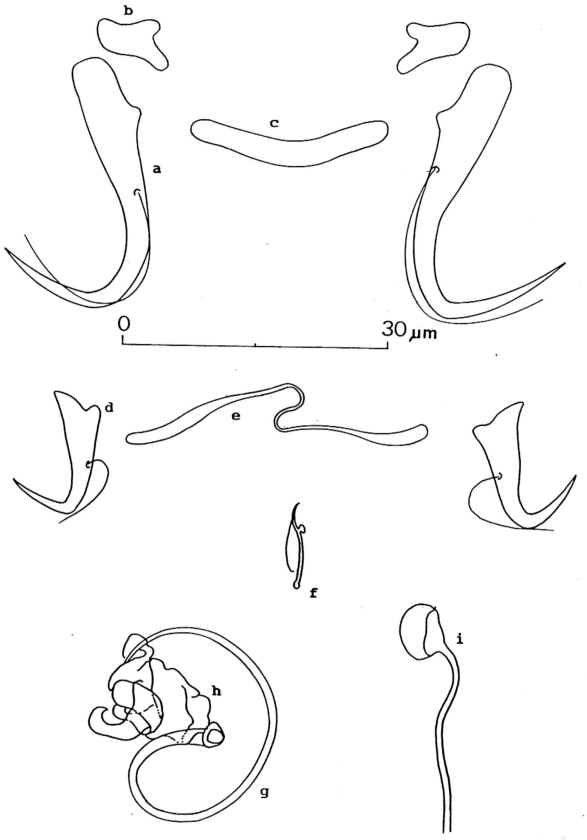


Fig. A34. Hard parts of *Thaparocleidus* n. sp. 12: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece; i, vaginal opening. Scale-bar in micrometres

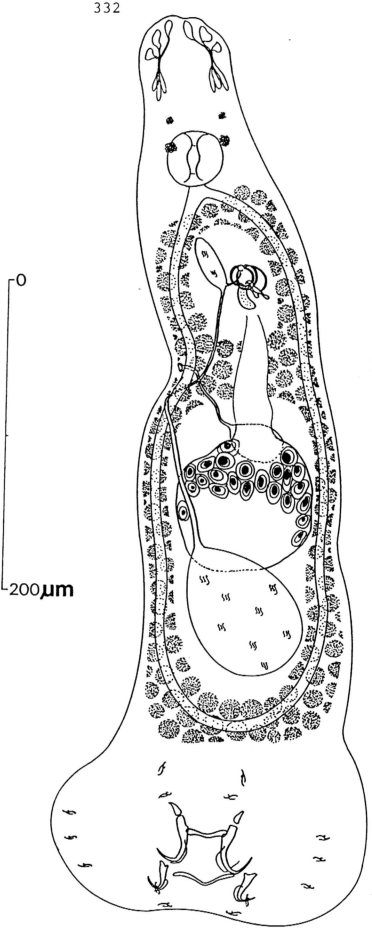


Fig. A35. Composite illustration of *Thaparocleidus* n. sp. 13 (dorsal view). Sc
bar in micrometres

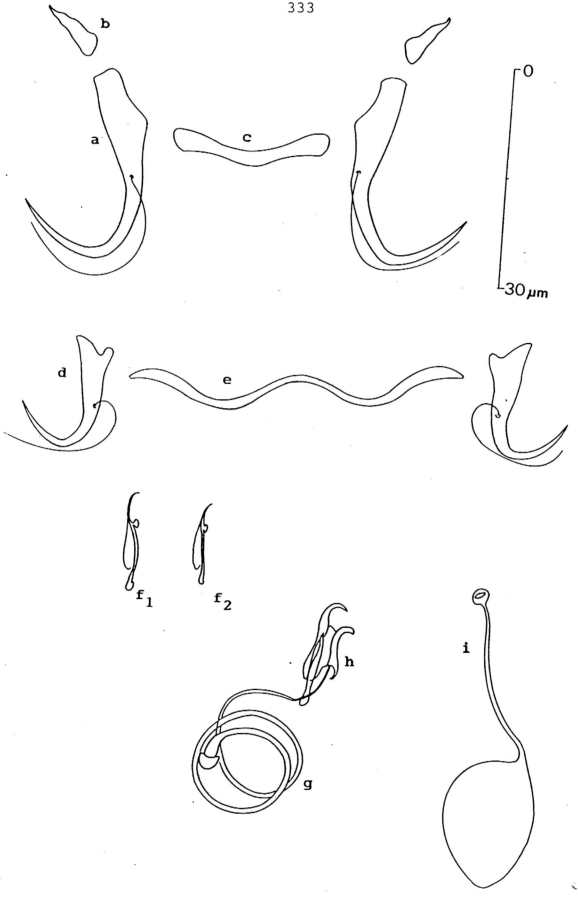


Fig. A36. Hard parts of *Thaparocleidus* n. sp. 13: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system with seminal receptacle. Scale-bar in micrometres

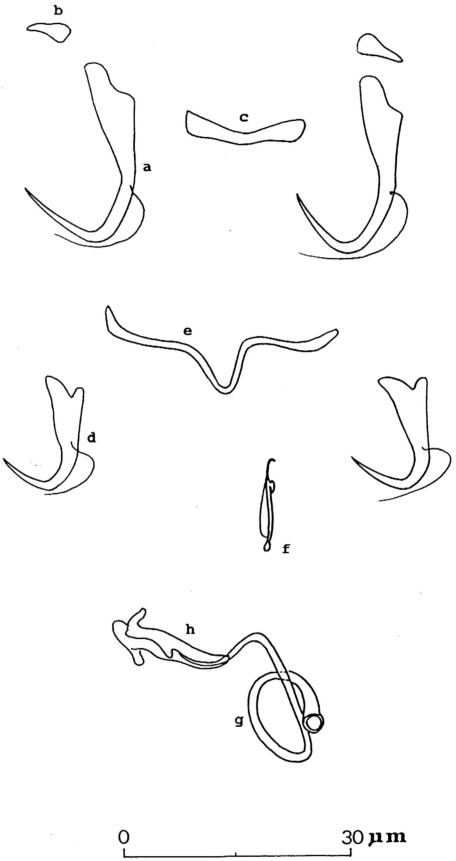


Fig. A37. Hard parts of *Thaparocleidus* n. sp. 14: a, dorsal anchor; b, patch; dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulat tube; h, accessory piece. Scale-bar in micrometres

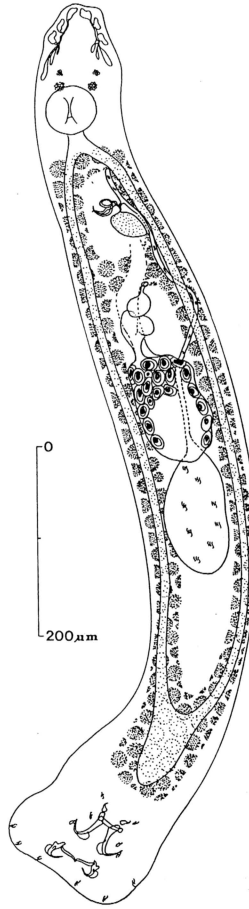


Fig. A38. Composite illustration of *Thaparocleidus* n. sp. 15 (ventral view). Scale-bar in micrometres

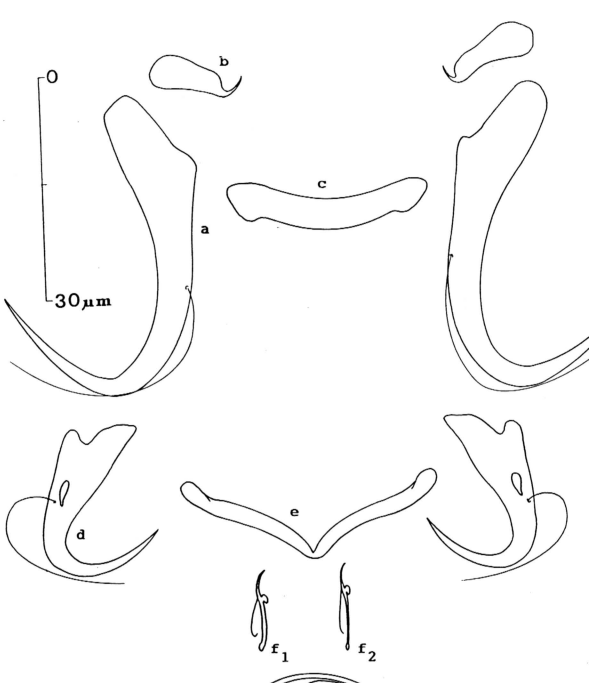


Fig. A39. Hard parts of *Thaparocleidus* n. sp. 15: a, dorsal anchor; b, patch; c dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g copulatory tube; h, accessory piece. Scale-bar in micrometres

Appendix 3. 3: Monogeneans of Clariidae and Heteropneustidae

Introduction

The monogeneans of Clariidae and Heteropneustidae will be discussed together since the only species of Heteropneustidae examined was found to possess the same species of monogenean as one of the Clariidae.

There are two genera of Clariidae in Southeast Asia, *Clarias* Scopoli, 1777 and *Encheloclarias* Herre & Myers, 1937. *Encheloclarias* is restricted to the island of Borneo and Peninsular Malaysia (Roberts, 1989) and not recorded thus far in Thailand.

There are seven species of *Clarias* in Thailand; *Clarias batrachus* (Linnaeus, 1758), *Clarias cataractus* (Fowler, 1939), *Clarias leiacanthus* Bleeker, 1851, *Clarias macrocephalus* Gunther, 1864, *Clarias meladerma* Bleeker, 1847, *Clarias nieuhofi* (Val. in Cuv. & Val., 1840) and *Clarias teysmanni* (Bleeker, 1857). *Clarias gariepinus* Burchell, 1822 (syn. *Clarias lazera* Val. in Cuv. & Val., 1840) the African catfish was recently introduced into Thailand for culture purpose. The hybrid of *C. macrocephalus* and *C. gariepinus* is now widely cultured in Thailand. Except for *C. leiacanthus* and *C. teysmanni* the other five *Clarias* species as well as the introduced *Clarias gariepinus* and the hybrid were examined for monogeneans.

Heteropneustes fossilis (Bloch, 1797) is the sole representative of the *Heteropneustes* Muller, 1840 (Heteropneustidae) in Thailand (see Smith, 1945). This fish species was examined for monogeneans in this study. Thus far, only *Bychowskyella fossilisi* Majumdar & Agarwal, 1988 and *Gyrodactylus gussevi* Dubey, Gupta & Agarwal, 1990 were recorded on *H. fossilis* from India (see Majumdar & Agarwal, 1988; Dubey, Gupta & Agarwal, 1990).

To date six ancyrocephalin species (four species of *Bychowskyella* Achmerow, 1952 and two species of *Quadriacanthus* Paperna, 1961) and two species of *Gyrodactylus* Nordman, 1832 were recorded from *Clarias* species in the Oriental region; (see Ha, 1968; Lerssutthichawal & Lim, 1997; Lim, 1991b; Lim & Furtado, 1983; Long, 1981; Zhang & Ji, 1981). While eight species of *Quadriacanthus*, one species of *Paraquadriacanthus* Ergens, 1988 and two species were found on the African clariids (Table A3).

Results

In this study, a total of nine monogeneans species (seven species of *Bychowskyella* Achmerow, 1952 and two species of *Quadriacanthus* Paperna, 1961) were collected from five *Clarias* species, including the introduced *C. gariepinus* and the hybrid. The seven species of *Bychowskyella* collected include two previously described species and five new species. *B. tchangi* Gussev, 1976 was found on *C. batrachus* and *C. macrocephalus*, while *B. teysmanni* Lim, 1991 was collected from *C. meladerma*. The other five new *Bychowskyella* species were found on *C. batrachus* (one species), *C. meladerma* (one species) and *C. nieuhofi* (three species). *B. tchangi* was also collected from *H. fossilis* (Heteropneustidae).

The two species of *Quadriacanthus* were *Q. kobiensis* Ha, 1968 (from *C. batrachus*, *C. macrocephalus*, *C. meladerma* and *C. cataractus*) and *Q. bagrae* Paperna, 1979 (from *C. gariepinus* and the *Clarias* hybrid).

1. *Bychowskyella tchangi* Gussev, 1976 (Fig. A40)

Type host: *Clarias batrachus* (Linnaeus, 1758)
Type locality: Lucknow, India
Present hosts: *C. batrachus* (12 individuals examined, 6 infected, 41 monogeneans collected from sites 1, 3, 4 & 5); *C. macrocephalus* Gunther, 1864 (16 individuals examined, 9 infected, 68 monogeneans collected from sites 1, 2, 4 & 5); *H. fossilis* (Bloch, 1797) (10 individuals examined, 5 infected, 5 monogeneans collected from site 7)
Localities: Khog-kram subdistrict, Nakornsithammarat (site 1); Cha-uad district, Nakornsithammarat (site 2); Mun River, Ubonratchathanee (site 3); Muang district, Pattanee (site 4); Nong-haan, Sakol-nakorn (site 5); Ubonratana Reservoir, Khon-kean (site 6); Tapi River, Surat-thani (site 7)
No. of monogenean specimens collected and studied: 114

Remark: *Bychowskyella tchangi* Gussev, 1976 could be found on *C. batrachus* of India, Malaysia, Thailand and China (see Gussev, 1976, Lim & Furtado, 1983, Lerssutthichawal & Lim, 1997, Long, 1981), and on Thai *C. macrocephalus* (see Lerssutthichawal & Lim, 1997). *B. tchangi* was also collected from Thai *H. fossilis*. Long (1981) proposed a new genus for *B. tchangi* re-naming it *Clariotrema tchangi*. However in this study *Clariotrema* is considered invalid and the original name, *B. tchangi*, is retained and *C. tchangi* is made a junior synonym of *B. tchangi*. *H. fossilis* (Heteropneustidae) is a new host species record for *B. tchangi*.

2. *Bychowskyella teysmanni* Lim, 1991 (Fig. A41)

Type host: *Clarias teysmanni* Bleeker, 1857
Type locality: Selangor, Peninsular Malaysia
Present host: *Clarias meladerma* Bleeker, 1847 (4 individuals examined, 2 infected)
Locality: Khog-kram subdistrict, Nakornsithammarat
No. of monogenean specimens collected and studied: 5

Remark: *Bychowskyella teysmanni* Lim, 1991 was first described from *C. teysmanni* in Malaysia (see Lim, 1991). In the present study *B. teysmanni* was obtained from *C. meladerma*. This represents a new host record for *B. teysmanni*.

3. *Quadriacanthus kobiensis* Ha, 1968 (Figs. A42 & A43)

Type host: *Clarias fuscus*
Type locality: North Vietnam

Present hosts: *C. batrachus* (Linnaeus, 1758) (12 individuals examined, 9 infected, 68 monogeneans collected from sites 1, 3, 4 & 5); *C. macrocephalus* Gunther, 1864 (16 individuals examined, 9 infected, 55 monogeneans collected, from sites 1, 2, 4, 5 & 6); *C. cataractus* (Fowler, 1939) (5 individuals examined, 4 infected, 21 monogeneans collected from site 7); *C. meladerma* Bleeker, 1847 (4 individuals examined, 1 infected, 4 monogeneans collected from site 1)
Localities: Khog-Kram subdistrict, Nakornsithammarat (site 1); Cha-uad district, Nakornsithammarat (site 2); Mun River, Ubonratchathanee (site 3); Muang district, Pattanee (site 4); Nong-haan, Sakol-nakorn (site 5); Ubonratana Reservoir, Khon-kean (site 6); Yong Waterfall National Park, Nakornsithammarat (site 7)
No. of monogenean specimens collected and studied: 144
No. of monogenean specimens measured: 10

Body size 587 (538-714) x 101 (84-126). Four eye spots. Haptor size 100 (84-126) x 160 (126-201). Dorsal anchors: *Quadriacanthus*-type, total length 27 (24-30); long recurved point 24 (22-26). Dorsal patches (on dorsal anchors), size 12 x 3 (3-4). Ventral anchors: without root, total length 29 (28-30); long, recurved point 27 (24-28). Ventral patches (on ventral anchors), size 8 x 2. Dorsal bar T-shaped, size 42 (38-48) x 42 (40-46) (with process). Ventral bars paired, fenestrated, size of each side 44 (42-48) x 8 (7-9). Seven pairs of marginal hooks, 3 types: one large pair with well-developed handle (1/2 of total length), length 20 (20-22), one pair handle reduced, length 12 (12-13) and 5 pairs without handle, length 12 (12-13).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum. Two seminal vesicles are dilated portions of vas deferens. Ejeculatory duct leaves the second seminal vesicle to enter initial part of copulatory tube. Copulatory organ consists of short curved copulatory tube length 14 (14-16), widening at initial part, diameter 6 (5-8) and curved rod-like accessory piece, length 18 (16-20), width 6 (5-8). Two prostatic reservoirs bean-shaped, enter separately into initial part of copulatory tube. Vaginal opening sinistral, sclerotised rosette-like, connected to ovoid seminal receptacle with short vaginal tube.

Remark: *Quadriacanthus kobiensis* Ha, 1968 was first collected and described from the Vietnamese *Clarias fuscus*. It could also be found on *C. batrachus* of India, Malaysia and Thailand (see Ha, 1968; Gussev, 1976; Lim & Furtado, 1983; present study). In the present study *Q. kobiensis* could also be found on *C. macrocephalus*, *C. cataractus* and *C. meladerma*.

The original description of *Q. kobiensis* by Ha (1968) and subsequent reports by Gussev (1976) and Lim & Furtado (1983) did not mention the vaginal armament of *Q. kobiensis*. In this study, a sclerotised rosette-like vaginal opening was observed in some specimens. The presence of *Q. kobiensis* on four *Clarias* species indicates that *Q. kobiensis* is common on clariid fishes.

4. *Quadriacanthus bagrae* Paperna, 1979 (Fig. A44)

Type host: *Bagrus docmac* (Forsskal, 1775)
Type locality: Uganda
Other hosts: *Bagrus bayad* (Forsskal, 1775) from Uganda; *Bagrus orientalis* (Boulenger, 1902) from Tanzania; *Clarias gariepinus* Burchell, 1822 (syn. *C. lazera*) from Egypt
Present hosts: Introduced *C. gariepinus* (4 individuals examined, 2 infected, 76 mono-geneans collected from sites 1 & 2); the *Clarias* hybrid (27 individuals examined, 9 infected, 121 monogeneans collected from sites 1, 2, 3, 4 & 5)
Localities: Nakornsithammarat Agricultural Campus (RIT), Nakornsithammarat (site 1); Lumpang Agricultural Campus (RIT), Lumpang (site 2); Ayudthaya Agricultural Campus (RIT), Ayudthaya (site 3); Ubonratchathanee Fishery Station, Ubonratchathanee (site 4); Muang district, Pattanee (site 5)
No. of monogenean specimens collected and studied: 197
No. of monogenean specimens measured: 10

Body size 601 (462-697) x 110 (92-126). Four eye spots. Haptor size 89 (67-101) x 119 (92-151). Dorsal anchors: *Quadriacanthus*-type, total length 35 (32-36); long, recurved point 12 (11-10). Dorsal patches, size 10 (8-10) x 5 (4-6). Ventral anchors: without root, total length 27 (24-28); long, recurved point 12 (10-14). Ventral patches, size 4 x 2 (2-3). Dorsal bar with short process, size 42 (38-48) x 51 (44-56) (with process). Ventral bars paired, fenestrated, size of each side 44 (42-48) x 9 (8-10). Seven pairs of marginal hooks, 3 types: one large pair with well-developed handle (1/2 of total length), length 25 (20-30), one pair, handle reduced, length 15 (14-18) and 5 pairs with-out handle, length 13 (12-14).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum. Two seminal vesicle are dilated portions of vas deferens. Ejeculatory duct leaves the second seminal vesicle to enter initial part of copulatory tube. Copulatory organ consists of short straight copulatory tube, length 24 (22-26), widening at initial part, diameter 3 (2-4) and rod-like accessory piece, length 23 (22-24), width 3 (2-5). Vaginal opening not observed.

Remark: There are seven *Quadriacanthus* species on the African *C. gariepinus* (syn. *C. lazera*) (see Paperna, 1969; Kritsky & Kulo, 1988). The seven species are *Quadriacanthus clariadis* Paperna, 1961, *Q. aegypticus* El-Naggar & Serag, 1986, *Q. allobychowskiella* Paperna, 1979, *Q. bagrae* Paperna, 1979, *Q. papernai* Kritsky & Kulo, 1988, *Q. ashuri* Kritsky & Kulo, 1988 and *Q. numidus* Kritsky & Kulo, 1988.

In the present study only one species, *Q. bagrae,* was found on *C. gariepinus* introduced into Thailand. The morphology and morphometric data of the present species are similar to the original morphometric data of *Q. bagrae* from *Bagrus docmac* (Bagridae) in Uganda (Paperna, 1979) and on *C. lazera* from the Nile River in Egypt (Kritsky & Kulo, 1988). In Thailand, *Q. bagrae* was collected from both *C. gariepinus* and the hybrid of *C. macrocephalus* and *C. gariepinus*.

5. *Bychowskyella* n. sp. 1 (Fig. A45)

Type host: *Clarias batrachus* (Linnaeus, 1758) (12 individuals examined, 4 infected from site 1)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Khog-kram subdistrict, Nakornsithammarat (site 2); Cha-uad district, Nakornsithammarat (site 3); Muang district, Pattanee (site 4); Nong-haan, Sakol-nakorn (site 5)
No. of monogenean specimens collected and studied: 46
No. of monogenean specimens measured: 10

Body size 541 (420-672) x 87 (76-101). Four eye spots. Haptor, size 94 (76-109) x 139 (109-168). Dorsal anchors: *Bychowskyella*-type, total length 46 (42-48) and short point 8. Patches long curved, size 36 (34-41) x 4 (4-5). Ventral anchors: *Bychowskyella*-type, total length 24 (20-28), elongate recurved point 11 (10-12). Dorsal bar fenestrated in middle, size 12 (10-14) x 41 (38-44). Ventral bars paired, fenestrated, size of each side 41 (38-44) x 8 (6-10). One pair of rod-like sclerotised pieces observed near dorsal anchors, length 8 (6-10). Seven pairs of marginal hooks, 4 types: one large pair, with well-demarcated handle (2/3 of total length), length 38 (34-40); one pair of medium size hooks, with small handle, length 16 (14-16); 4 small pairs, handle reduced as knob, length 13 (12-14) and one pair near ventral anchors, length, 12 (12-13).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum. Two seminal vesicles are dilated portions of vas deferens. Ejeculatory duct leaves the second seminal vesicle to enter initial part of copulatory tube. Copulatory organ consists of curved copulatory tube, length 41 (38-48), widening at initial part, diameter 7 (6-10) and rod-like accessory piece, length 32 (30-34), width 2 (2-3). Prostatic reservoir bean-shaped, enters separately into initial part of copulatory tube. Vaginal opening not observed.

Differential diagnosis: The present species is similar to *B. tchangi* Gussev, 1976 in having similar types of haptoral armaments, but differs from it in having noticeably larger copulatory tube (twice the length of the copulatory tube of *B. tchangi*). This species is also different from the other known *Bychowskyella* species in having one large pair of marginal hooks and comparatively larger curved copulatory tube. This species is thus considered a new species and denoted as *Bychowskyella* n. sp. 1.

6. *Bychowskyella* n. sp. 2 (Fig. A46)

Type host: *Clarias meladerma* Bleeker, 1847 (4 individuals examined, 3 infected from sites 1 & 2)
Localities: Khog-kram subdistrict, Nakornsithammarat (type locality) (site 1); Yong Waterfall National Park, Nakornsithammarat (site 2)
No. of monogenean specimens collected and studied: 9
No. of monogenean specimens measured: 7

Body size 598 (442-752) x 72 (55-78). Four eye spots. Haptor size 72 (60-100) x 149 (104-200). Dorsal anchors: *Bychowskyella*-type, total length 51 (48-54); short point 8 (7-8). Patches long curved, size 37 (34-40) x 4 (3-4). Ventral anchors: *Bychowskyella*-type, total length 24 (20-26); recurved point 10 (8-10). Dorsal bar fenestrated in middle, size 13 (12-14) x 40 (38-42). Ventral bars paired, fenestrated, size of each side 52 (50-54) x 4 (4-5). One pair of rod-like sclerotised pieces observed near dorsal anchors, length 19 (16-20). Seven pairs of marginal hooks, 5 types: one large pair with well-demarcated handle (2/3 of total length), length 39 (36-40); one pair of medium sized hook with demarcated handle (half of total length), length 22 (20-22); one pair with short handle (1/4 of pivot), length 17 (16-20); 3 small pairs, handle reducing as knob, length 12 (11-12) and one pair near ventral anchors, length 11 (10-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum. Two seminal vesicles are dilated portions of vas deferens. Ejeculatory duct leaves the second seminal vesicle to enter initial part of copulatory tube. Copulatory organ consists of curved copulatory tube, length 28 (24-32), widening at initial part, diameter 2 and plate-like accessory piece with recurved shield-like process at its proximal part, size 36 (34-38) x 3 (3-4). Vaginal opening sinistral, guarded with sclerotised piece.

Differential diagnosis: The present species is similar to *B. teysmanni* Lim, 1991 in having similar types of haptoral armaments. The present species differs from it and other *Bychowskyella* species in the morphology of copulatory organ and vaginal armaments. The present species possesses an elongate plate-like accessory piece with a shield-like process at the proximal end and a vaginal opening guarded with sclerotised piece, while in *B. teysmanni* the accessory piece is rod-like and sclerotised vaginal opening is funnel-like. Hence, it is considered a new species and denoted in this thesis as *Bychowskyella* n. sp. 2.

7. *Bychowskyella* n. sp. 3 (Figs. A47 & A48)

Type host: *Clarias nieuhofi* (Val., in Cuv. & Val., 1840) (11 individuals examined, 7 infected from sites 1 & 2)
Localities: Cha-uad district, Nakornsithammarat (type locality) (site 1); Acid sulphate soil swamp, Narathiwas (site 2)
No. of monogenean specimens collected and studied: 74
No. of monogenean specimens measured: 10

Body size 467 (378-546) x 78 (59-101). Four eye spots. Haptor size 76 (59-84) x 146 (109-168). Dorsal anchors: *Bychowskyella*-type, total length 36 (34-38); short point 4. Patches long curved with hook-like distal tips, size 32 (30-34) x 3 (3-4). Ventral anchors: *Bychowskyella*-type, total length 24 (20-28); recurved point 10 (8-12). Dorsal bar fenestrated in middle, size 10 (8 -10) x 35 (30-38). Ventral bars paired, fenestrated, size of each side 51 (48-52) x 7 (5-8). One pair of rod-like sclerotised pieces observed near dorsal anchors, length 13 (12-15). Seven pairs of marginal hooks, 4 types: one large pair with well-demarcated handle, length 28 (26-30); one pair of medium size hooks, with half demarcated handle,

length 22 (20-24); 4 small pairs, handle reducing as knob, length 13 (12-14) and one pair near ventral anchors, length 12 (10-13) 13).

Vas deferens arises from anterior region of testis loop round left intestinal caecum. Two seminal vesicles are dilated portions of vas deferens. Ejeculatory duct leaves the second seminal vesicle to enter initial part of copulatory tube. Copulatory organ consists of curved copulatory tube, length 22 (20-24), widening at initial part, diameter 2 and rod-like accessory piece with bifurcated piece at proximal region, size 20 (16-24) x 3 (2-4). Prostatic reservoir bean-shaped, enters separately into initial part of copulatory tube. Vaginal opening slightly sclerotised funnel-like, connected to round seminal receptacle with short vaginal tube.

Differential diagnosis: The present species is different from the other known *Bychowskyella* species in having a long curved patch with hook-like distal tip. This species is considered a new species and identified as *Bychowskyella* n. sp. 3.

8. *Bychowskyella* n. sp. 4 (Fig. A49)

Type host: *Clarias nieuhofi* (Val. in Cuv. & Val., 1840) (11 individuals examined, 7 infected from sites 1 & 2)
Localities: Cha-uad district, Nakornsithammarat (type locality) (site 1), Acid sulphate soil swamp, Narathiwas (site 2)
No. of monogenean specimens collected and studied: 55
No. of monogenean specimens measured: 10

Body size 554 (462-698) x 87 (76-101). Four eye spots. Haptor size 89 (76-101) x 144 (126-168). Dorsal anchors: *Bychowskyella*-type, total length 46 (44-48); short point 6 (5-6). Long curved patches, size 38 (34-40) x 4 (3-4). Ventral anchors: *Bychowskyella*-type: total length 23 (20-24) and recurved point 8 (6-10). Dorsal bar fenestrated in middle, size 12 (10-14) x 39 (36-42). Ventral bars paired, fenestrated, size of each side 56 (52-60) x 8 (6-10). One pair of thin sclerotised rod, length 17 (13-20). Seven pairs of marginal hooks, 5 types: one large pair with well-demarcated handle (2/3 of total length), length 38 (35-40); one pair of medium size hooks, with demarcated handle (half of total length), length 23 (20-26); one pair with small handle (1/3 of total length), length 15 (14-16); 3 small pairs, handle reducing as knob, length 12 (11-12) and one pair, near ventral anchors, length 12 (10-12).

Vas deferens arises from anterior region of testis loop round left intestinal caecum. Two seminal vesicles are dilated portions of vas deferens. Ejeculatory duct leaves the second seminal vesicle to enter initial part of copulatory tube. Copulatory organ consists of curved copulatory tube, length 22 (16-26), widening at initial part, diameter 3 (2-4) and stick-like accessory piece with long process at the proximal region, size 26 (24-30) x 4 (3-4). Vaginal opening slightly sclerotised funnel-like. Vaginal tube short.

Differential diagnosis: The present species is similar to *B. teysmanni* Lim, 1991 and *Bychowskyella* n. sp. 1 in having similar types of haptoral armaments, but differs from them in the morphology of copulatory organ. The present species possesses a long process at the proximal part of accessory piece of copulatory organ, while this structure is absent in *Bychowskyella* n. sp. 1 and *B. teysmanni* (see Figs. A41 & A45). The present species is also different from the other known *Bychowskyella* species in the detailed morphology of the vaginal opening. This species is considered new and identified as *Bychowskyella* n. sp. 4.

9. *Bychowskyella* n. sp. 5 (Fig. A50)

Type host: *Clarias nieuhofi* (Cuv. in Cuv. & Val., 1840) (11 individuals examined, 4 infected from sites 1 & 2)
Localities: Cha-uad district, Nakornsithammarat (type locality) (site 1); Acid sulphate soil swamp, Narathiwas (site 2)
No. of monogenean specimens collected and studied: 10
No. of monogenean specimens measured: 7

Body size 398 (345-436) x 71 (52-82). Four eye spots. Haptor size 89 (76-101) x 95 (82-148). Dorsal anchors: *Bychowskyella*-type, total length 39 (37-42); short point 10 (8-11). Short massive, curved patches, size 26 (25-28) x 4(4-5). Ventral anchors: *Bychowskyella*-type, total length 22 (20-24); recurved point 10 (8-10). Dorsal bar fenestrated in middle, size 12 (10-13) x 39 (36-42). Ventral bars paired, non-fenestrated, size of each side 35 (34-37) x 6 (6-8). One pair of rod-like sclerotised pieces, length 12(11-13). Seven pairs of marginal hooks, 4 types: one large pair well-demarcated handle (2/3 of total length), length 27 (25-28); one pair of medium size hooks, with small handle, length 19 (18-19); 4 small pairs, handle reducing as knob, length 13 (12-13) and one pair near ventral anchors, length 12 (11- 12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum. Two seminal vesicles are dilated portions of vas deferens. Ejeculatory duct leaves the second seminal vesicle to enter initial part of copulatory tube. Copulatory organ consists of curved copulatory tube, length 30 (27-32), widening at initial part, diameter 2 (2-3) and rod-like accessory piece with bifurcated piece and long process at its proximal region, size 30 (29-33) x 3 (3-4). Vaginal opening slightly sclerotised funnel-like. Vaginal tube short.

Differential diagnosis: The present species is similar to *B. teysmanni* Lim, 1991, *Bychowskyella* n. sp. 1 and *Bychowskyella* n. sp. 4 in having similar types of haptoral armaments, but differs from them in having a comparatively smaller body size, short massive curved patches, and non-fenestrated paired ventral bars. This species is also different from the other known *Bychowskyella* species in the morphology of patches and ventral bars. It is thus considered a new species and is denoted as *Bychowskyella* n. sp. 5.

Discussion

Thus far only three monogenean genera: *Bychowskyella*, *Quadriacan-thus* and *Gyrodactylus* were recorded from Asian clariids (see Gussev, 1976; Ha, 1968; Hanek & Furtado, 1973; Lim, 1991b, Lim & Furtado, 1983; Long, 1981; Lerssutthichawal, 1997; Zhang & Ji, 1981), whilst *Quadriacanthus*, *Paraquadriacanthus* and *Gyrodactylus* were recorded from African clariids (see Ergens, 1988; Kritsky, 1990; Kritsky & Kulo, 1988; Paperna, 1961, 1969; Paperna & Thurston, 1968) (Table A3).

***Bychowskyella* Achmerow, 1952**

Currently there are 23 described species of *Bychowskyella* and four of these species are from Clariidae (see Gussev, 1976; Lim, 1991b; Long, 1981; Zhang & Ji, 1981 & Table 4.7: Chapter 4). The five new species of *Bychowskyella* found in the present study increases the number of *Bychowskyella* species described from Clariidae to nine.

Members of this genus could be found on Bagridae (see Gussev, 1985; Li & Zhang, 1992; Long, 1981; Majumdar & Agarwal, 1988), Clariidae (see Gussev, 1976; Lim, 1991b; Lerssutthichawal & Lim, 1997; Lim & Furtado, 1983; Long, 1981; Zhang & Ji, 1981), Heteropneustidae (see Majumdar & Agarwal, 1988, present data), Schilbeidae (see Gussev, 1976, 1977, 1978; Jain, 1959, 1961; Tripathi, 1957), Siluridae (see Jain, 1959; Lim, 1991b; Rajeswari & Kulkarni, 1983) and Sisoridae (see Lim, 1991b; Ma, Wang & Li, 1983) (see Table 4.7). In the present study *Bychowskyella* species were collected from the Clariidae and Heteropneustidae, as well as Sisoridae (see also Appendix 3.7: Monogeneans of Sisoridae).

Morphologically, the haptoral armament of the different *Bychowskyella* species from the various *Clarias* species are almost similar, except in the number of large marginal hooks and the detailed morphology of the copulatory organ. Unlike the *Bychowskyella* species on schilbeids and sisorids which possess one or more onchium (see Tripathi, 1957; Gussev, 1977; Lim, 1991b; Ma, Wang & Li, 1983), all the four species of *Bychowskyella* from the Clariidae lack onchium (see Gussev, 1976; Lim, 1991b; Long, 1981).

***Quadriacanthus* Paperna, 1961**

To date, 11 *Quadriacanthus* species were described from three fish families; Clariidae, Bagridae and Cichlidae (see Table 4.9: Chapter 4). Of these 11 species, two are from Asian *Clarias* species: *Q. kobiensis* on *C. batrachus*, *C. macrocephalus*, *C. cataractus* and *C. meladerma* and *Q. gyrocirrus* on *C. fuscus* (see Gussev, 1976; Ha, 1968; Lerssutthichawal & Lim, 1997; Lim & Furtado, 1983; Long, 1981; present study). The other nine *Quadriacanthus* species were found on African fishes: eight species from Clariidae and one species (*Q. tilapiae* Paperna, 1973) from *Tilapia esculenta* (Cichlidae) (see Paperna, 1973). Of the eight *Quadriacanthus* species found on clariids, *Q. bagrae* and *Q. clariadis* were

also found on the *Bagrus* species (Bagridae) (see Paperna, 1979; Paperna & Thurston, 1968).

There are seven species of *Quadriacanthus* and one species of *Paraquadriacanthus* on *C. gariepinus* in Africa (Table A3), but only *Q. bagrae* was found on *C. gariepinus* introduced into Thailand.

The present study indicates that *Q. kobiensis* is common to the *Clarias* species (found on four of the seven *Clarias* species examined). *Q. kobiensis* is not only distributed on a wide range of fish species, but it also has a wide geographical distribution, from the Indian subcontinent, Malaysia, Thailand to Indo-China) (Gussev, 1976; Ha, 1968; Lerssutthichawal & Lim, 1997; Lim & Furtado, 1983).

Q. bagrae was found on the introduced *C. gariepinus* as well as on their hybrid which is a cross between *C. macrocephalus* and *C. gariepinus*. *Q. bagrae* was introduced into Thailand when *C. gariepinus* was introduced. Although *C. macrocephalus* is host to *B. tchangi* and *Q. kobiensis* somehow these monogeneans are not found on the hybrid.

Clariidae and Heteropneustidae are morphologically closely related, (Munshi & Hughes, 1992); they also possess the same monogenean species, *B. tchangi*. However, *B. fossilisi* found on *H. fossilis* in India (see Majumdar & Agarwal, 1988) was not found on the Thai *H. fossilis* (present study). The original description and illustrations given for *B. fossilisi* by Majumdar and Agarwal (1988) are similar to that of *B. tchangi* from the *C. batrachus* in India (Gussev, 1976). The only difference is the size of haptoral structures: in *B. fossilisi* which are comparatively smaller than that of *B. tchangi*. It is possible that the *B. fossilisi* could be synonym of *B. tchangi*.

Lim and Furtado (1983) noted that the development stages of *Quadriacanthus* and *Bychowskyella* are similar and suggested that the two genera are phylogenetically related.

Table A3 Monogeneans of the clariids and heteropneustid (PM: Peninsular Malysia)

Fish host species	Monogenean species	Localities	References
Clariidae			
Clarias batrachus	*Bychowskyella tchangi*	India	Gussev, 1976
		China	Long, 1981
		PM	Lim & Furtado, 1983
		Thailand	present study
	Bychowskyella n.sp.1	"	present study
	Quadriacanthus kobiensis	India	Gussev, 1976
		PM	Lim & Furtado, 1983
		Thailand	present study
	Q. gyrocirrus	China	Long, 1981
	Gyrodactylus fernandoi	PM	Hanek & Furtado, 1978
C. cataractus	*Q. kobiensis*	Thailand	present study
C. fuscus	*B. austrofujianensis*	China	Zhang & Ji, 1981
	B. meridionalis	"	Zhang & Ji, 1981
	Q. kobiensis	Vietnam	Ha,1968
	Gyrodactylus fusci	"	Ha, 1968
C. gariepinus	*Q. aegypticus*	Egypt	El-Naggar & Serag, 1985
(*C. lazera*)		"	Kritsky & Kulo, 1988
	Q. allobychowskiella	"	El-Naggar & Serag, 1985
		"	Kritsky & Kulo, 1988
		Uganda	Paperna, 1979
	Q. ashuri	Egypt	Kritsky & Kulo, 1988
	Q. bagrae	"	Kritsky & Kulo, 1988
		Thailand	Lerssutthichawal & Lim, 1997
	Q. clariadis	Israel	Paperna, 1961
		Egypt	Molnar & Mossalam, 1985
		"	Kritsky & Kulo, 1988
		Ghana	Paperna, 1969
	Q. numidus	Egypt	Kritsky & Kulo, 1988
	Q. papernai	"	Kritsky & Kulo, 1988
	Paraquadriacanthus nasalis	"	Ergens, 1988; Kritsky & Kulo, 1988; Kritsky, 1990
	G. groschafti	"	Ergens, 1973
	G. rusavyi	"	Ergens, 1973

Table A3 cont'd

Fish host species	Monogenean species	Localities	References
C. macrocephalus	*B. tchangi*	PM	Lim, 1991b
		Thailand	present study
	Q. kobiensis	"	present study
C. meladerma	*Q. kobiensis*	"	present study
	B. teysmanni	"	present study
	Bychowskyella n.sp.2	"	present study
C. mossambicus	*Q. clariadis*	"	Paperna & Thurston, 1968
C. nieuhofi	*Bychowskyella* n.sp.3	"	present study
	Bychowskyella n.sp.4	"	present study
	Bychowskyella n.sp.5	"	present study
C. teysmanni	*B. teysmanni*	PM	Lim, 1991b
C. walkeri	*Q. voltaensis*	Ghana	Paperna, 1969
Clarias hybrid*	*Q. bagrae*	Thailand	present study
	Gyrodactylus sp.	"	present study
Heterobranchus isopterus	*Q. clariadis*	Ghana	Paperna, 1965; 1969
Heteropneustidae			
Heteropneustes fossilis	*B. fossilisi*	India	Majumdar & Agarwal, 1988
	G. gussevi	"	Dubey, Gupta & Agarwal, 1990
	B. tchangi	Thailand	present study

(*crossbred between *C. macrocephalus* and *C. gariepinus*)

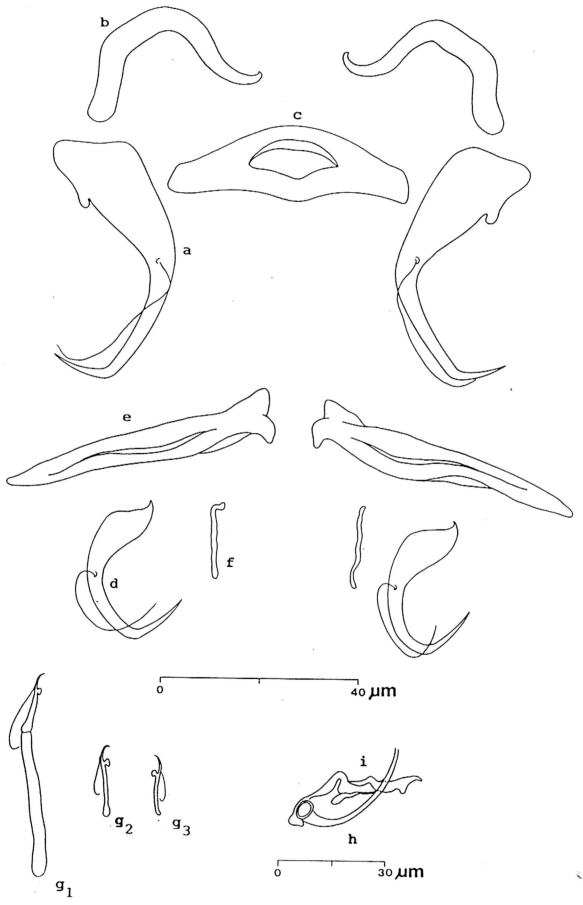


Fig. A40. Hard parts of *Bychowskyella tchangi* Gussev, 1976: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, sclerotised rod; g_1, g_2, g_3 marginal hooks; h, copulatory tube; i, accessory piece. Scale-bar in micrometres

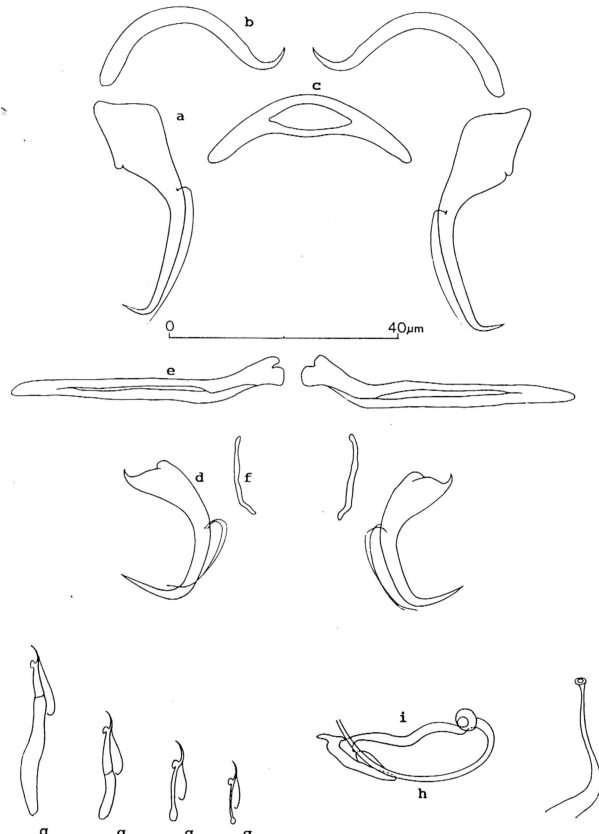


Fig. A41. Hard parts of *Bychowskyella teysmanni* Lim, 1991: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, sclerotised rod; g_1, g_2, g_3, g_4, marginal hooks; h, copulatory tube; i, accessory piece; j, vaginal opening. Scale-bar in micrometres

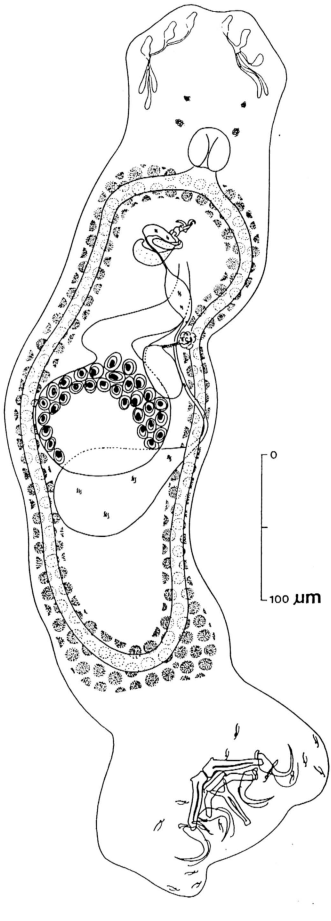


Fig. A42. Composite illustration of *Quadriacanthus kobiensis* Ha, 1968 (ventral view). Scale-bar in micrometres

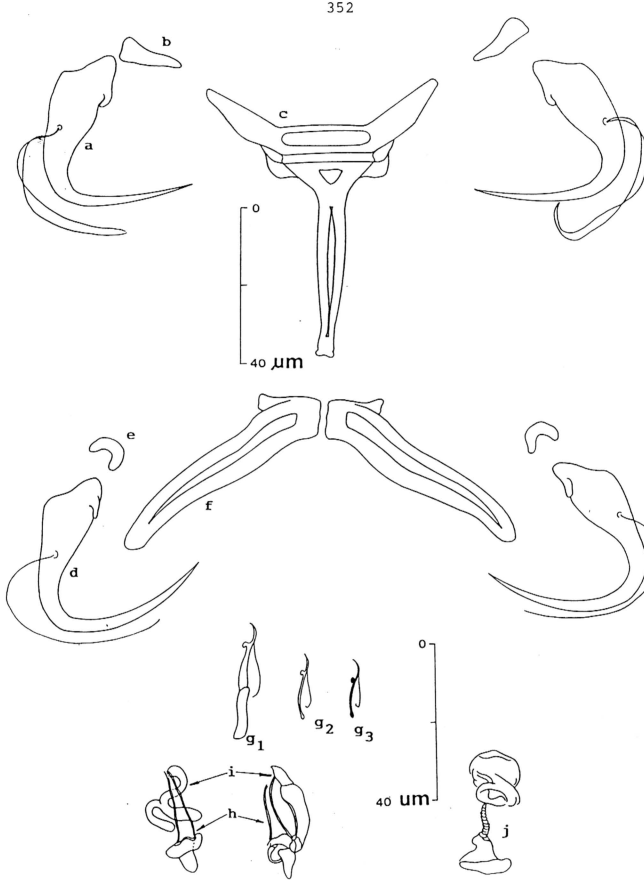


Fig. A43. Hard parts *Quadriacanthus kobiensis* Ha, 1968 : a, dorsal anchor; b, dorsal patch; c, dorsal bar; d, ventral anchor; e, ventral patch; f, ventral bar; g_1, g_2, g_3, marginal hooks; h, copulatory tube; i, accessory piece; j, vaginal system. Scale-bar in micrometres

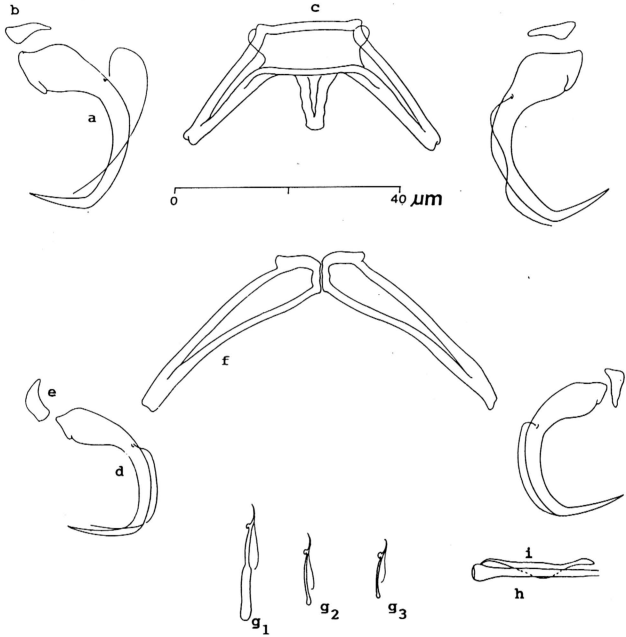


Fig. A44. Hard parts of *Quadriacanthus bagrae* Paperna, 1979: a, dorsal anchor; b, dorsal patch; c, dorsal bar; d, ventral anchor; e, ventral patch; f, ventral bar; g_1, g_2, g_3, marginal hooks; h, copulatory tube; i, accessory piece. Scale-bar in micrometres

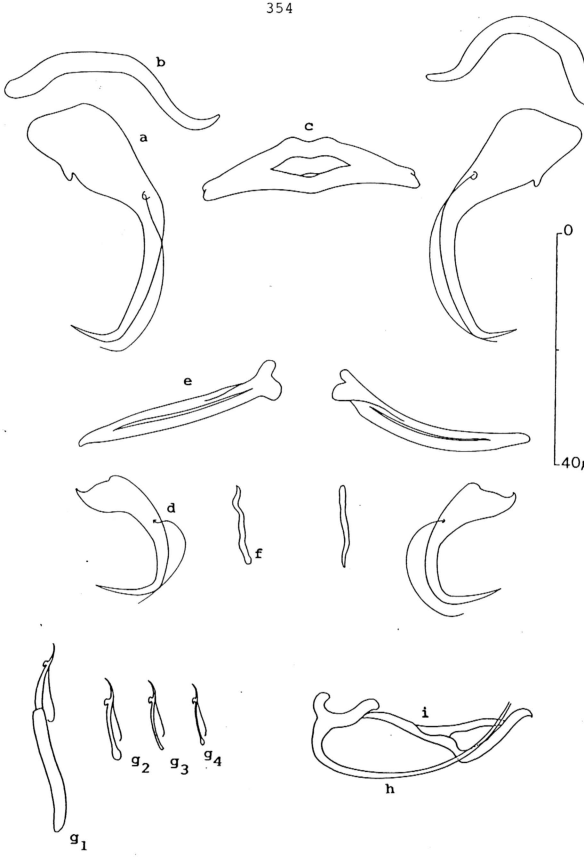


Fig. A45. Hard parts of *Bychowskyella* n. sp. 1: a, dorsal anchor; b, patch; dorsal bar; d, ventral anchor; e, ventral bar; f, sclerotised rod; g_1, g_2, g_4, marginal hooks; h, copulatory tube; i, accessory piece. Scale-bar micrometres

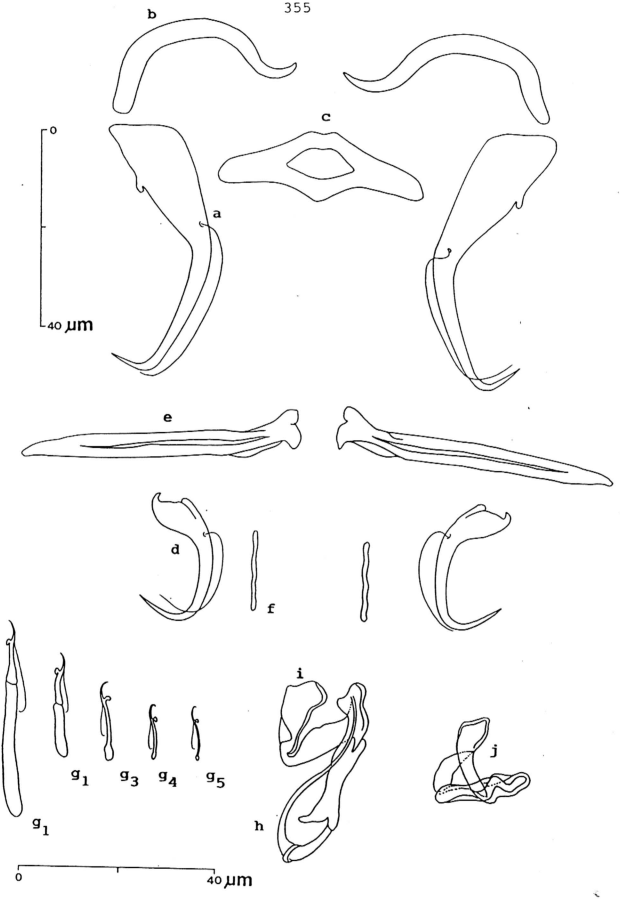
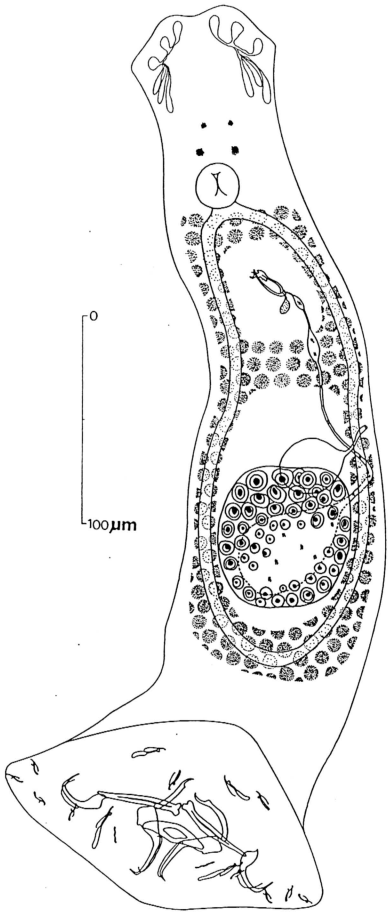


Fig. A46. Hard parts of *Bychowskyella* n. sp. 2: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, sclerotised rod; g_1, g_2, g_3, g_4, g_5, marginal hooks; h, copulatory tube; i, accessory piece; j, vaginal opening. Scale-bar in micrometres



Figs. A47. Composite illustration of *Bychowskyella* n. sp. 3 (ventral view). Scale-bar in micrometres

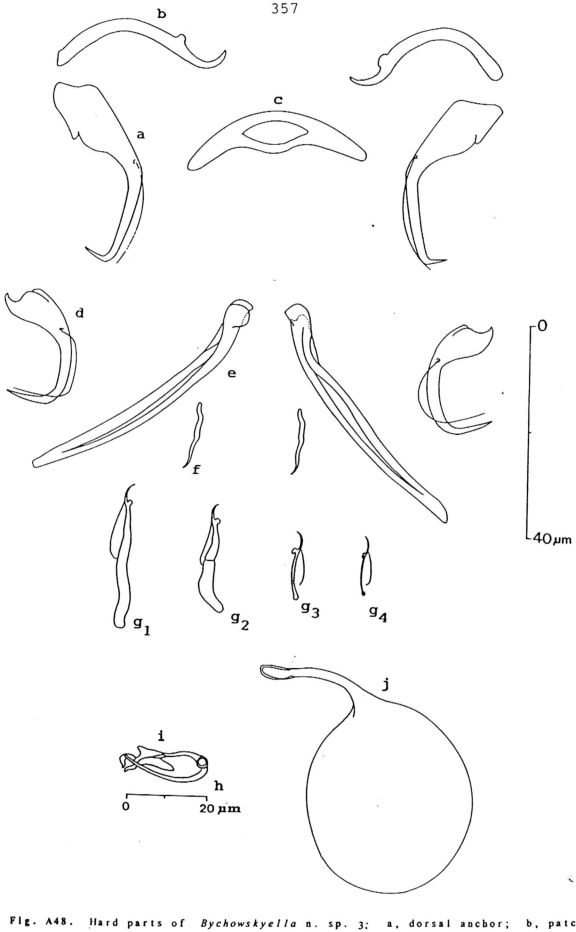


Fig. A48. Hard parts of *Bychowskyella* n. sp. 3; a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, sclerotised rod; g_1, g_2, g_3, g_4, marginal hooks; h, copulatory tube; i, accessory piece; j, vaginal system with seminal receptacle. Scale-bar in micrometres

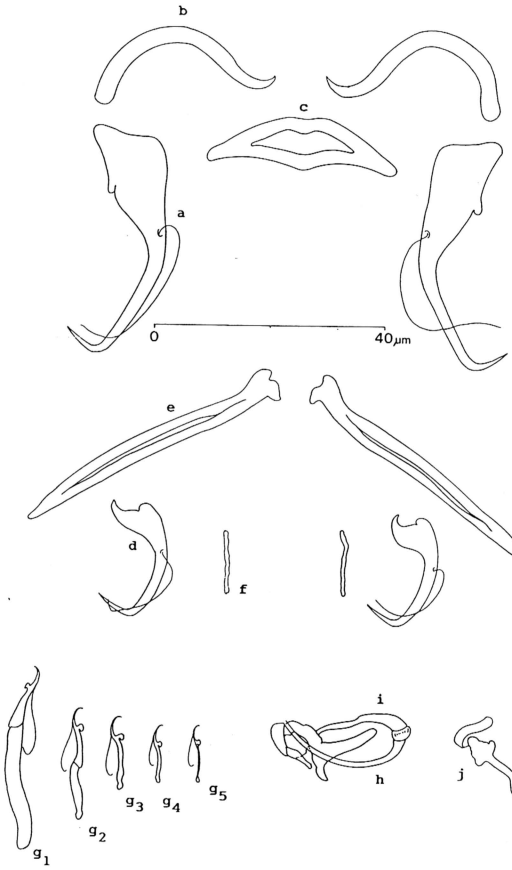


Fig. A49. Hard parts of *Bychowskyella* n. sp. 4: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, sclerotised rod; g_1,g_2,g_3,g_4,g_5, marginal hooks; h, copulatory tube; i, accessory piece; j, vaginal opening. Scale-bar in micrometres

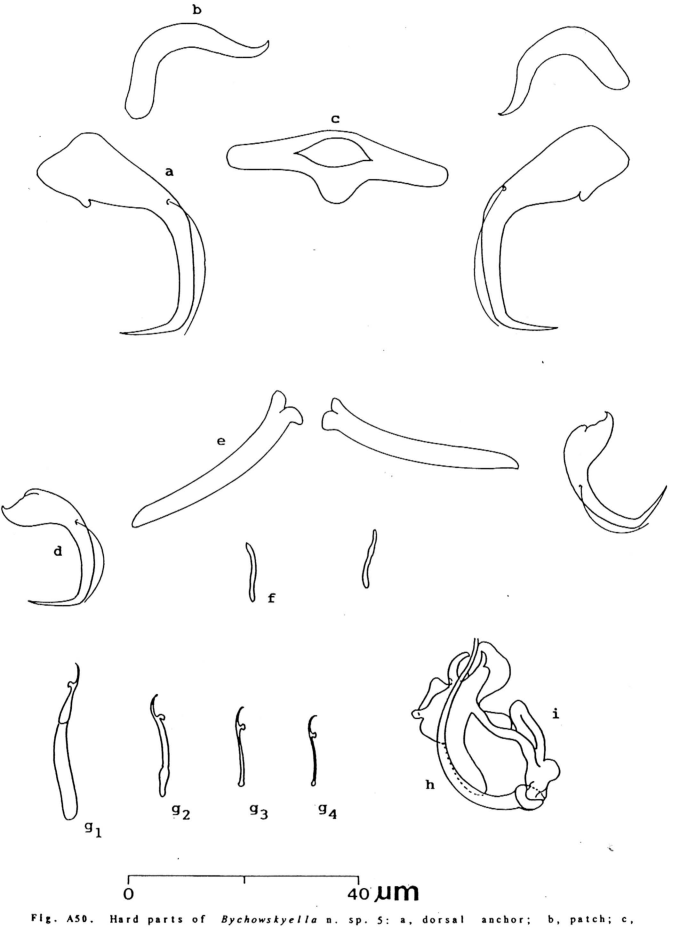


Fig. A50. Hard parts of *Bychowskyella* n. sp. 5: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, sclerotised rod; g_1, g_2, g_3, g_4, marginal hooks; h, copulatory tube; i, accessory piece. Scale-bar in micrometres

Appendix 3.4: Monogeneans of Pangasiidae

Introduction

There are 12 species of Pangasiidae belonging to four genera in Thailand: *Helicophagus* Bleeker, 1858 (one species), *Pangasianodon* Chevey, 1930 (two species), *Pangasius* Valenciennes, 1840 (seven species) and *Pteropangasius* Fowler, 1937 (two species) (see Vidthayanon & Roongthongbaisuree, 1993). In this study ten pangasiid species were examined for monogeneans: *Helicophagus waandersii* Bleeker, 1858, *Pangasianodon hypophthalmus* (Sauvage, 1878), *Pangasianodon gigas* Chevey, 1930, *Pangasius bocourti* Sauvage, 1880, *Pangasius conchophilus* Roberts & Vidthayanon, 1991, *Pangasius krempfi* Fang & Chaux, 1949, *Pangasius larnaudii* Bocourt, 1866, *Pangasius macronema* Bleeker, 1851, *Pangasius sanitwongsei* Smith, 1931 and *Pteropangasius pleurotaenia* (Sauvage, 1878). All except *P. gigas* were infected with *Thaparocleidus* species.

Presently four *Thaparocleidus* species have been recorded from two pangasiid fishes; *Thaparocleidus caecus* (Kritsky & Mizelle, 1969) Lim, 1996 and *Thaparocleidus siamensis* (Lim, 1990) Lim, 1996 from *P. hypophthalmus* (syn. *Pangasius sutchi*) cultured in Peninsular Malaysia (imported from Thailand), *Thaparocleidus campylopterocirrus* (Zeng, 1988) Lim, 1996 from *P. hypophthalmus* in China and *Thaparocleidus pangasi* (Tripathi, 1957) Lim, 1996 from *Pangasius pangasius* in India (see Lim, 1990b, 1996b; Tripathi, 1957; Zeng, 1988).

Results

Nineteen species of *Thaparocleidus* Jain, 1952, 17 new and two previously described species, were obtained from nine Thai pangasiid species. The two previously described species are *Thaparocleidus caecus* (Mizelle & Kritsky, 1969) Lim, 1996 and *T. siamensis* (Lim, 1990) Lim, 1996. *T. caecus* was obtained from six species of pangasiid, *Pangasianodon hypophthalmus*, *Pangasius conchophilus*, *P. krempfi*, *P. larnaudii*, *Pteropangasius pleurotaenia* and *Helicophagus waandersii*, whilst *T. siamensis* was found only on *Pangasianodon hypophthalmus*.

The other 17 new *Thaparocleidus* species were found on *Helicophagus waandersii* (two new species), *Pangasius bocourti* (two new species), *P. conchophilus* (three new species), *P. krempfi* (two new species), *P. larnaudii* (five new species), *P. macronema* (four new species), *P. sanitwongsei* (one new species) and *Pteropangasius pleurotaenia* (five new species). No monogenean species was found on *Pangasianodon gigas* in this study. Of the 17 new *Thaparocleidus* species, eight species are present on two or more pangasiid host species.

1. *Thaparocleidus caecus* (Mizelle & Kritsky, 1969) Lim, 1996 (Fig. A51)

Type host: Unknown aquarium fish (imported species)
Type locality: unknown from Aquarium (probably imported from Thailand)
Present hosts: *Helicophagus waandersii* Bleeker, 1858 (7 individuals examined, 6 infected, 161 monogeneans collected from sites 1 & 2); *Pangasianodon hypophthalmus* (Sauvage, 1878) (9 individuals examined, 3 infected, 240 monogeneans collected, from sites 2, 3 & 4); *Pangasius conchophilus* Roberts &

Vidthayanon, 1991 (10 individuals examined, 8 infected, 76 monogeneans collected from sites 1, 2, 5 & 6); *Pangasius krempfi* Fang & Chaux, 1949 (2 individuals examined, 2 infected, 26 monogeneans collected from site 1); *Pangasius larnaudii* Bocourt, 1866 (4 individuals examined, 4 infected, 56 monogeneans collected from sites 1, 2 & 6); *Pteropangasius pleurotaenia* (Sauvage, 1878) (7 individuals examined, 2 infected, 11 monogeneans collected from sites 1, 2 & 6)
Localities: Me-kong River, Ubonratchathanee (site 1); Mun River, Ubonratchathanee (site 2); Ping River, Tak (site 3); NIFI Aquarium, Bangkok (site 4), Pitsanulok Fishery Station (site 5); Chao-praya River, Chinat (site 6)
No. of monogenean specimens collected and studied: 570

Remark: *Thaparocleidus caecus* (Mizelle & Kritsky, 1969) Lim, 1996 was collected from the six pangasiid species mentioned above. *T. caecus* was first described from an unknown aquarium fish imported from Thailand to the US (Mizelle & Kritsky, 1969). Lim (1991b) also found *T. caecus* on *Pangasianodon hypophthalmus* (syn. *Pangasius sutchi*) imported from Thailand into Peninsular Malaysia for culture and suggested that the unknown aquarium fish could be a *Pangasius* species. In the present study *T. caecus* was collected from six pangasiid host species which belong to four genera. Despite the distribution of *T. caecus* on these six species the original 'unknown host species' of *T. caecus* is probably *P. hypophthalmus* because this species is the only pangasiid species to be exported as aquarium fish from Thailand.

2. *Thaparocleidus siamensis* (Lim, 1990) Lim, 1996 (Fig. A52)

Type host: *Pangasianodon hypophthalmus* (Sauvage, 1878)
Type locality: Fish farms in Selangor, Peninsular Malaysia (imported from Thailand)
Present host: *Pangasianodon hypophthalmus* (9 individuals examined, 7 infected from sites 1, 2, 3, 4, 5 & 6)
Localities: Mun River, Ubonratchathanee (site 1); Ping River, Tak (site 2); Pitsanulok Fishery Station, Pitsanulok (site 3); NIFI Aquarium, Bangkok (site 4); Ayudthaya Campus (RIT), Ayudthaya (site 5); Nakornsithammarat Campus (RIT), Nakornsithammarat (site 6)
No. of monogenean specimens collected and studied: 258

Remark: *Thaparocleidus siamensis* (Lim, 1990) Lim, 1996 was first described from *P. hypophthalmus* imported from Thailand into Peninsular Malaysia (see Lim, 1990b). Although *T. siamensis* is found together with *T. caecus* on *P. hypophthalmus*, *T. siamensis* is more abundant than *T. caecus*. In terms of prevalence *T. siamensis* also has a higher prevalence (89 %) than *T. caecus* (44 %) (see Table 4.1: Chapter 4).

3. *Thaparacleidus* n. sp. 16 (Figs. A53 & A54)

Type host: *Helicophagus waandersii* Bleeker, 1858 (7 individuals examined, 5 infected, 74 monogeneans collected from sites 1 & 2)

Other host: *Pangasius conchophilus* Roberts & Vidthayanon, 1991 (10 individuals examined, 2 infected, 6 monogeneans collected from sites 1, 2 & 3)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanee (site 2); Chao-praya River, Chinat (site 3); Pitsanulok Fishery Station, Pitsanulok (site 4)
No. of monogenean specimens collected and studied: 80
No. of monogenean specimens measured: 15

Body size 749 (672-823) x 106 (84-126). Four eye spots. Haptor size 134 (92-151) x 172 (84-210). Dorsal anchors: inner length 56 (52-60); outer length 46 (42-52); inner root 12 (8-15); stumpy outer root; recurved point 26 (24-28). Patches triangular with spinous tips, size 18 (16-20) x 6 (4-8). Ventral anchors: fenestrated at mainpart, inner length 26 (24-28); outer length 22 (20-23); inner root 8 (6-10); outer root 2 and recurved point 16 (14-18). Dorsal bar slightly V-shaped, size 36 (32-38) x 6 (5-6). Ventral bar V-shaped, size of one side 29 (26-32) x 3. Seven pairs of marginal hooks, 2 types: 6 pairs, length 14 (14-16); one pair near ventral anchors, length 12 (12-14).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Ejeculatory duct leaves the base of seminal vesicle to enter initial part of copulatory tube. Copulatory organ consists of curved copulatory tube, length along the tube, 53 (44-60), diameter of initial part 8 (7-10) and C-shaped rod-like accessory piece, size 32 (28-40) x 2. Prostatic reservoir large ovoid, enters separately into initial part of copulatory tube. Vaginal opening midbody slightly to right side, connected to ovoid seminal receptacle with coiled vaginal tube.

Differential diagnosis: The present species is similar to *T. caecus* in having ventral anchor with its mainpart fenestrated and patch with spinous tip. This species is different from *T. caecus* in having a C-shaped copulatory tube. It is also different from *T. pangasi* from Indian *P. pangasius* in having fenestrated ventral anchors. This species is also different from the other known *Thaparocleidus* species in the morphology of copulatory organ. It is thus a new species and identified as *Thaparocleidus* n. sp. 16.

4. *Thaparocleidus* n. sp. 17 (Figs. A55 & A56)

Type host: *Helicophagus waandersii* Bleeker, 1858 (7 individuals examined, 7 infected, 73 monogeneans collected from sites 1 & 2)
Other hosts: *Pangasius bocourti* Sauvage, 1880 (8 individuals examined, 7 infected, 44 monogeneans collected from 1 & 2); *P. krempfi* Fang & Chaux, 1949 (2 individuals examined, 2 infected, 9 monogeneans collected from site 2)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanee (site 2)
No. of monogenean specimens collected and studied: 126
No. of monogenean specimens measured: 15

Body size 1475 (1300-1680) x 167 (120-200). Four eye spots. Haptor size 251 (143-336) x 250 (168-420). Dorsal anchors: massive, inner length 119 (112-

127); outer length 102 (97-107); inner root 23 (20-27); stumpy outer root; recurved point 55 (50-62). Patches large triangular with curved tips, size 48 (45-52) x 17 (14-22). Ventral anchors: inner length 52 (47-57); outer length 40 (36-45); inner root 19 (16-22); outer root 4 (3-4) and recurved point 29 (25-32). Dorsal bar broad V-shaped, size 65 (60-74) x 10 (8-10). Ventral bar V-shaped, size of one side 38 (30-44) x 4 (3-5). Seven pairs of marginal hooks, 2 types, same length 17 (16-18).

Testis elongate oval, posterior to ovary. Vas deferens arises anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Ejeculatory duct leaves seminal vesicle, enters initial part of copulatory tube. Copulatory organ consists of long loosely coiled copulatory tube, diameter of initial part 10. Accessory piece absent. Prostatic reservoir ovoid. Vaginal opening midbody slightly to right side, connected to large ovoid seminal receptacle with long, irregular vaginal tube. Uterine pore dextral, in the same level of copulatory organ.

Differential diagnosis: The present species is different from the previously described *Thaparocleidus* species from pangasiid fishes in having (i) very large dorsal anchors, (ii) a long loosely coiled copulatory tube, and (iii) in lacking accessory piece in the copulatory organ. Coiled copulatory tube is also observed in the *Thaparocleidus* species from six silurid species of Thailand; *Belodontichthys dinema*, *Hemisilurus mekongensis*, *Kryptopterus apogon*, *K. bicirrhis*, *K. bleekeri* and *K. cryptopterus* (see Appendix 3.6: Monogeneans of Siluridae). However the copulatory tube of the present species is long and loosely coiled, while that of *Thaparocleidus* from silurids is coiled like a spring (see Lim, 1986a). This species is considered a new species and identified as *Thaparocleidus* n. sp. 17.

5. *Thaparocleidus* n. sp. 18 (Fig. A57)

Type host: *Pangasius bocourti* Sauvage, 1880 (8 individuals examined, 3 infected from sites 1 & 2)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanee (site 2)
No. of monogenean specimens collected and studied: 19
No. of monogenean specimens measured: 8

Body size 2676 (2352-3108) x 275 (210-378). Four eye spots. Haptor size 143 (101-168) x 176 (101-252). Dorsal anchors: inner length 46 (44-48); outer length 36 (34-36); inner root 15 (14-16); stumpy outer root; recurved point 24 (22-24). Patches with spinous tips, size 9 (9-10) x 7 (6-8). Ventral anchors: without root, fenestrated at mainpart, total length 25 (24-26); recurved point 14 (12-14). Dorsal bar flat V-shaped, size 34 (36-36) x 6. Ventral bar V-shaped, broader at both ends, size of one side 31 (30-32) x 3 (2-3). Seven pairs of marginal hooks, same shape, length 12 (11-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Ejeculatory duct leaves seminal vesicle to enter initial part of copulatory tube. Two prostatic reservoirs enter separately into initial part of copulatory tube. Copulatory organ consists of sinuous copulatory tube, length 87 (78-94), with spine-like structure near distal

end, diameter of initial part of copula-tory tube 16 (14-18) and grooved accessory piece bearing grooved process at its proximal part, size 75 (68-80) x 8 (7-10). Vaginal opening midbody, funnel-like, connected to ovoid seminal receptacle with short vaginal tube. Trilobed structure of female reproductive system is present as described for *T. caecus* by Lim (1990b).

Differential diagnosis: The present species is very similar to *T. caecus* in having similar types of haptoral armaments, sinuous copulatory tube with a spine near the distal end, and trilobed structure (see Lim, 1990b) near vaginal opening. The present species is different from *T. caecus* in the morphology of accessory piece (compare Figs. A51 & A57) and in having ventral anchors without roots. This species is considered a new species and identified as *Thaparocleidus* n. sp. 18.

6. *Thaparocleidus* n. sp. 19 (Fig. A58)

Type host: *Pangasius conchophilus* Roberts & Vidthayanon, 1991 (10 individuals examined, 5 infected from sites 1, 2, 3)
Localities: Me-kong River, Ubonratchathanee (type locality) (site 1); Mun River, Ubonratchathanee (site 2); Chao-praya River, Chinat (site 3); Pitsanulok Fishery Station, Pitsanulok (site 4)
No. of monogenean specimens collected and studied: 32
No. of monogenean specimens measured: 8

Body size 1633 (1386-1890) x 231 (210-310). Four eye spots. Haptor size 266 (235-336) x 227 (193-252). Dorsal anchors: very large, inner length 184 (170-194); outer length 159 (148-170); inner root 30 (24-36); stumpy outer root, point 80 (72-76). Patches large triangular with curved tips, size 91 (82-100) x 20 (18-24). Ventral anchors: fenestrated at mainpart, about 5 times smaller than the dorsal anchors, inner length 34 (32-36); outer length 31 (30-34); inner root 11 (8-12); outer root 2 (1-4), recurved point 19 (16-20). Dorsal bar broad V-shaped, broader at both ends, size 63 (60-76) x 11 (10-12). Ventral bar V-shaped, size of one side 48 (45-52) x 4 (4-5). Seven pairs of marginal hooks, 2 types, same length 18 (18-19).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of curved sac-like copulatory tube size 60 (54-64) x 13 (10-16) and grooved accessory piece, size 32 (28-3) x 3 (3-4). Vaginal opening midbody, funnel-like, connected to large ovoid seminal receptacle with short vaginal tube.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 17 in having very large dorsal anchors and large patches with curved tips. However this species differs from *Thaparocleidus* n. sp. 17 in having fenestrated ventral anchors, curved sac-like copulatory tube and grooved accessory piece. The curved sac-like copulatory organ is unique to this species. It is thus considered a new species and denoted as *Thaparocleidus* n. sp. 19.

7. *Thaparocleidus* n. sp. 20 (Figs. A59 & A60)

Type host: *Pangasius conchophilus* Roberts & Vidthayanon, 1991 (10 individuals examined, 6 infected from sites 1, 2 & 3)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanee (site 2); Chao-praya River, Chinat (site 3); Pitsanulok Fishery Station, Pitsanulok (site 4)
No. of monogenean specimens collected and studied: 48
No. of monogenean specimens measured: 10

Body size 1497 (857-1722) x 198 (126-252). Four eye spots. Haptor size 229 (168-294) x 245 (168-294). Dorsal anchors: inner length 84 (78-88); outer length 65 (58-70); inner root 24 (18-26); stumpy outer root, point 39 (36-46). Patches triangular with spinous tips, size 31 (28-32) x 9 (6-10). Ventral anchors: massive, not fenestrated at mainpart, without roots, total length 67 (62-70); recurved point 22 (18-26). Dorsal bar broad V-shaped, broader at both ends, size 45 (42-50) x 7 (6-8). Ventral bar V-shaped, size of one side 47 (44-52) x 7 (6-10. Seven pairs of marginal hooks, 2 types: 6 pairs length 19 (18-20); one pair near ventral anchors, length 17 (16-17).

Vas deferens arises from anterior region testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of U-shaped sac-like copulatory tube, length along the tube 72 (64-82) and grooved plate-like acces-sory piece, size 27 (24-30) x 4. Vaginal opening midbody, funnel-like, connected to round seminal receptacle with short vaginal tube. The trilobed structure of female reproductive system is also observed in this species (see also previous species).

Differential diagnosis: The present species is different from the previously described species and the other two new *Thaparocleidus* species from *P. conchophilus* in having massive ventral anchors without roots and U-shaped sac-like copulatory tube. This species, hence is considered a new species and identified as *Thaparocleidus* n. sp. 20.

8. *Thaparocleidus* n. sp. 21 (Figs. A61 & A62)

Type host: *Pangasius krempfi* Fang & Chaux, 1949 (2 individuals examined, 2 infected)
Type locality: Me-kong River, Ubonratchathanee
No. of monogenean specimens collected and studied: 9
No. of monogenean specimens measured: 9

Body size 1922 (1596-2352) x 169 (101-235). Four eye spots. Haptor size 246 (168-336) x 228 (210-252). Dorsal anchors: inner length 82 (76-86); outer length 72 (64-74); inner root massive, club-shaped 17 (14-18); outer root 2 (2-3); recurved point 32 (28-34). Patches knee-shaped, size 37 (30-40) x 10 (8-10). Ventral anchors: fenestrated at mainpart, inner length 33 (32-34); outer length 27 (20-30); inner root 13 (10-14); outer root 2 (2-3); recurved point 20 (18-20). Dorsal bar flat V-shaped, size 61 (52-66) x 9 (8-10). Ventral bar V-shaped, size of

one side 38 (36-40) x 4 (4-5). Seven pairs of marginal hooks, 2 types: 6 pairs, length 12 (10-14); one pair near the ventral anchors, length 13 (10-14).

Testis elongate oval, posterior to ovary. Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long thin blind seminal vesicle. Ejeculatory duct leaves seminal vesicle to enter initial part of copulatory tube. Two prostatic reservoirs, enter separately into initial part of copulatory tube. Copulatory organ consists of short curved copulatory tube, length 32 (30- 34), widening at initial part, diameter 6 (6-8) and short, curved rod-like accessory piece, size 29 (26-32) x 4. Vaginal opening midbody, funnel-like, connected to small seminal receptacle with short vaginal tube.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 16 in having curved copulatory tube and short rod-like accessory piece. However the copulatory tube and accessory piece of the present species are comparatively shorter than that of *Thaparocleidus* n. sp. 16 (see Fig. A54). The present species also differs from *Thaparocleidus* n. sp. 16 in having dorsal anchors with club-shaped inner roots and large knee-shaped patches. This species is also different from the other known *Thaparocleidus* species in the structure of the copulatory tube. It is thus considered a new species and named *Thaparocleidus* n. sp. 21.

9. *Thaparocleidus* n. sp. 22 (Figs. A63 & A64)

Type host: *Pangasius larnaudii* Bocourt, 1866 (4 individuals examined, 2 infected from sites 1 & 3)
Localities: Me-kong River, Ubonratchathanee (type locality) (site 1); Mun River, Ubonratchathanee (site 2), Chao-praya River, Chinat (site 3)
No. of monogenean specimens collected and studied: 11
No. of monogenean specimens measured: 7

Body size 1168 (966-1334) x 158 (134-168). Four eye spots. Haptor size 168 (126-210) x 224 (168-294). Dorsal anchors: inner length 74 (72-76); outer length 62 (60-62); inner root 16 (14-18); stumpy outer root, point 32 (30-34). Patches triangular with spinous tips, size 28 (26-30) x 8 (8-10). Ventral anchors: fenestrated at mainpart, inner length 30 (30-32); outer length 26 (26-28); inner root 11 (11-12), recurved point 18 (14-20). Dorsal bar broad V-shaped, broader at both ends, size 44 (40-46) x 7 (6-8). Ventral bar flat V-shaped, size of one side 34 (32-36) x 3 (3-4). Seven pairs of marginal hooks, 2 types: 5 pairs, one pair anterior to dorsal anchors and 4 pairs situate near haptoral margin, same length, 22 (21-23); two short pairs, one pair near dorsal anchors and one pair near ventral anchors, same length 15 (13-15).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of long curved copulatory tube, length along the tube 98 (94-106), widening at initial part, diameter 13 (12-14) and bulbous accessory piece with bifurcated at proximal part, size 62 (56-64) x 13 (12-14). Vaginal opening sclerotised arrow-shaped, situates at midbody slightly to right side, size 20 (18-22), connected to ovoid seminal receptacle with long vaginal tube, length 44 (40-46).

Differential diagnosis: The present species is different from previously described *Thaparocleidus* species and the other 16 new *Thaparocleidus* species obtained from the pangasiid species in this study in having bulbous accessory piece which is bifurcated at its proximal end and a sclerotised arrow-shaped vaginal opening. The bulbous accessory piece and arrow-shaped vaginal opening are unique to the present species. This species is new to Science and identified as *Thaparocleidus* n. sp. 22 here.

10. *Thaparocleidus* n. sp. 23 (Figs. A65 & A66)

Type host: *Pangasius larnaudii* Bocourt, 1866 (4 individuals examined, 4 infected from sites 1, 2 & 3)
Localities: Me-kong River, Ubonratchathanee (type locality) (site 1); Mun River, Ubonratchathanee (site 2); Chao-praya River, Chinat (site 3)
No. of monogenean specimens collected and studied: 14
No. of monogenean specimens measured: 7

Body size 2196 (1764-2520) x 287 (252-378). Four eye spots. Haptor size 163 (126-210) x 270 (210-294). Dorsal anchors: inner length 67 (62-72); outer length 55 (54-58); inner root 17 (14-28); stumpy outer root, point 37 (34-40). Patches triangular with spinous tips, size 23 (22-24) x 6 (4-8). Ventral anchors: not fenestrated at mainpart, inner length 50 (48-54); outer length 50 (26-54); inner root 18 (16-24), outer root 7 (6-10); recurved point 26 (24-28). Dorsal bar slightly V-shaped, broader at both ends, size 55 (52-60) x 8 (6-9). Ventral bar V-shaped with protuberances at its ventral side near both ends, size of one side 52 (50-56) x 6 (5-7). Seven pairs of marginal hooks, 5 types: one long pair anterior to dorsal anchors, length 26 (25-26); one pair near the point of dorsal anchors, length 15 (15-17); 3 pairs near haptoral margin, length 25 (24-26); one pair near of ventral bar, length 20 (20-22); one pair near ventral anchors, length 24 (24-26).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of very long curved copulatory tube, widening at initial part, diameter 14 (12-14) and grooved accessory piece, size 59 (54-64) x 8 (7-8). Vaginal opening midbody slightly to right side, rounded (muscular-like), connected to large ovoid seminal receptacle with long irregular coiled vaginal tube.

Differential diagnosis: The present species is unique in having a ventral bar with protuberances on its ventral side, a very long curved copulatory tube and a large grooved accessory piece. This species is considered a new species and identified as *Thaparocleidus* n. sp. 23.

11. *Thaparocleidus* n. sp. 24 (Fig. A67)

Type host: *Pangasius larnaudii* Bocourt, 1866 (4 individuals examined, 2 infected from sites 1 & 3)
Localities: Me-kong River, Ubonratchathanee (type locality) (site 1); Mun River, Ubonratchathanee (site 2); Chao-praya River, Chinat (site 3)
No. of monogenean specimens collected and studied: 8

No. of monogenean specimens measured: 5

Body size 1241 (890-1428) x 197 (151-218). Four eye spots. Haptor size 221 (168-252) x 279 (210-319). Dorsal anchors: inner length 91 (90-94); outer length 77 (76-78); inner root 19 (18-20); stumpy outer root; recurved point 41 (40-42). Patches large triangular with curved tips, size 45 (44-46) x 7 (6-8). Ventral anchors: fenestrated at mainpart, inner length 32 (31-32); outer length 29 (28-30); inner root 10 (9-10); outer root 2; recurved point 20 (18-20). Dorsal bar slightly V-shaped, broader at both ends, size 55 (54-56) x 13 (12-14). Ventral bar flat V-shaped, size of one side 44 (42-46) x 2. Seven pairs of marginal hooks, 3 types: 5 pairs situate near haptoral margin, length 20 (20-22); one pair near dorsal anchors, length 15 (15-16); one thin pair near ventral anchors, length 20 (20-21).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Single prostatic reservoir rounded, enters separately into initial part of copulatory tube. Copulatory organ consists of long straight copulatory tube with wedged end, length along the tube 100 (106-118), widening at initial part, diameter 8 (8-10) and curved rod-like accessory piece, size 63 (62-64) x 10 (10-11). Vaginal opening not observed.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 22 in having similar types of haptoral armaments, but differs from it in having long straight copulatory tube with wedged end. This species is also different from the other known *Thaparocleidus* species in the morphology of copulatory tube. The present species is thus considered a new species and identified as *Thaparocleidus* n. sp. 24.

12. *Thaparocleidus* n. sp. 25 (Fig. A68)

Type host: *Pangasius larnaudii* Bocourt, 1866 (4 individuals examined, 4 infected from sites 1, 2 & 3)
Localities: Me-kong River, Ubonratchathanee (type locality) (site 1); Mun River, Ubonratchathanee (site 2), Chao-praya River, Chinat (site 3)
No. of monogenean specimens collected and studied: 39
No. of monogenean specimens measured: 8

Body size 1770 (1344-1949) x 206 (168-252). Four eye spots. Haptor size 203 (168-252) x 270 (235-294). Dorsal anchors: small, without root, total length 54 (50-58); point 22 (20-24). Patches small triangular, size 3 (3-4) x 2. Ventral anchors: massive, without roots and not fenestrated at mainpart, total length 73 (68-78) and point 25 (22-28). Dorsal bar V-shaped, broader at the middle, size 28 (26-30) x 5 (4-6). Ventral bar massive, V-shaped, size of one side 54 (50-60) x 12 (10-16). Seven pairs of marginal hooks, 3 type: 5 pairs situate near haptoral margin, length 18 (18-20); one pair near dorsal anchors, length 8 (7-9); one pair near ventral anchors, length 18 (17-18).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of long loosely coiled copulatory tube, widening at initial part, diameter 10 (8-12) and small grooved plate-like accessory piece, size 29 (26-32). Vaginal opening

midbody, slightly to right side, connected to round seminal receptacle with very long irregular coiled vaginal tube.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 20 from *P. conchophilus* in having similar types of ventral anchor and ventral bar (see Figs. A60 & A68 for comparison). This species differs from *Thaparocleidus* n. sp. 20 in the morphologies of dorsal anchors and copulatory organ. The present species possesses noticeably small dorsal anchors without roots, very small patches and long loosely coiled copulatory tube, while *Thaparocleidus* n. sp. 20 possesses dorsal anchor with well- developed inner root and sac-like copulatory tube. The small dorsal anchors without roots and small patches are unique to the present species, and not observed in all the other *Thaparocleidus* species from pangasiids. It is thus, considered a new species and is named *Thaparocleidus* n. sp. 25 here.

13. *Thaparocleidus* n. sp. 26 (Fig. A69)

Type host: *Pangasius larnaudii* Bocourt, 1866 (4 individuals examined, 3 infected, 50 monogeneans collected from sites 1 & 3)
Other host: *Pangasius sanitwongsei* Smith, 1931 (2 individuals examined, 2 infected, 5 monogeneans collected from site 4)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanee (site 2); Chao-praya River, Chinat (site 3); Jatujak Fish Market, Bangkok (site 4)
No. of monogenean specimens collected and studied: 55
No. of monogenean specimens measured: 7

Body size 2097 (1554-2646) x 200 (168-235). Four eye spots. Haptor size 235 (168-319) x 245 (168-336). Dorsal anchors: inner length 77 (72-80); outer length 66 (62-68); inner root 17 (14-18); stumpy outer root; recurved point 38 (36-40). Patches triangular with spinous tips, size 24 (20-28) x 6 (6-7). Ventral anchors: fenestrated at mainpart, inner length 24 (24-25); outer length 22 (22-23); inner root 7 (6-8); outer root 2 (1-2); recurved point 10 (9-11). Dorsal bar straight, broader at both ends, size 33 (30-34) x 6 (5-6). Ventral bar flat V-shaped, size of one side 32 (30-34) x 2. Seven pairs of marginal hooks, same length 12 (12-13).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of curved copulatory tube, length 74 (68-80), widening at initial part, diameter 13 (10-14) and curved stick-like accessory piece, size 35 (32-38) x 4 (3-4). Vaginal opening midbody, funnel-like, connected to seminal receptacle with short vaginal tube.

Differential diagnosis: The present species is similar to *T. caecus* and *Thaparocleidus* n. sp. 25 in having similar types of haptoral armaments, but differs from them in having a short straight dorsal bar and short curved copulatory tube (see Figs. A51 & A68 for comparison). This species is also different from the other known *Thaparocleidus* species in the morphologies of dorsal bar and copulatory organ. This species is new to Science and is named *Thaparocleidus* n. sp. 26.

14. *Thaparocleidus* n. sp. 27 (Fig. A70)

Type host: *Pangasius macronema* Bleeker, 1851 (11 individuals examined, 8 infected, 44 monogeneans collected from sites 1 & 2)
Other host: *Pteropagasius pleurotaenia* (Sauvage, 1878) (7 individuals examined, 3 infected, 43 monogeneans collected from site 3)
Localities: Ping River, Tak (type locality) (site 1); Chao-praya River, Chinat (site 2); Mun River, Ubonratchathanee (site 3); Me-kong River, Ubonratchathanee (site 4)
No. of monogenean specimens collected and studied: 87
No. of monogenean specimens measured: 8

Body size 689 (622-756) x 106 (84-126). Four eye spots. Haptor size 91 (76-118) x 108 (101-126). Dorsal anchors: inner length 47 (44-50); outer length 37 (36-38); inner root 10 (8-12); stumpy outer root; recurved point 22 (20-22). Patches triangular with spinous tips, size 14 (12-14) x 4 (4-5). Ventral anchors: fenestrated at mainpart, inner length 22 (22-24); outer length 17 (16-18); inner root 7 (6-8); outer root 2; recurved point 12 (12-14). Dorsal bar slightly V-shaped, size 25 (24-26) x 4 (4-5). Ventral bar V-shaped, size of one side 26 (26-28) x 2. Seven pairs of marginal hooks, same length 14 (12-14).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of C-shaped copulatory tube, length along the tube 56 (48-66), widening at initial part, diameter 6 (6-7) and curved rod-like accessory piece, size 41 (38-44) x 2 (2-3). Vaginal opening midbody, funnel-like, connected to small ovoid seminal receptacle with sigmoid vaginal tube.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 16 and *T. pangasi* (Tripathi, 1957) Lim, 1996 from *P. pangasius* (see Tripathi, 1957) in having similar types of haptoral armaments and copulatory organ. However the present species is different from the two *Thaparocleidus* species in having comparatively smaller haptoral armaments, longer curved rod-like accessory piece and sigmoid vaginal tube. This species is also different from the other known *Thaparocleidus* species in the morphology of vaginal system. This species is thus considered a new species and is named *Thaparocleidus* n. sp. 27.

15. *Thaparocleidus* n. sp. 28 (Fig. A71)

Type host: *Pangasius macronema* Bleeker, 1851 (11 individuals examined, 10 infected, 61 monogeneans collected from sites 1 & 2)
Other host: *Pteropagasius pleurotaenia* (Sauvage, 1878) (7 individuals examined, 2 infected, 9 monogeneans collected from site 3)
Localities: Ping River, Tak (type locality) (site 1); Chao-praya River, Chinat (site 2); Mun River, Ubonratchathanee (site 3); Me-kong River, Ubonratchathanee (site 4)
No. of monogenean specimens collected and studied: 70
No. of monogenean specimens measured: 10

Body size 827 (630-1008) x 113 (92-126). Four eye spots. Haptor size 125 (92-149) x 134 (101-168). Dorsal anchors: inner length 56 (52-60); outer length 51 (48-54); inner root massive, club-shaped 8 (6-10); stumpy outer root; short recurved point 16 (12-18). Patches massive knee-shaped, size 27 (24-28) x 7 (6-10). Ventral anchors: fenestrated at mainpart, inner length 24 (22-26); outer length 24 (22-26); inner root 6 (6-7); outer root 4 (3-4); recurved point 8 (6-10). Dorsal bar V-shaped, broader at both ends, size 31 (28-34) x 4 (4-5). Ventral bar V-shaped, size of one side 24 (22-26) x 4 (3-4). Seven pairs of marginal hooks, 3 types: 5 large pairs, length 17 (16-18); one short pair near the point of dorsal anchors, length 9 (7-10); one long thin pair near ventral anchors, length 17 (16-17).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of curved tapering copulatory tube, length 59 (48-64), with wing-like expasion at initial part, width 34 (30-38) and forked stick-like accessory piece, size 44 (36-50) x 15 (12-18). Vaginal opening midbody, funnel-like slightly to left side, connected to seminal receptacle with short vaginal tube.

Differential diagnosis: The present species is different from the previously described *Thaprocleidus* species and the other 16 new *Thaparocleidus* species from pangasiid fishes in this study in the morphology of copulatory tube (curved tapering tube with large wing- like expansion at initial part). The present species is considered a new species and identified as *Thaparocleidus* n. sp. 28.

16. *Thaparocleidus* n. sp. 29 (Fig. A72)

Type host: *Pangasius macronema* Bleeker, 1851 (11 individuals examined, 9 infected, 42 monogeneans collected from sites 1 & 2)
Other host: *Pteropagasius pleurotaenia* (Sauvage, 1878) (7 individuals examined, 4 infected, 11 monogeneans collected from site 3)
Localities: Ping River, Tak (type locality) (site 1); Chao-praya River, Chinat (site 2); Mun River, Ubonratchathanee (site 3); Me-kong River, Ubonratchathanee (site 4)
No. of monogenean specimens collected and studied: 53
No. of monogenean specimens measured: 10

Body size 636 (504-714) x 118 (76-134). Four eye spots. Haptor size 96 (69-118) x 108 (84-143). Dorsal anchors: inner length 40 (38-40); outer length 38 (36-38); inner root massive, club-shaped 6 (4-7); stumpy outer root; short recurved point 8 (6-8). Patches knee-shaped with bifurcated tips, size 16 (16-17) x 4 (4-5). Ventral anchors: fenestrated at mainpart, inner length 22 (21-23); outer length 22 (20-22); inner root 7 (6-8); outer root 2 (2-4); recurved point 9 (9-10). Dorsal bar slightly V-shaped, size 28 (26-30) x 4 (3-4). Ventral bar V-shaped, size of one side 22 (18-24) x 3 (3-4). Seven pairs of marginal hooks, 4 types: 4 large pairs near haptoral margin, length 18 (16-19); one pair medium size, anterior to dorsal anchors, length 15 (15-16); one short pair near the shaft of dorsal anchors, length 10 (8-10); one thin pair near ventral anchors, length 16 (16-18).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ, consists of short curved tapering copulatory tube, length 29 (24-30), widening at initial part, diameter 6 (6-9) and forked stick-like accessory piece, size 25 (22-26) x 2 (2-3). Prostatic reservoir bean-shaped, enters separately into initial part of copulatory tube. Vaginal opening midbody, connected to ovoid seminal receptacle with short vaginal tube.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 28 from *P. macronema* and *P. pleurotaenia* in having similar types of haptoral armaments, but differs from it in the morphology of copulatory organ. The present species possesses a small lightly sclerotised copulatory tube and accessory piece, while in *Thaparocleidus* n. sp. 28 the copulatory tube is large and heavily sclerotised (see Fig. A71). This species is also different from the other known *Thaparocleidus* species in the morphologies of patches and copulatory organ. It is thus considered a new species and is named *Thaparocleidus* n. sp. 29.

17. *Thaparocleidus* n. sp. 30 (Fig. A73)

Type host: *Pangasius macronema* Bleeker, 1851 (11 individuals examined, 5 infected from sites 1 & 2)
Localities: Ping River, Tak (type locality) (site 1); Chao-praya River, Chinat (site 2)
No. of monogenean specimens collected and studied: 12
No. of monogenean specimens measured: 10

Body size 572 (378-798) x 111 (84-143). Four eye spots. Haptor size 94 (76-109) x 108 (84-126). Dorsal anchors: inner length 43 (42-44); outer length 40 (38-42); inner root massive, club-shaped 6 (5-8); stumpy outer root; short recurved point 12 (10-14). Patches knee-shaped, size 24 (22-24) x 7 (6-8). Ventral anchors: fenestrated at mainpart, inner length 22 (22-23); outer length 22 (21-23); inner root 6 (4-7); outer root 2; recurved point 10 (8-12). Dorsal bar slightly V-shaped, size 36 (34-38) x 5 (4-6). Ventral bar V-shaped, size of one side 24 (22-26) x 3 (2-3). Seven pairs of marginal hooks, 3 types: 5 pairs near haptoral margin, with well-developed handles, length 15 (14-16); one pair near the shaft of dorsal anchors, handle reducing as knob-like, length 14 (13-150); one pair near ventral anchors, length 16 (16-18).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of long sac-like copulatory tube, length 43 (40-44), widening at initial part, diameter 10 (8-10) and forked stick-like accessory piece, size 33 (30-36) x 3 (3-4). Prostatic reservoir bean-shaped, enters separately into initial part of copulatory tube. Vaginal opening not observed.

Differential diagnosis: The present species is very similar to *Thaparocleidus* n. sp. 29 in having similar types of haptoral armaments, but differs from it in having a lightly sclerotised sac-like copulatory tube. Although sac-like copulatory tube is also present in *Thaparocleidus* n. sp. 20 from *Pangasius conchophilus*, but that of *Thaparocleidus* n. sp. 20 is comparatively larger and U-shaped sac-like. This species

is different from other known *Thaparocleidus* species in the morphology of copulatory organ. This species is thus considered a new species and identified as *Thaparocleidus* n. sp. 30.

18. *Thaparocleidus* n. sp. 31 (Fig. A74)

Type host: *Pteropangasius pleurotaenia* (Sauvage, 1878) (7 individuals examined, 2 infected from site 1)
Localities: Me-kong River, Ubonratchathanee (type locality) (site 1); Mun River, Ubonratchathanee (site 2); Chao-praya River, Chinat (site 3)
No. of monogenean specimens collected and studied: 8
No. of monogenean specimens measured: 5

Body size 924 (840-991) x 111 (84-143). Four eye spots. Haptor size 143 (109-185) x 101 (101-118). Dorsal anchors: inner length 48 (48-50); outer length 38 (36-40); inner root 12 (11-12); stumpy outer root; recurved point 20 (18-22). Patches triangular, with spinous tips, size 11 (10-12) x 3. Ventral anchors: fenestrated at mainpart, inner length 26 (24-28); outer length 22 (20-24); inner root 9 (8-12); outer root 2 (2-3); recurved point 14 (12-16). Dorsal bar slightly V-shaped, size 24 (22-26) x 4 (4-5). Ventral bar V-shaped, size 24 (22-26) x 3 (2-3). Seven pairs of marginal hooks, 2 types: 5 pairs situate near haptoral margin, length 16 (16-17); 2 pairs, one pair near dorsal anchors and one pair near ventral anchors, same length 10 (9-10).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of long twisted copulatory tube, length along the tube 80 (76-84), initial part bulbous, diameter 16 (14-17) and curved rod-like accessory piece, size 35 (34-36) x 3 (2-3). Prostatic reservoir ovoid, enters separately into initial part of copulatory tube. Vaginal opening midbody, sclerotised funnel-like, connected to ovoid seminal receptacle with sigmoid vaginal tube.

Differential diagnosis: The present species is different from the previously known *Thaparocleidus* species from pangasiids and the other 16 new *Thaparocleidus* species in this study in having copulatory tube with bulbous initial part and curved rod-like accessory piece. This species, thus considered new and is named *Thaparocleidus* n. sp. 31.

19. *Thaparocleidus* n. sp. 32 (Fig. A75)

Type host: *Pteropangasius pleurotaenia* (Sauvage, 1878) (7 individuals examined, 3 infected from site 1)
Localities: Me-kong River, Ubanratchathanee (type locality) (site 1); Mun River, Ubonratchathanee (site 2); Chao-praya River, Chinat (site 3)
No. of monogenean specimens collected and studied: 8
No. of monogenean specimens measured: 6

Body size 623 (546-798) x 84 (50-101). Four eye spots. Haptor size 102 (84-103) x 87 (67-109). Dorsal anchors: inner length 43 (42-44); outer length 35 (34-36); inner root 12 (12-14); stumpy outer root; recurved point 20 (18-20). Patches triangular with spinous tips, size 15 (13-16) x 3 (3-4). Ventral anchors: not fenestrated, inner length 29 (26-32); outer length 30 (26-32); inner root 10 (8-12); outer root 4 (3-4); short recurved point 9 (8-10). Dorsal bar slightly V-shaped, size 24 (22-26) x 4 (3-4). Ventral bar V-shaped, size 25 (22-27) x 3 (3-4). Seven pairs of marginal hooks, 2 types: 6 pairs, length 16 (15-16); one thin pair near ventral anchors, length 14 (14-15).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of short curved copulatory tube, length 21 (19-23), initial part bulbous, diameter 22 (21-22) and short curved accessory piece, size 25 (22-27) x 1 (1-2). Vaginal opening midbody, funnel-like. Vaginal tube short straight.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 31 in having copulatory tube with bulbous initial part and in having similar accessory piece (see Fig. A74). However the present species is different from *Thaparocleidus* n. sp. 31 in having non-fenestrated ventral anchor and short curved copulatory tube. This species is also different from the other known *Thaparocleidus* species in the morphologies of ventral anchor and copulatory organ. This species is considered a new species and identified as *Thaparocleidus* n. sp. 32.

Discussion

Thus far, only four *Thaparocleidus* species were recorded on two pangasiid species (see Introduction). The 17 new *Thaparocleidus* species found on the pangasiids in this study increases the total number of *Thaparocleidus* species on pangasiid hosts to 21.

Based on the morphology of the haptoral armaments, especially the ventral anchors, the *Thaparocleidus* species from Pangasiidae can be divided into two groups: (i) species with fenestrated ventral anchors (14 species), as exemplified by *T. caecus* and *T. siamensis* (Figs. A51 & A52) and (ii) species with ventral anchors which are non-fenestrated (five species). Species with non-fenestrated ventral anchors can be further divided into two subgroups: in one group the roots of the ventral anchors are developed (three species) as in *Thaparocleidus* n. sp. 17, *Thaparocleidus* n. sp. 23 and *Thaparocleidus* n. sp.32. Whilst the other group contains two species (*Thaparocleidus* n. sp. 20 and *Thaparocleidus* n. sp. 25) with massive ventral anchors without roots.

There are four types of patches on the *Thaparocleidus* species from the Pangasiidae: patches with spinous tips (ten species), large knee-shaped patches (five species), small triangular patches (one species) and patches with curved tips (three species).

All the *Thaparocleidus* species of the Pangasiidae have accessory pieces except for *Thaparocleidus* n. sp. 17. Thirteen of the 19 species possess curved copulatory tubes (see Figs. A54 & A57, for examples). There are three species with long loosely coiled tube (see Figs. A56, A66 & A68) and three species with sac-like copulatory tube (see Figs. A58, A60 & A73).

Of the 19 *Thaparocleidus* species, 12 species (63 %) are host-specific, while the other seven species (37 %) are found on more than one host species. Except for *T. caecus* which is found on six fish host species (from four genera) and *Thaparocleidus* n. sp. 17 which is found on three pangasiid species (*H. waandersii*, *P. krempfi* and *P. bocourti*), the other five *Thaparocleidus* species are found on two pangasiid species each (Table 4.1).

Except for *P. gigas* (without monogeneans) and *P. sanitwongsei* (with one *Thaparocleidus* species), the other eight pangasiid species were infected with two or more *Thaparocleidus* species (Table 4.1).

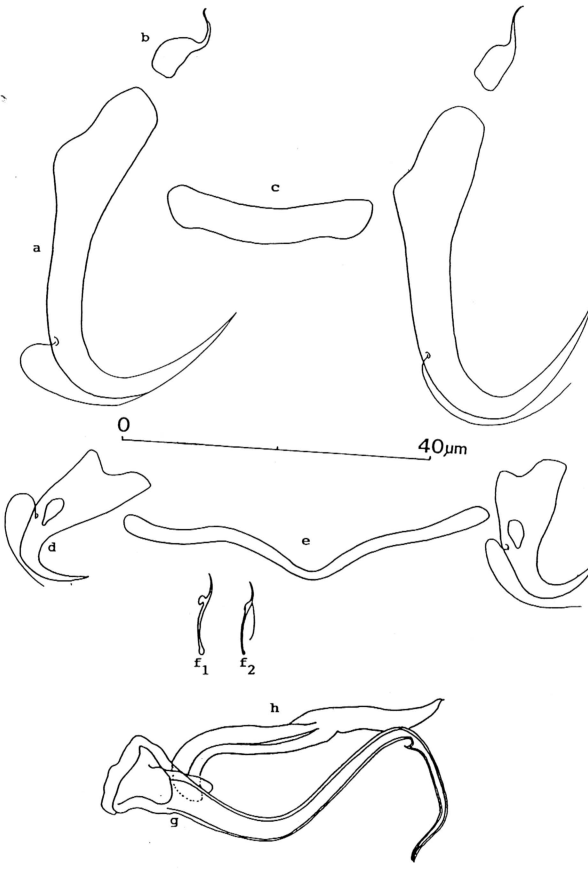


Fig. A51. Hard parts of *Thaparocleidus caecus* (Mizelle & Kritsky, 1969) Lim, 1996: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

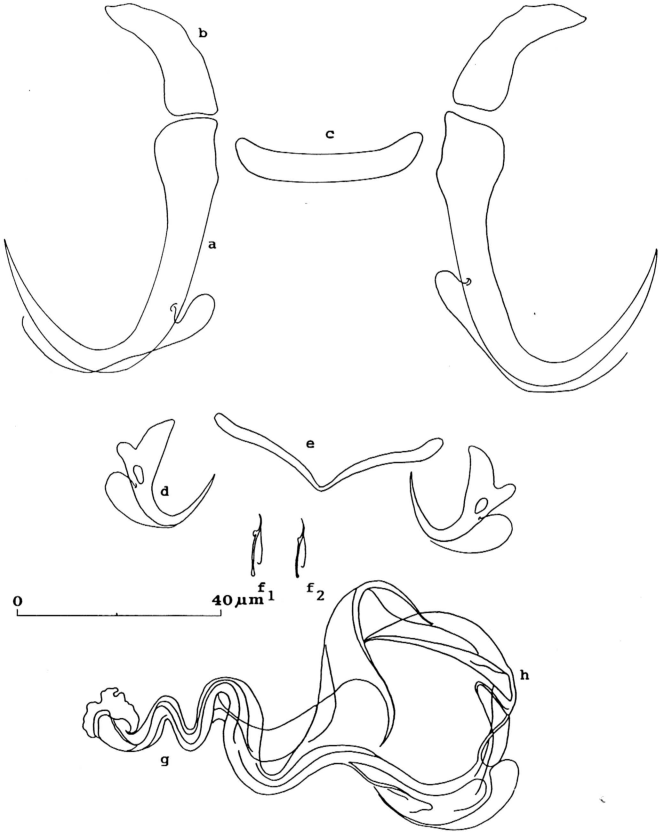


Fig. A52. Hard parts of *Thaparocleidus siamensis* (Lim, 1991) Lim, 1996: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

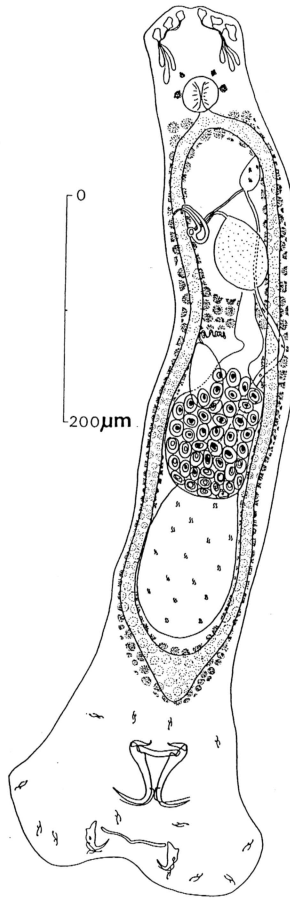


Fig. A53. Composite illustration of *Thaparocleidus* n. sp. 16 (ventral view). Scale bar in micrometres

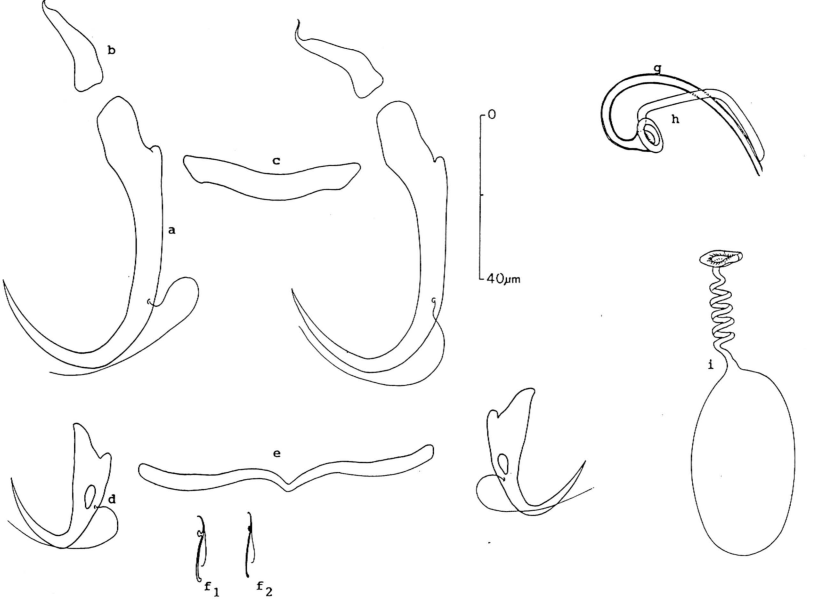


Fig. A54. Hard parts of *Thaparocleidus* n. sp. 16: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system with seminal receptacle. Scale-bar in micrometres

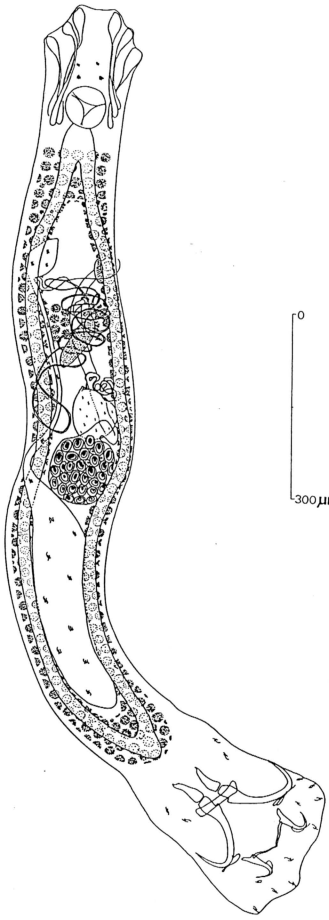


Fig. A55. Composite illustration of *Thaparocleidus* n. sp. 17 (ventral view). Sca
bar in micrometres

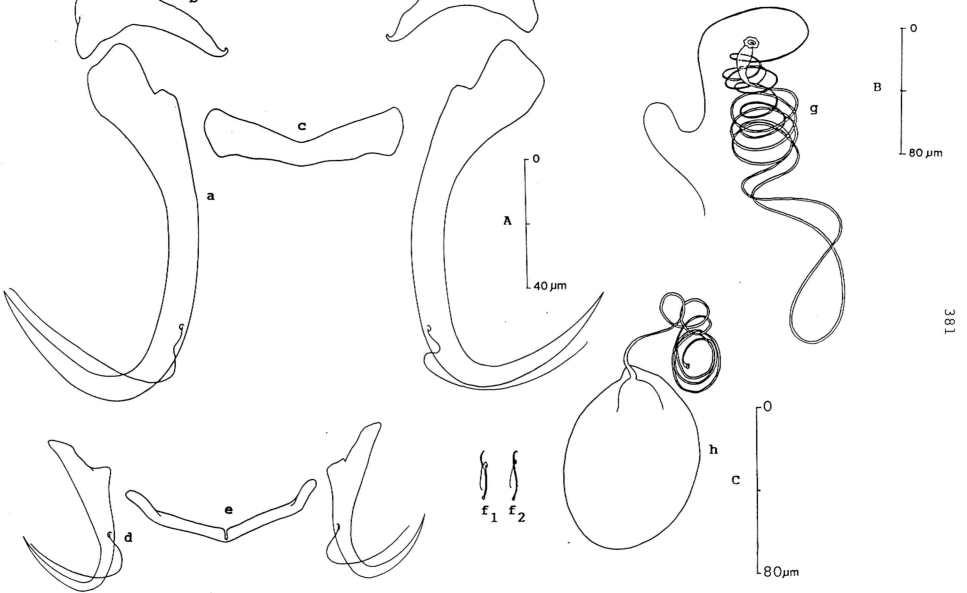


Fig. A56. Hard parts of *Thaparocleidus* n. sp. 17: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, vaginal system with seminal receptacle. Scale-bar in micrometres: Scale A for a, b, c, d, e, f_1, f_2; Scale B for g and Scale C for h

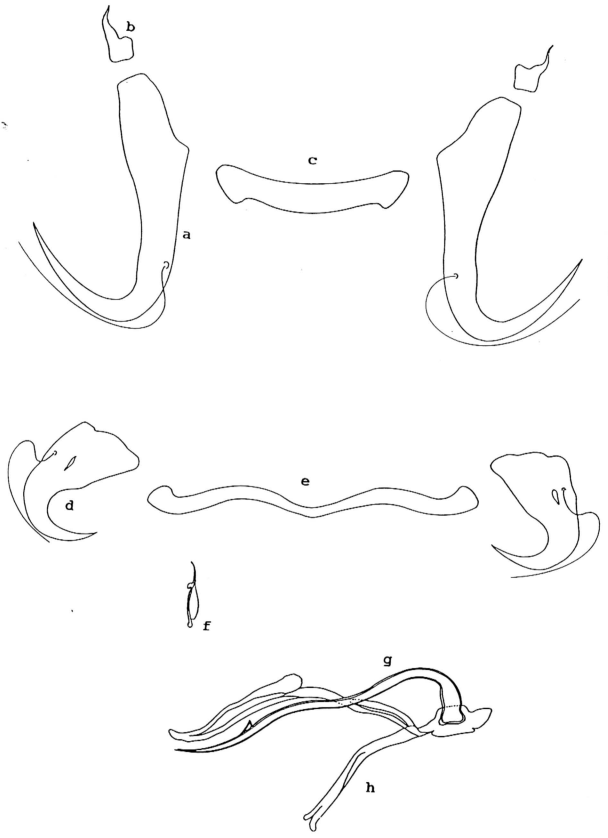


Fig. A57. Hard parts of *Thaparocleidus* n. sp. 18: a, dorsal anchor; b, patch; dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hooks; g, copulatory t h, accessory piece. Scale-bar in micrometres

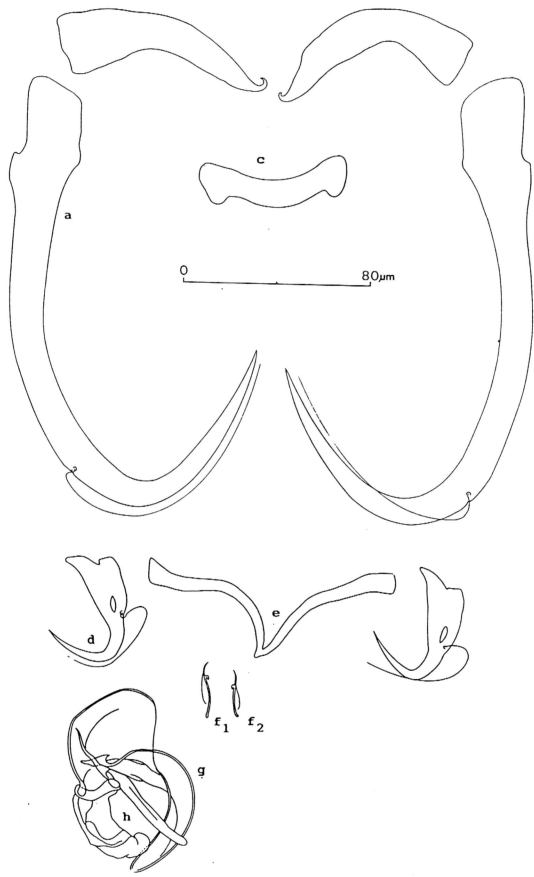


Fig. A58. Hard parts of *Thaparocleidus* n. sp. 19: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

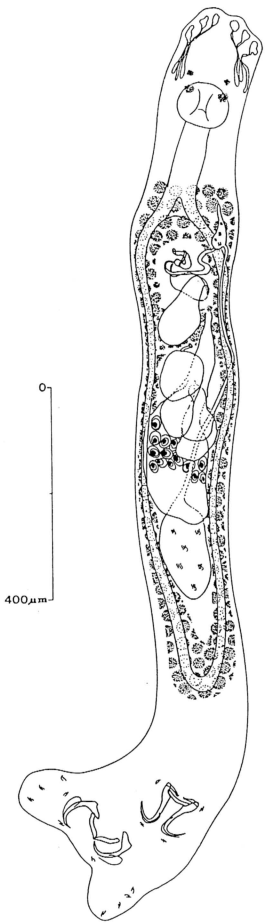


Fig. A59. Composite illustration of *Thaparocleidus* n. sp. 20 (ventral view). Scale-bar in micrometres

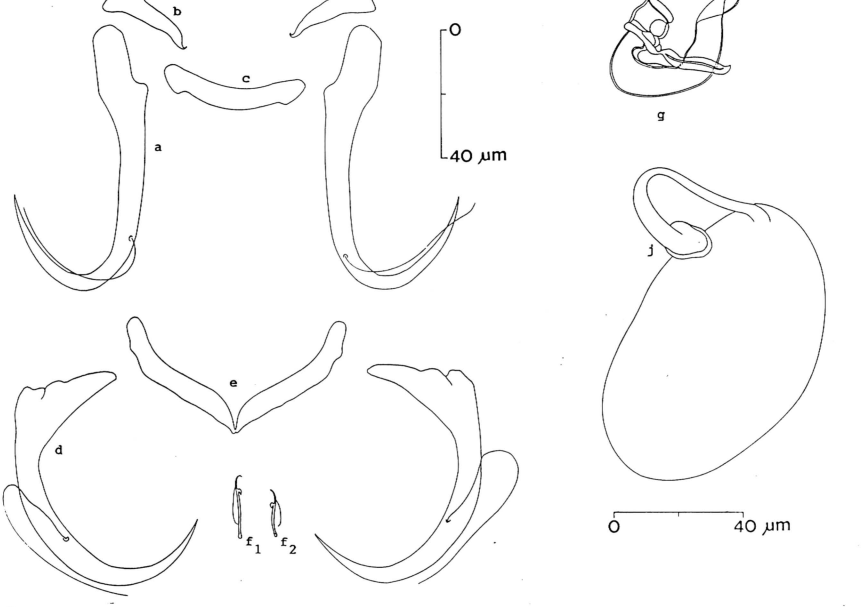


Fig. A60. Hard parts of *Thaparocleidus* n. sp. 20: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system with seminal receptacle. Scale-bar in micrometres

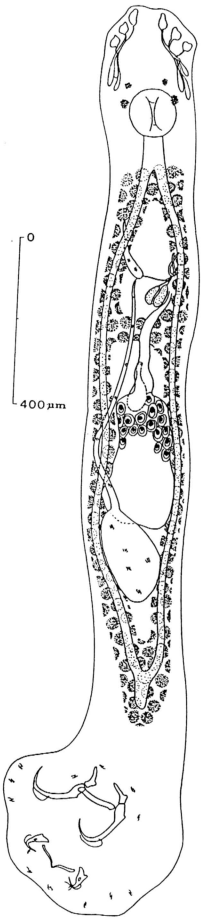


Fig. A61. Composite illustration of *Thaparocleidus* n. sp. 21 (dorsal view). Scale bar in micrometres

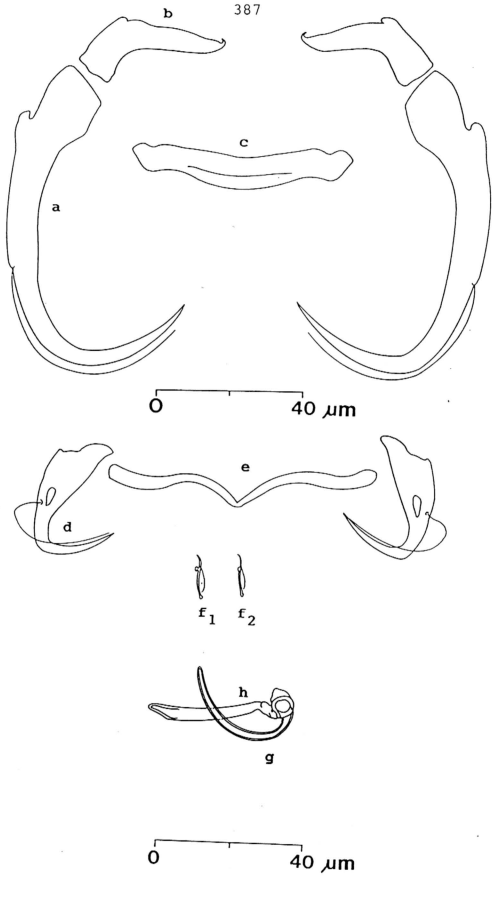


Fig. A62. Hard parts of *Thaparocleidus* n. sp. 21: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

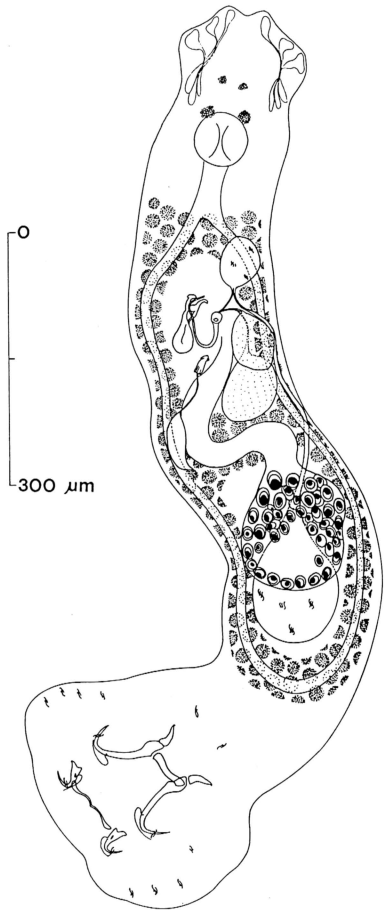


Fig. A63. Composite illustration of *Thaparocleidus* n. sp. 22 (ventral view). Scale-bar in micrometres

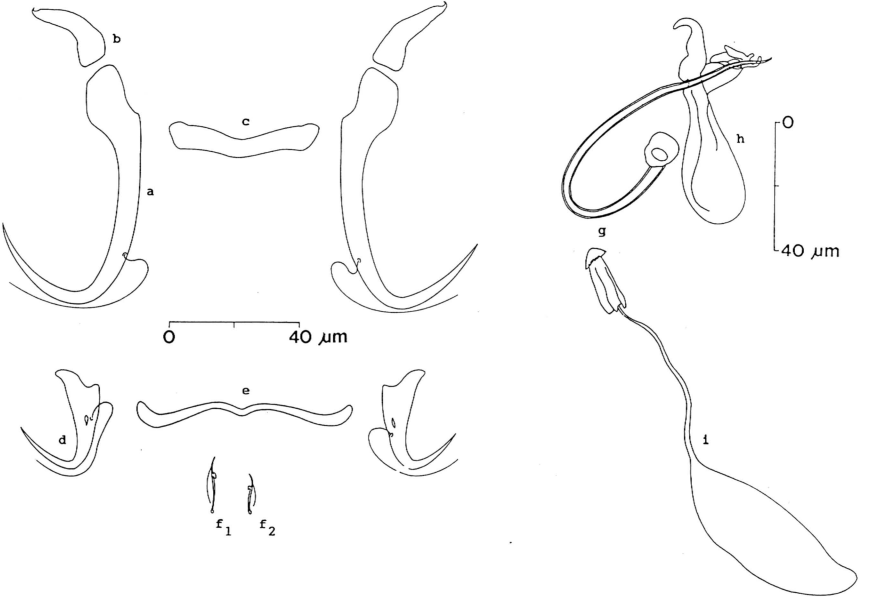


Fig. A64. Hard parts of *Thaparocleidus* n. sp. 22: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system with seminal receptacle. Scale-bar in micrometres

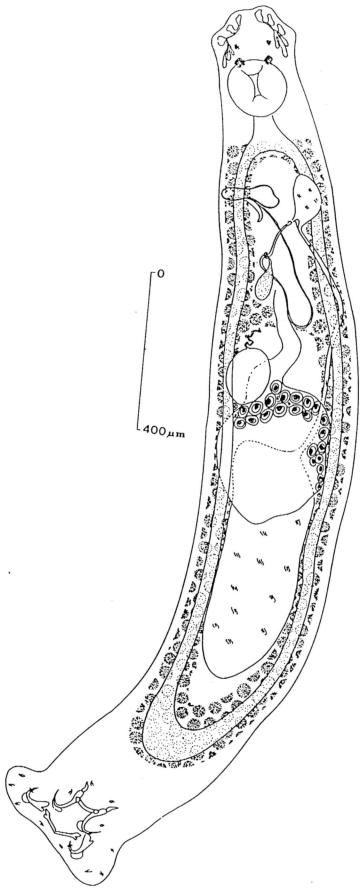


Fig. A65. Composite illustration of *Thaparocleidus* n. sp. 23 (ventral view). Sc
bar in micrometres

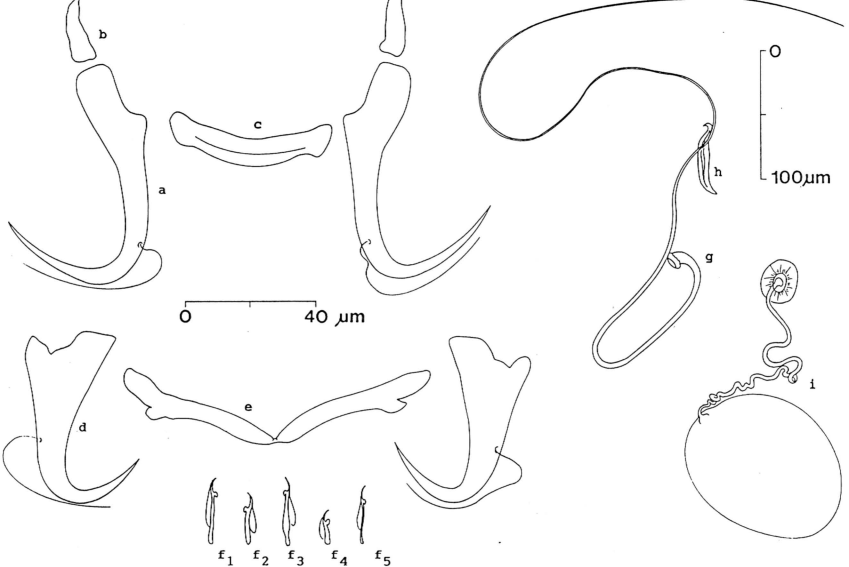


Fig. A66. Hard parts of *Thaparocleidus* n. sp. 23: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, f_3, f_4, f_5, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system with seminal receptacle. Scale-bar in micrometres

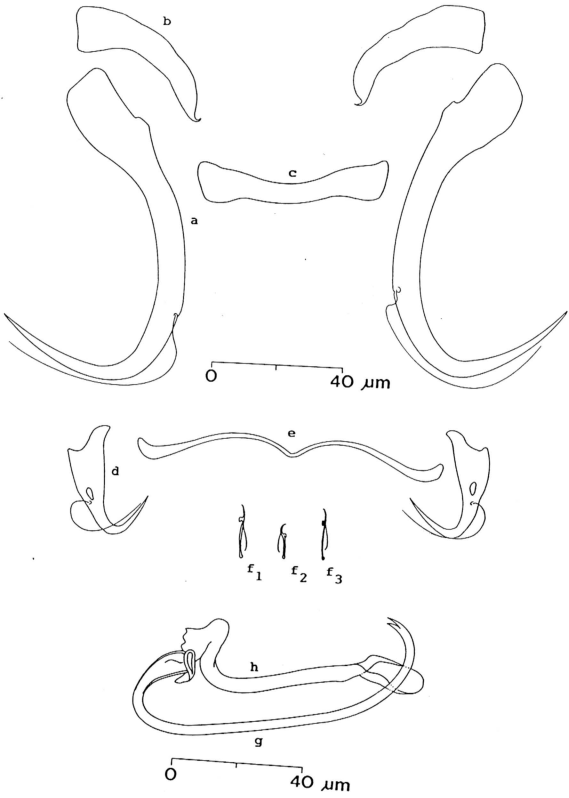


Fig. A67. Hard parts of *Thaparocleidus* n. sp. 24: a, dorsal anchor; b, patch; c dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, f_3, marginal hooks; g copulatory tube; h, accessory piece. Scale-bar in micrometres

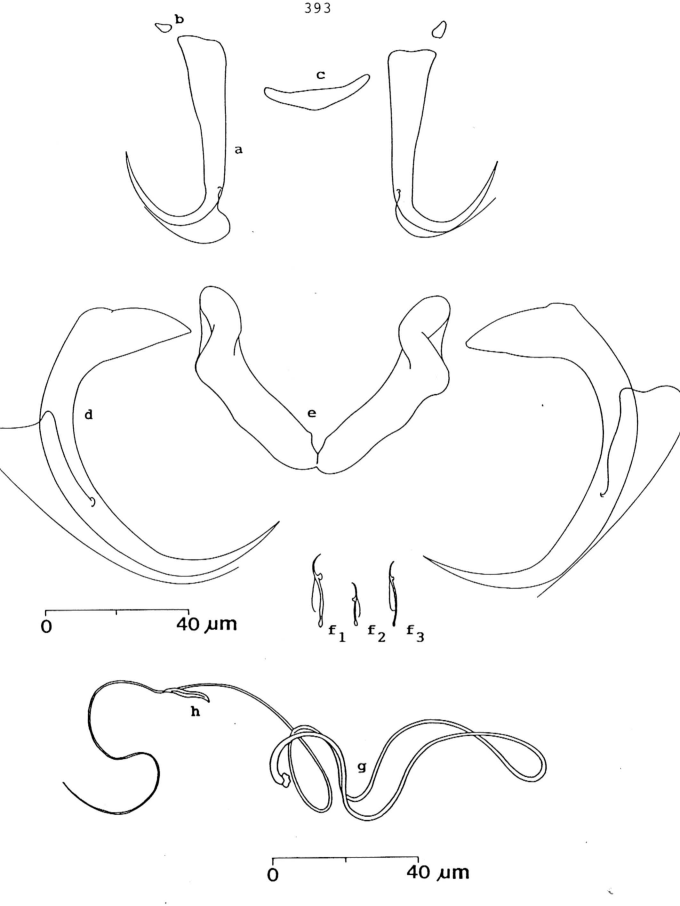


Fig. A68. Hard parts of *Thaparocleidus* n. sp. 25: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, f_3, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

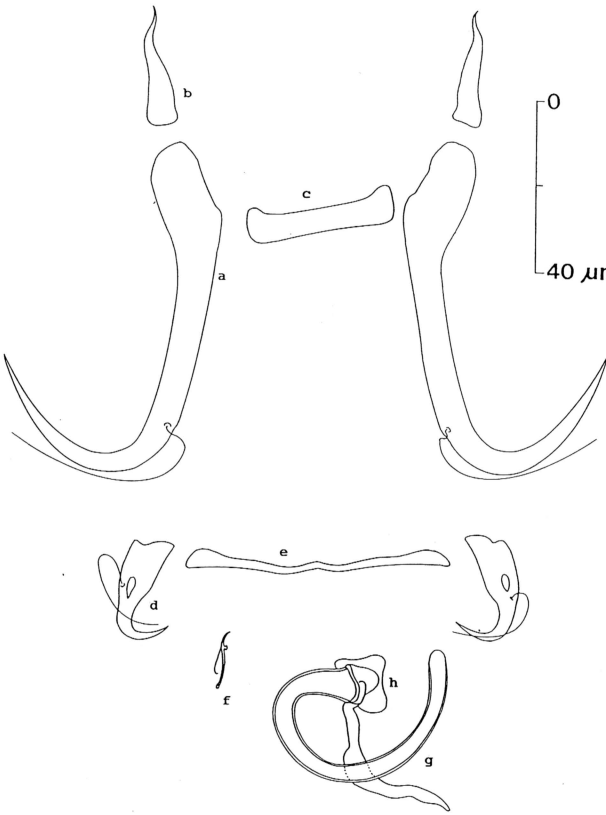


Fig. A69. Hard parts of *Thaparocleidus* n. sp. 26: a, dorsal anchor; b, patch; dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hooks; g, copulate tube; h, accessory piece. Scale-bar in micrometres

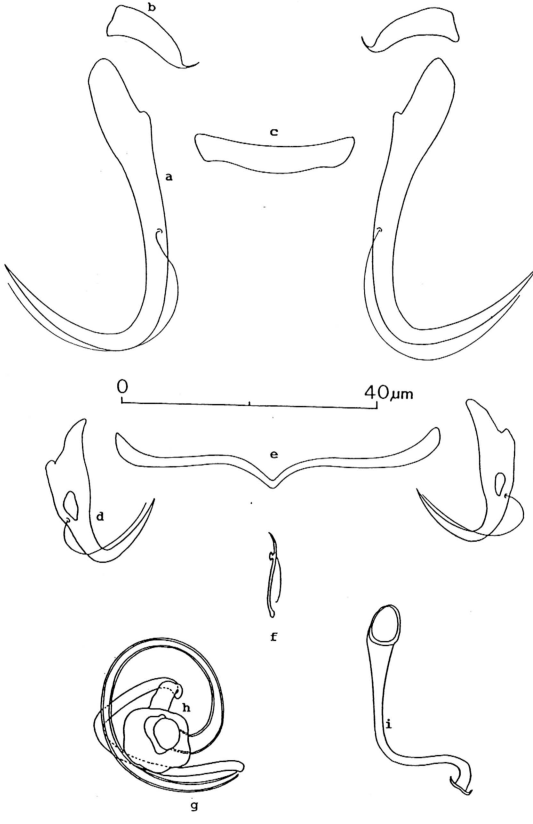


Fig. A70. Hard parts of *Thaparocleidus* n. sp. 27: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece; i, vaginal system. Scale-bar in micrometres

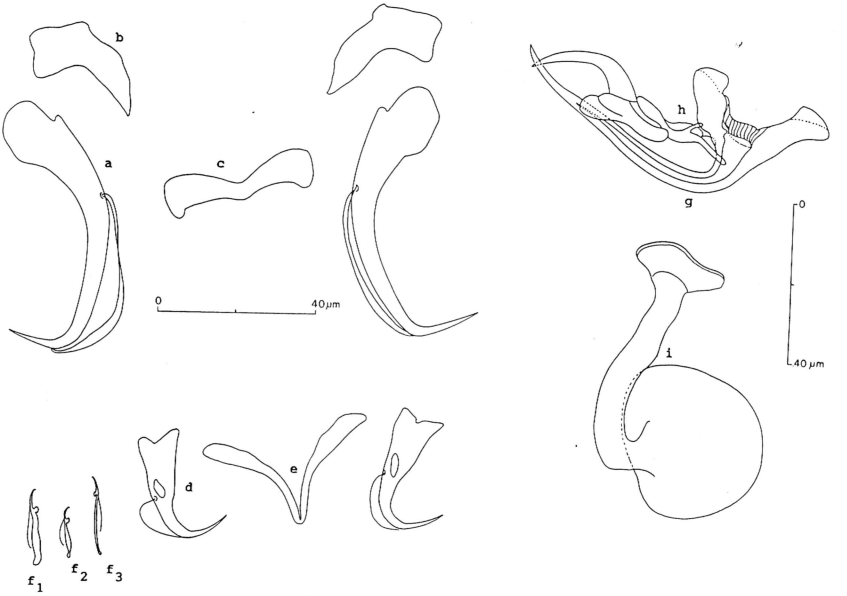


Fig. A71. Hard parts of *Thaparocleidus* n. sp. 28: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, f_3, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system with

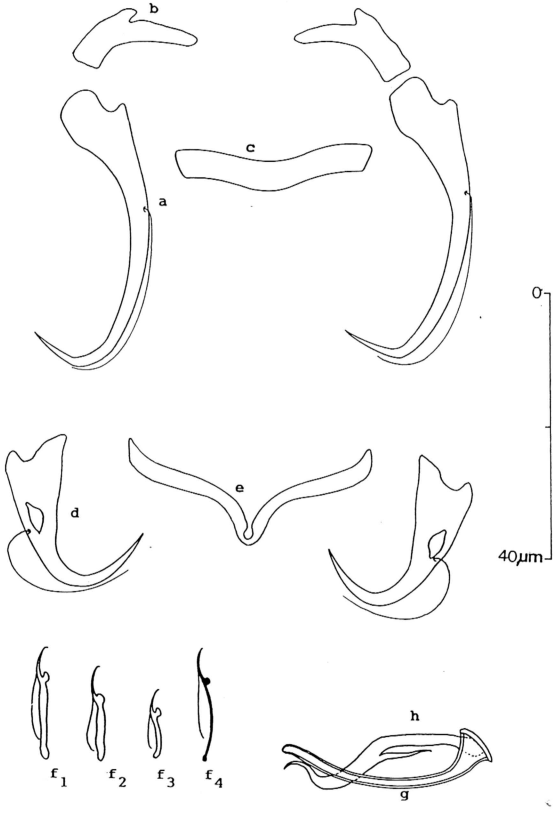


Fig. A72. Hard parts of *Thaparocleidus* n. sp. 29: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, f_3, f_4, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

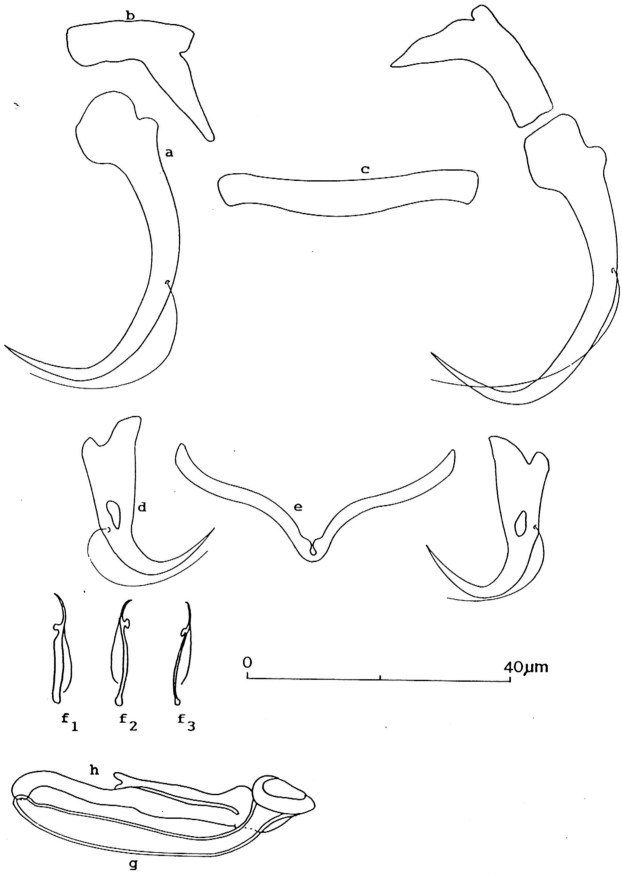


Fig. A73. Hard parts of *Thaparocleidus* n. sp. 30: a, dorsal anchor; b, patch; c dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, f_3, marginal hooks; g copulatory tube; h, accessory piece. Scale-bar in micrometres

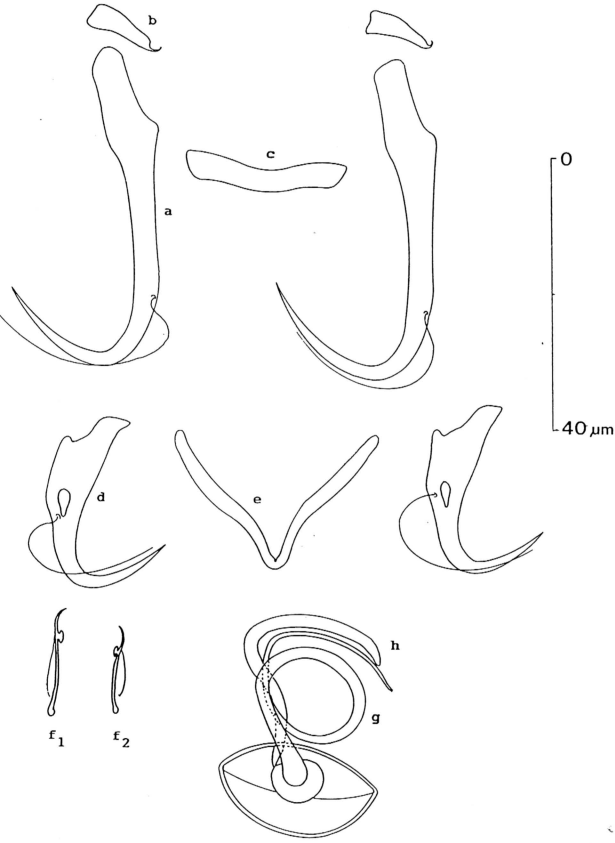


Fig. A74. Hard parts of *Thaparocleidus* n. sp. 31: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

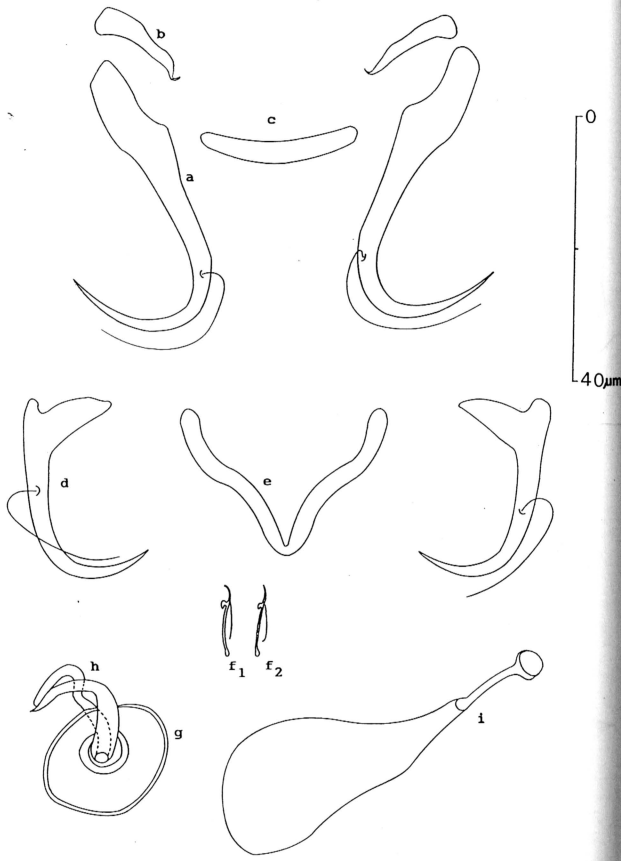


Fig. A75. Hard parts of *Thaparocleidus* n. sp. 32: a, dorsal anchor; b, patch; c dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g copulatory tube; h, accessory piece; i, vaginal system with seminal receptacle Scale-bar in micrometres

Appendix 3.5: Monogeneans of Schilbeidae

Introduction

Five species of Schilbeidae belonging to four genera were recorded in Thailand. The four genera are *Clupisoma* Swainson, 1838 (two species), *Eutropiichthys* Bleeker, 1862 (one species), *Laides* Jordan, 1919 (one species) and *Platytropius* Hora, 1937 (one species) (see Vidthayanon & Roongthongbaisuree, 1993). Only *Laides hexanema* (Bleeker, 1852) was examined and found to be infected with two new species of *Thaparocleidus* Jain, 1952.

To date, 13 monogenean species belonging to two genera were recorded from five schilbeid species in India; eight species of *Bychowskyella* Achmerow, 1952 and five species of *Thaparocleidus* Jain, 1952. Two species of *Bychowskyella* and two species of *Thaparocleidus* were found on *Eutropiichthys vacha*, four species of *Bychowskyella* and two species of *Thaparocleidus* on *Pseudeutropius garua*, one species of *Bychowskyella* on *Pseuduetropius taakree*, one species of *Bychowskyella* and one species of *Thaparocleidus* on *Silonia silondia* (see Dubey, Gupta & Agarwal, 1992a; Gussev, 1976, 1977; Jain, 1957b, 1959, 1961b; Lim, 1996b; Majumdar & Agarwal, 1988; Tripathi, 1957) (Table A4).

The African schilbeids, on the other hand, were infected with *Schilbetrema* Paperna & Thurston, 1968 and *Schilbetrematoides* Kritsky & Kulo, 1992. A total of 12 species of *Schilbetrema* and one species of *Schilbetrema-toides* were found on four schilbeid species in Africa (see Kritsky & Kulo, 1992a, 1992b; Paperna, 1969, 1973; Paperna & Thurston, 1968) (Table A4).

Results

Two new species of *Thaparocleidus* Jain, 1952 were obtained from four specimens of *Laides hexanema.*

1. *Thaparocleidus* n. sp. 33 (Fig. A76)

Type host: *Laides hexanema* (Bleeker, 1852) (4 individuals examined, 4 infected)
Type locality: Chao-praya River, Chinat
No. of monogenean specimens collected and studied: 23
No. of monogenean specimens measured: 8

Body size 882 (726-940) x 185 (150-216). Four eye spots. Haptor size 126 (102 168) x 168 (112-196). Dorsal anchors: inner length 44 (43-46); outer length 36 (34-38); inner root 16 (14-18), stumpy outer root and recurved point 20 (18-22). Patches triangular, size 16 (16-18) x 4 (3-4). Ventral anchors: inner length 22 (20-22); outer length 18 (17-20); inner root 8 (7-8); outer root 2 and recurved point 12 (12-14). Dorsal bar slightly V-shaped, size 36 (34-36) x 6 (5-6). Ventral bar V-shaped, size of one side 20 (20-22) x 4 (3-4). Seven pairs of marginal hooks, 2 types, same length 14 (12-14).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of highly coiled copulatory tube (8-9 coils), flattened at initial part, diameter 2 and grooved accessory piece, size 30 (27-34) x 16 (12-18). Vaginal opening sinistral, guarded with sclerite, size 28 (24-32) x 16 (14-16). Vaginal tube highly coiled.

Differential diagnosis: The present species is similar to *Thaparocleidus multispiralis* (Jain, 1957) Lim, 1996 from *Silonia silondia* in having similar morphologies of haptoral armaments and coiled copulatory tube (see Jain, 1957b), but differs from it in the morphology of accessory piece. This species also differs from *Thaparocleidus vachi* (Tripathi, 1957) Lim, 1996, *T. vachius* (Jain, 1961) Lim, 1996 from *Eutropiichthys vacha* (see Jain, 1961b; Tripathi, 1957), *Thaparocleidus raipurensis* (Dubey, Gupta & Agarwal, 1992) Lim, 1996 and *Thaparocleidus vaginalis* (Gussev, 1976) Lim, 1996 (see Dubey, Gupta & Agarwal, 1992a; Gussev, 1976) in having coiled copulatory tube. This species also similar to *Thaparocleidus tasekherai* (Lim, 1986) Lim, 1996 and *Thaparocleidus convolvulus* (Lim, 1986) Lim, 1996 from *Ompok hypophthalmus* (syn. *Silurodes hypophthalmus*) (see Lim, 1986a, 1996b) in having coiled copulatory tube and coiled vaginal tube, but differs from them in having a more coiled copulatory tube (8-9 coils) and large grooved accessory piece. This species is also different from other previously described *Thaparocleidus* species in the morphology of dorsal anchor and detailed morphologies of the copulatory organ and vaginal opening. This species is thus considered a new species and named *Thaparocleidus* n. sp. 33.

2. *Thaparocleidus* n. sp. 34 (Fig. A77)

Type host: *Laides hexanema* (Bleeker, 1852) (4 individuals examined, 4 infected)
Type locality: Chao-praya River, Chinat
No. of monogenean specimens collected and studied: 19
No. of monogenaen specimens measured: 8

Body size 700 (605-840) x 98 (75-126). Four eye spots. Haptor size 100 (75-118) x 123 (84-168). Dorsal anchors: with stumpy, club-shaped inner root, total length 44 (43-45); short recurved point 8 (8-10). Patches knee-shaped, size 14 (12-15) x 4 (4-6). Ventral anchors: inner length 18 (18-20); outer length 18 (17-18); inner root 6 (4-6); outer root 2; recurved point 12 (10-12). Dorsal bar slightly V-shaped, size 22 (20-24) x 4 (4-6). Ventral bar V-shaped, size of one side 22 (20-22) x 2 (2-3). Seven pairs of marginal hooks, 2 types, same length 12 (10-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of less coiled copulatory tube (2-3 coils), flattened at initial part, diameter 2 and clipper-like accessory piece, size 28 (26-34) x 10 (8-16). Vaginal opening not observed.

Differential diagnosis: The present species is different from *Thaparocleidus* n. sp. 33 in the morphologies of dorsal anchor, patch and copulatory organ. The present species possesses dorsal anchor with stumpy, club-shaped inner root, long knee-shaped patch and in having a copulatory tube with less coils (2-3 coils). This species is also different from the other known *Thaparocleidus* species from Indian schilbeids in the morphologies of dorsal anchor, patch and accessory piece. This species is hence considered a new species and is named *Thaparocleidus* n. sp. 34.

Discussion

Morphologically, copulatory organs of the two new *Thaparocleidus* species from *Laides hexanema* (Schilbeidae) are similar to that found in the *Thaparocleidus* species from Siluridae, for example *Thaparocleidus convolvulus* and *T. tasekberai* from *O. hypophthalmus* (see Lim, 1986a), *T. wallagonius* Jain, 1952 and *T. kao* Lim & Lerssutthichawal, 1996 from *Wallago attu* (see Lim & Lerssutthichawal, 1996: Appendix 3.8).

To date eight species of *Bychowskyella* and five species of *Thaparocleidus* were described on four schilbeid species from India (Table A4). However only *Thaparocleidus* species were found on Thai schilbeid species (*L. hexanema*). The African schilbeids were infected with *Schilbetrema* and *Schilbetrematoides* (see Paperna, 1969, Paperna & Thurston, 1968; Kritsky & Kulo, 1992a, 1992b).

Table A4 Monogeneans of the schilbeids

Fish host species	Monogenean species	Localities	References
Eutropiichthys vacha	*Bychowskyella gomtia*	India	Jain, 1959; Gussev, 1976
	B. vacha	"	Tripathi, 1957; Gussev, 1976
	Thaparocleidus vachi	"	Tripathi, 1957; Lim, 1996b
	T. vachius	"	Jain, 1961b; Lim, 1996b
Laides hexanema	*Thaparocleidus* n.sp.33	Thailand	present study
	Thaparocleidus n.sp.34	"	present study
Pseudeutropius garua	*Bychowskyella caballeroi*	India	Gussev, 1977
	B. gharui	"	Tripathi, 1957; Gussev, 1976
	B. gussevi	"	Majumdar & Agrawal, 1988
	B. pricei	"	Majumdar & Agrawal, 1988
	Thaparocleidus raipurensis	"	Dubey, Gupta & Agrawal, 1992a; Lim, 1996b
	T. vaginalis	"	Gussev, 1976; Lim, 1996b
P. taakree	*Bychowskyella bychowskyii*	"	Gussev, 1977
Physalia pellucida (syn. *Parailia pellucida*)	*Schilbetrema bicornis*	Ghana	Paperna, 1969
Schilbe intermedius	*S. aegyptica*	Egypt	El-Naggar, 1985
		Togo	Kritsky & Kulo, 1992a
	S. acornis	Ghana	Paperna, 1969
		Togo	Kritsky & Kulo, 1992a
		Uganda	Paperna, 1979; Paperna & Thurston, 1968
	S. calamocleithrum	Togo	Kritsky & Kulo, 1992a
	S. quadricornis	Ghana	Paperna, 1969;
		Togo	Kritsky & Kulo, 1992a
		Uganda	Paperna, 1979; Paperna & Thurston, 1968
	S. undinula	Togo	Kritsky & Kulo, 1992a
	S. vacillans	"	Kritsky & Kulo, 1992a

Table A4 cont'd

Fish host species	Monogenean species	Localities	References
S. mystus	*S. eutropii*	Ghana	Paperna, 1969
		Togo	Kritsky & Kulo, 1992a
	S. hexacornis	Ghana	Paperna, 1969
		Togo	Kritsky & Kulo, 1992a
	S. spirocirra	Ghana	Paperna, 1969
		Togo	Kritsky & Kulo, 1992a
	S. torula	"	Kritsky & Kulo, 1992a
	Schilbetrematoides pseudodactylogyrus	"	Kritsky & Kulo, 1992b
Schilbe sp.	*Schilbetrema tricera*	Tanzania	Paperna, 1973; Kritsky & Kulo, 1992a
Silonia silondia	*Bychowskyella cauveryi*	India	Tripathi, 1957; Gussev, 1976
	Thaparocleidus multispiralis	"	Jain, 1957b; Lim, 1996b

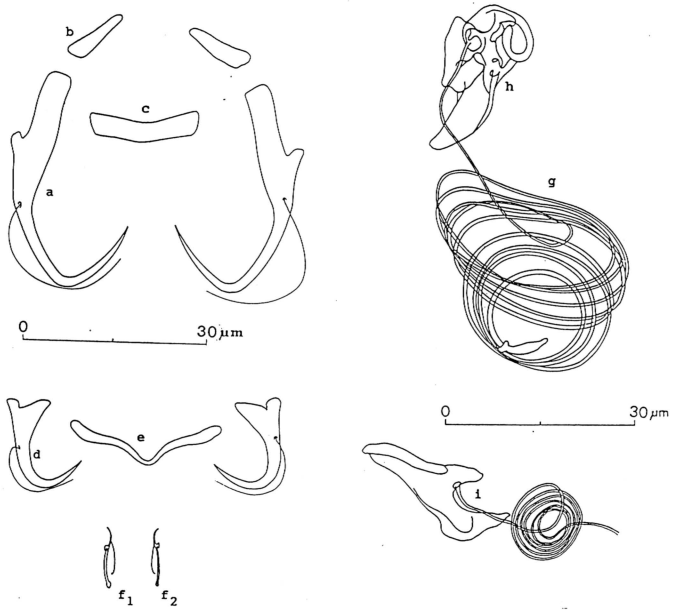


Fig. A76. Hard parts of *Thaparocleidus* n. sp. 33: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor;

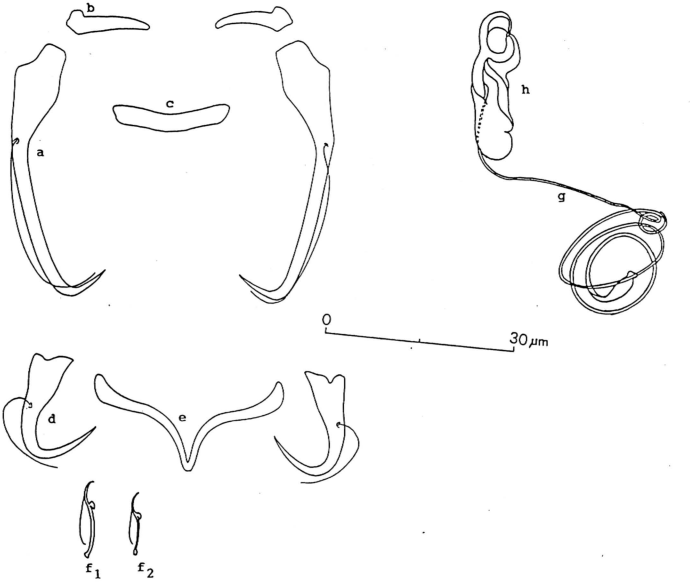


Fig. A77. Hard parts of *Thaparocleidus* n. sp. 34: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

Appendix 3.6: Monogeneans of Siluridae

Introduction

There are 23 species of Siluridae belonging to eight genera in Thailand. The eight genera are *Belodontichthys* Bleeeker, 1858 (one species), *Ceratoglanis* Myers, 1938 (one species), *Hemisilurus* Bleeker, 1858 (one species), *Kryptopterus* Bleeker, 1858 (nine species), *Ompok* Lacepede, 1803 (three species), *Silurichthys* Bleeker, 1856 (four species), *Silurus* Linnaeus, 1758 (two species) and *Wallago* Bleeker, 1851 (two species) (see Bornbusch, 1995; Kottelat, 1989; Smith, 1945).

In this study, nine silurid species were examined for monogenaens: *Belodontichthys dinema* Bleeeker, 1851, *Hemisilurus mekongensis* Bornbusch & Lundberg, 1989, *Kryptopterus apogon* (Bleeker, 1851), *Kryptopterus bleekeri* Gunther, 1864, *Kryptopterus bicirrhis* (Valenciennes, 1840), *Kryptopterus cryptopterus* (Bleeker, 1851), *Ompok bimaculatus* (Bloch, 1797), *Silurichthys* sp. and *Wallago attu* (Bloch & Schneider, 1802). All the nine fish species examined were found to be infected with monogeneans.

Currently 72 monogenean species belonging to seven genera have been recorded from eight silurid species. The distribution of these seven monogenean genera on the eight silurid species is listed in Table A5. The seven genera are *Ancylodiscoides* Yamaguti, 1937 (one species), *Bychowskyella* Achmerow, 1952 (four species), *Hamatopeduncularia* Yamaguti, 1953 (two species), *Heteronchocleidus* Bychowsky, 1957 (one species), *Neocalceostoma* Tripathi, 1957 (one species), *Mizelleus* Jain, 1957 (six species) and *Thaparocleidus* Jain, 1952 (57 species) (see Gussev, 1985; Lim, 1986a; 1996b; Lim & Lerssutthichawal, 1996 & Appendix 1) (see Discussion).

Results

Nineteen monogenean species (one *Mizelleus* species and 18 *Thaparocleidus* species) were obtained from nine silurid species in this study. Of the 19 monogenean species, three species were previously described; *Mizelleus siamensis* Lim & Lerssutthichawal, 1996, *Thaparocleidus indicus* (Kulkarni, 1969) Lim, 1996 and *Thaparocleidus kao* Lim & Lerssutthichawal, 1996 (see Appendix 3.8; Figs. A78-A80). The other 16 new *Thaparocleidus* species were collected from *B. dinema* (two *Thaparocleidus* species), *H. mekongensis* (two species), *K. apogon* (two species), *K. bleekeri* (four species), *K. bicirrhis* (two species), *K. cryptopterus* (three species), *O. bimaculatus* (four species) and *Silurichthys* sp. (one species). *K. apogon* shares two *Thaparocleidus* species with *K. bleekeri*, *K. cryptopterus* shares one *Thaparocleidus* species with *K. bicirrhis* and another with *K. bleekeri*.

1. *Thaparocleidus* n. sp. 35 (Figs. A81 & 82)

Type host: *Belodontichthys dinema* Bleeker, 1851 (4 individuals examined, 4 infected from sites 1 & 2)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchathanaee (site 2)

No. of monogenean specimens collected and studied: 139
No. of monogenean specimens measured: 12

Body size 634 (395-798) x 100 (76-143). Four eye spots, posterior pair larger. Haptor size 103 (59-168) x 104 (50-168). Dorsal anchors: inner length 40 (32-43); outer length 30 (24-32); inner root 12 (10-12), stumpy outer root and recurved point 22 (18-23). Patches small, size 8 (6-8) x 4 (3-4). Ventral anchors: inner length 22 (18-23); outer length 22 (18-23); inner root 6 (5-6); outer root 2; recurved point 14 (10-14). Dorsal bar slightly V-shaped, size 26 (26-28) x 4 (3-4). Ventral bar V-shaped, size of one side 20 (16-20) x 3 (2-3). Seven pairs of marginal hook, 2 types, same length 14 (14-15).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long thin blind seminal vesicle. Copulatory organ consists of long recurved copulatory tube, length 49 (44-54), widening at initial part, diameter 9 (6-10) and grooved, stick-like accessory piece, size 35 (30-40) x 4 (3-4). Vaginal opening midbody, funnel-like, connected to ovoid seminal receptacle with short vaginal tube.

Differential diagnosis: The present species is very similar to *Thaparocleidus laisensis* (Lim, 1986) Lim, 1996 from *Ompok hypophthalmus* (see Lim, 1986a, 1996b) in having similar types of haptoral armaments and copulatory tube. However the copulatory tube of the present species is comparatively longer than that of *T. laisensis*. The present species is also different from *T. laisensis* in the morphology of accessory piece and vaginal system. Grooved stick-like accessory piece with a long process at the proximal part and lightly sclerotised funnel-like vaginal opening are observed in the present species. The present species is different from *T. sudhakari* (Gussev, 1976) Lim, 1996 from *W. attu* (see Gussev, 1976) in the morphology of copulatory tube. The present species is considered a new species and identified as *Thaparocleidus* n. sp. 35.

2. *Thaparocleidus* n. sp. 36 (Figs. A83 & A84)

Type host: *Belodontichthys dinema* Bleeker, 1851 (4 individuals examined, 4 infected from sites 1 & 2)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Me-kong River, Ubonratchahanee (site 2)
No. of monogenean specimens collected and studied: 77
No. of monogenean specimens measured: 12

Body size 700 (605-840) x 98 (75-126). Four eye spots. Haptor size 100 (75-118) x 123 (84-168). Dorsal anchors: inner length 40 (38-44); outer length 32 (29-36); inner root 11 (11-12), stumpy outer root and recurved point 20 (16-22). Patches knee-shaped, size 14 (10-15) x 5 (4-6). Ventral anchors: inner length 21 (18-24); outer length 19 (17-22); inner root 6 (4-6); outer root 2 and recurved point 12 (10-14). Dorsal bar slightly V-shaped, broader at both ends, size 27 (24-32) x 4(4-6). Ventral bar V-shaped, size of one side 25 (20-30) x 2 (2-3). Seven pairs of marginal hooks, 2 types, same length 12 (10-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of highly coiled copulatory tube (8-9 coils), flattened at initial part, diameter 2 and clipper-like accessory piece, size 28 (26-34) x 10 (8-16). Vaginal opening sinistral, guarded with large sclerite, size 48 (42-52) x 14 (11-16). Vaginal tube highly coiled.

Differential diagnosis: The present species is similar to *Thaparocleidus macrocleithrius* (Lim, 1986) Lim, 1996, *Thaparocleidus convolvulus* (Lim, 1986), Lim, 1996 and *Thapa-rocleidus tasekberai* (Lim, 1986) Lim, 1996 from *O. hypophthalmus* (see Lim, 1986a, 1996b) and *Thaparocleidus* n. sp. 33 from *Laides hexanema* (Schilbeidae) (see Appendix 3.5: Monogeneans of Schilbeidae) in having a highly coiled copulatory tube and a clipper-like accessory piece. The copulatory tube of the three *Thaparocleidus* species from *O. hypophthalmus* have less coils (6-8 coils) compared to the present species which has more coils (8-9 coils). The present species also differs from the other known *Thaparocleidus* in the morphologies of haptoral armaments and sclerite of the vaginal opening. This species is considered a new species and identified as *Thaparocleidus* n. sp. 36.

3. *Thaparocleidus* n. sp. 37 (Fig. A85)

Type host: *Hemisilurus mekongensis* Bornbusch & Lundberg, 1989 (one individual examined, one infected)
Type locality: Me-kong River, Ubonratchathanee
No. of monogenean specimens collected and studied: 5
No. of monogenean specimens measured: 5

Body size 536 (480-600) x 86 (80-120). Four eye spots. Haptor size 131 (112-144) x 134 (112-160). Dorsal anchors: inner length 38 (38-40); outer length 29 (28-30); inner root 12 (10-12), stumpy outer root and recurved point 16 (16-18). Patches triangular, size 13 (12-14) x 4 (4-5). Ventral anchors: inner length 18 (18-20); outer length 18 (18-9); inner root 4; outer root 2; recurved point 8 (8-9). Dorsal bar slightly V-shaped, broader at both side, size 26 (22-28) x 4 (4-5). Ventral bar V-shaped, size of one side 22 (20-22) x 2 (2-3). Seven pairs of marginal hooks, 2 types, same length 10 (10-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of highly coiled copulatory tube (9-10 coils), flattened at initial part, diameter 2 and clipper-like (horn-shaped) accessory piece, size 24 (22-26) x 11 (10-12). Vaginal opening sinistral, guarded with large sclerite, size 60 (54-70) x 31 (28-36). Vaginal tube highly coiled.

Differential diagnosis: The present species is very similar to *T. tasekberai* (Lim, 1986) Lim, 1996 from *O. hypophthalmus*, *Thaparocleidus* n. sp. 36 from *B. dinema* and *Thaparocleidus* n. sp. 33 from *Laides hexanema* (Schilbeidae) in having similar types of haptoral armaments and copulatory tube but differs from them in the morphology of accessory piece and comparatively larger sclerotised vaginal opening. This species also differs from the other known *Thaparocleidus*

species in the morphology of accessory piece. It is thus a new species and denoted as *Thaparocleidus* n. sp. 37 in this study.

4. *Thaparocleidus* n. sp. 38 (fig. A86)

Type host: *Hemisilurus mekongensis* Bornbusch & Lundberg, 1989 (one individual examined, one infected)
Type locality: Me-kong River, Ubonratchathanee
No. of monogenean specimens collected and studied: 6
No. of monogenean specimens measured: 5

Body size 444 (420-462) x 86 (84-92). Four eye spots. Haptor size 76 (67-84) x 9 (84-126). Dorsal anchors: inner length 34 (32-34); outer length 25 (22-26); inner root 11 (10-12), outer root 2 (1-2); recurved point 14 (14-16). Small patches, size 9 (8-10) x 4. Ventral anchors: inner length 18 (17-18); outer length 16 (15-16); inner root 4; outer root 2; recurved point 7 (6-8). Dorsal bar slightly V-shaped, size 25 (22-28) x 4 (3-4). Ventral bar V-shaped, size of one side 22 (20-24) x 1(1-2). Seven pairs of marginal hooks, 2 types: 6 pairs, length 12 (10-12); one thin pair near ventral anchors, length 11 (11-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of highly coiled tube (9-10 coils), flattened at initial part and clipper-like accessory piece, size 20 (19-20) x 10 (9-10). Vaginal opening sinistral, guarded with large sclerite, size 36 (30-40) x 11 (10-12). Vaginal tube highly coiled tube.

Differential diagnosis: The present species is very similar to *T. tasekberai* (Lim, 1986) Lim, 1996, *Thaparocleidus* n. sp. 36 and *Thaparocleidus* n. sp. 37 in having similar types of haptoral armaments and copulatory organ. However the present species is different from the three species mentioned in having comparatively smaller haptoral structures and in the detailed morphologies of accessory piece of copulatory organ and sclerite of vaginal opening (see Figs. A84 & A85, for comparison). Hence, this species is considered a new species and identified as *Thaparocleidus* n. sp. 38.

5. *Thaparocleidus* n. sp. 39 (Fig. A87)

Type host: *Kryptopterus apogon* (Bleeker, 1851) (5 individuals examined, 3 infected, 18 monogeneans collected from sites 1 & 2)
Other host: *Kryptopterus bleekeri* Gunther, 1864 (9 individuals examined, 4 infected, 191 monogeneans collected from sites 1 & 3)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Chao-praya River, Chinat (site 2); Ubonratana Reservoir, Khon-kean (site 3); Nong-haan, Sakol-nakorn (site 4)
No. of monogenean specimens collected and studied: 209
No. of monogenean specimens measured: 12

Body size 436 (378-479) x 99 (76-126). Four eye spots. Haptor size 76 (57-84) x 88 (59-126). Dorsal anchors: inner length 37 (36-38); outer length 30

(28-30); inner root 10 (8-12); stumpy outer root; recurved point 16 (16-18). Patches boot-shaped, size 13 (10-14) x 4 (3-5). Ventral anchors: inner length 20 (18-20); outer length 18 (16-19); inner root 6 (5-6); outer root 2; recurved point 11 (10-12). Dorsal bar slightly V-shaped, size 24 (22-26) x 4 (3-4). Ventral bar V-shaped, length of one side (10-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of coiled copulatory tube (about 6-7 coils), widening at initial part, diameter 3 (3-4) and clipper-like accessory piece, size 14 (12-6) x 6 (5-6). Vaginal opening sinistral, guarded with small sclerite, size 18 (15-24). Vaginal tube highly coiled.

Differential diagnosis: The present species is very similar to *T. tasekberai* (Lim, 1986) Lim, 1996 in having similar haptoral structures (except patch), copulatory tube and vaginal tube, but differs from it in having boot-shaped patch and comparatively smaller accessory piece. The present species also differs from *T. convolvulus* (Lim, 1986) Lim, 1996 in the shape of the ventral anchor. This species also differs from the other known *Thaparocleidus* species in the morphologies of the patch and accessory piece. It is considered a new species and is named *Thaparocleidus* n. sp. 39.

6. *Thaparocleidus* n. sp. 40 (Fig. A88)

Type host: *Kryptopterus apogon* (Bleeker, 1851) (5 individuals examined, 3 infected, 28 monogeneans collected from sites 1 & 2)
Other host: *Kryptopterus bleekeri* Gunther, 1864 (9 individuals examined, 5 infected, 58 monogeneans collected from sites 1, 2 & 4)
Localities: Mun River, Ubonratchathanee (type locality) (site 1); Chao-praya River, Chinat (site 2); Ubonratana Reservoir, Khon-kean (site 3); Nong-haan, Sakol-nakorn (site 4)
No. of monogenean specimens collected and studied: 86
No. of monogenean specimens measured: 13

Body size 753 (420-1092) x 118 (67-151). Four eye spots. Haptor size 108 (67-168) x 130 (59-202). Dorsal anchors: inner length 55 (46-66); outer length 42 (36-54); inner root 13 (10-18); stumpy outer root; recurved point 25 (20-30). Patches triangular, size 19 (14-26) x 5 (4-6). Ventral anchors: inner length 23 (20-24); outer length 22 (18-24); inner root 7 (5-10); outer root 2 (2-4) and recurved point 15 (14-16). Dorsal bar slightly V-shaped, size 25 (20-32) x 4 (2-6). Ventral bar V-shaped, length of one side 19 (18-22). Seven pairs of marginal hooks, 2 types, same length 16 (14-18).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long thin blind seminal vesicle. Copulatory organ consists of long twisted copulatory tube, length along the tube 58 (55-64), widening at initial part, diameter 4 (2-5) and grooved pipe-like accessory piece, size 26 (22-32) x 2 (2-3). Vaginal opening sinistral, lightly sclerotised bulbous. Vaginal tube short curved.

Differential diagnosis: The present species is very similar to *T. sudhakari* (Gussev, 1976) Lim, 1996 in having similar types of haptoral armaments and copulatory tube, but differs from it in having short grooved pipe-like accessory piece. The present species is similar to *Thaparocleidus* n. sp. 35 from *B. dinema* in having similar types of haptoral armaments and copulatory tube. However the copulatory tube of this species is comparatively longer than that of *Thaparocleidus* n. sp. 35. The present species possesses a grooved pipe-like accessory piece which is comparatively shorter than that of *Thaparocleidus* n. sp. 35. The present species is also different from the other known *Thaparocleidus* species in the morphologies of copulatory tube and accessory piece. This species is new to Science and identified as *Thaparocleidus* n. sp. 40.

7. *Thaparocleidus* n. sp. 41 (Fig. A89)

Type host: *Kryptopterus bicirrhis* (Cuv. in Cuv. & Val., 1839 (2 individuals examined, 2 infected)
Type locality: NIFI Aquarium, Bangkok
No. of monogenean specimens collected and studied: 25
No. of monogenean specimens measured: 10

Body small, size 325 (235-420) x 71 (59-84). Four eye spots. Haptor size 55 (42-84) x 79 (59-109). Dorsal anchors: small, inner length 16 (14-18); outer length 13 (12-14); inner root 4 (3-4); stumpy outer root; recurved point 6 (6-8). Patches small trapezoid, size 2 (2-3) x 1. Ventral anchors: forceps-like, inner root 17 (14-20); outer length 19 (15-21), inner root 4 (3-4); outer root 4 (3-4) and recurved point 4 (3-4). Dorsal bar slightly V-shaped, size 12 (10-12) x 2. Ventral bar V-shaped, length of one side 20 (16-20). Seven pairs of marginal hooks, length 12 (12-14).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of coiled copulatory tube (6-7 coils), flattened at initial part, diameter 2 and small clipper-like accessory piece, size 10 (8-12) x 5 (4-6). Vaginal opening sinistral, guarded with sclerotised piece, size 15 (14-20) x 10 (8-10). Vaginal tube highly convulated.

Differential diagnosis: The present species is similar to *T. convolvulus* (Lim, 1986) Lim, 1996 in having similar types of haptoral armaments (except for dorsal anchor), copulatory organ and vaginal system. This species is different from other *Thaparocleidus* species from silurids in having dorsal anchors which are smaller than the ventral anchors. The present species is thus considered a new species and identified as *Thaparocleidus* n. sp. 41 in this thesis.

8. *Thaparocleidus* n. sp. 42 (Fig. A90)

Type host: *Kryptopterus bicirrhis* (Cuv. in Cuv. & Val., 1839) (2 individuals examined, 2 infected, 98 monogeneans collected from site 1)
Other host: *Kryptopterus cryptopterus* (Bleeker, 1851) (6 individuals examined, 4 infected; 66 monogeneans collected from sites 2 & 3)

Localities: NIFI Aquarium, Bangkok (type locality) (site 1); Jatujak Fish Market, Bangkok (site 2), Mun River, Ubonratchathanee (site 3), Chao-praya River, Chinat (site 4)
No. of monogenean specimens collected and studied: 164
No. of monogenean specimens measured: 8

Body size 351 (302-420) x 82 (51-151). Four eye spots. Haptor size 59 (42-76) x 89 (67-126). Dorsal anchors: inner length 27 (24-30); outer length 23 (20-24); inner root 6 (6-8); outer root 2 (1-2); recurved point 10 (8-12). Patches small, slightly knee-shaped, size 9 (6-10) x 2 (2-3). Ventral anchors: inner length 16 (14-20); outer length 14 (13-16); inner root 2 (2-4); outer root 2 and recurved point 8 (6-10). Dorsal bar slightly V-shaped, size 17 (14-20) x 2 (1-3)). Ventral bar V-shaped, length of one side 18 (16-20). Seven pairs of marginal hooks, length 10 (10-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of coiled copulatory tube (7-8 coils), widening at initial part, diameter 3 (2-4) and small clipper-like accessory piece, size 10 (8-12) x 6 (3-7). Vaginal opening sinistral, guarded with sclerotised piece, size 18 (14-26) x 10 (6-12). Vaginal tube highly coiled.

Differential diagnosis: The present species is very similar to *T. tasekberai* (Lim, 1986) Lim 1996 and *Thaparocleidus* n. sp. 39 in having similar morphology of haptoral armaments, copulatory tube and vaginal tube. However, the present species is different from these two species in having (i) a more slender dorsal anchor, (ii) more coiled copulatory tube and (iii) different types of sclerotised vaginal opening. This species also differs from other known *Thaparocleidus* species in the morphology of vaginal opening. This species is considered a new species and identified as *Thaparocleidus* n. sp. 42.

9. *Thaparocleidus* n. sp. 43 (Fig. A91)

Type host: *Kryptopterus cryptopterus* (Bleeker, 1851) (6 individuals examined, 2 infected from sites 1 & 2)
Localities: Jatujak Fish Market, Bangkok (type locality) (site 1), Mun River, Ubonratchathanee (site 2), Chao-praya river, Chinat (site 3)
No. of monogenean specimens collected and studied: 42
No. of monogenean specimens measured: 7

Body size 534 (361-588) x 113 (76-168). Four eye spots. Haptor size 73 (59-84) x 84 (59-1). Dorsal anchors: inner length 44 (38-50); outer length 35 (30-40); inner root 10 (8-14); stumpy outer root; recurved point 10 (8-12). Triangular patches, size 9 (6-10) x 2 (2-3). Ventral anchors: fenestrated at mainpart, inner length 16 (14-18); outer length 14 (13-16); inner root 4 (3-4); outer root 2 and recurved point 8 (7-8). Dorsal bar, size 18 (16-20) x 3 (2-4). Ventral bar V-shaped, length of one side 19 (18-20). Seven pairs of marginal hooks, 2 types: 6 pairs, length 13 (12-14; one thin pair near ventral anchors, length 12 (12-13).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long thin blind seminal vesicle. Copulatory

organ consists of long straight copulatory tube, length 66 (60-80), widening at initial part, diameter 4 (3-5) and grooved accessory piece, size 25 (22-28) x 4 (3-5). Vaginal opening sinistral, funnel-like, diameter 2 (1-2). Vaginal tube, length 52 (48-60).

Differential diagnosis: The present species is different from the other 17 *Thaparocleidus* species from Thai silurid species in having fenestrated ventral anchor and long straight copulatory tube. Long straight copulatory tube is also observed in *T. sudhakari* (Gussev, 1976) Lim, 1996, *Thaparocleidus mediacanthus* (Gussev, 1985) Lim, 1996 and *Thaparocleidus macracanthus* (Gussev, 1985) Lim, 1996 from *Silurus soldatovi* and *S. asotus* (see Gussev, 1976, 1985). However all the aforementioned species are different from the present species in not having fenestrated ventral anchors. This species is considered a new species and identified as *Thaparocleidus* n. sp. 43 in this study.

10. *Thaparocleidus* n. sp. 44 (Fig. A92)

Type host: *Kryptopterus cryptopterus* (Bleeker, 1851) (6 indiviuals examined, 3 infected, 8 monogeneans collected from sites 1, 2 & 3)
Other host: *Kryptopterus bleekeri* Gunther, 1864 (9 individuals examined, 3 infected, 30 monogeneans collected from sites 3 & 4)
Localities: Jatujak Fish Merket, Bangkok (type locality) (site 1); Mun River, Ubonratchathanee (site 2); Chao-praya River, Chinat (site 3); Nong-haan Reservoir, Sakol-nakorn (site 4)
No. of monogenean specimens collected and studied: 38
No. of monogenean specimens measured: 13

Body size 470 (336-638) x 92 (50-168). Four eye spots. Haptor size 77 (50-101) x 72 (42-126). Dorsal anchors: inner length 36 (30-40); outer length 29 (22-34); inner root 9 (8-12); stumpy outer root, recurved point 18 (14-22). Patches knee-shaped, size 13 (12-16) x 4 (3-6). Ventral anchors: small (about 1/3 of dorsal anchors), without root, total length 14 (12-16); recurved point 6 (4-8). Dorsal bar slightly V-shaped, size 20 (18-22) x 3 (2-5). Ventral bar V-shaped, length of one side 18 (16-20). Seven pairs of marginal hooks, length 11 (10-12).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of coiled copulatory tube (7-8 coils), widening at initial part, diameter 3 (2-4) and clipper-like accessory piece, size 18 (14-24) x 7 (5-10). Vaginal opening sinistral, guarded with large sclerite, size 30 (24-44) x 10 (8-10). Vaginal tube highly coiled.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 39 and *Thaparocleidus* n. sp. 42 in having similar types of haptoral armaments, copulatory tube and vaginal tube. However this species is different from *Thaparocleidus* n. sp. 39 and *Thaparocleidus* n. sp. 42 in having smaller ventral anchor without root (about 1/3 of dorsal anchor) (see Figs. A87 & A90 for comparison). This species is also different from the other known *Thaparocleidus* species in the morphology of ventral anchor and detailed morphologies of

accessory piece and vaginal opening. This species is new to Science and denoted as *Thaparocleidus* n. sp. 44 in this study.

11. *Thaparocleidus* n. sp. 45 (Fig. A93)

Type host: *Kryptopterus bleekeri* Gunther, 1864 (9 individuals examined, 2 infected from site 1)
Localities: Chao-praya River, Chinat (type locality) (site 1); Mun River, Ubonrat-chathanee (site 2); Nong-haan Reservoir, Sakol-nakorn (site 3); Ubonratana Reservoir, Khon-kean (site 5)
No. of monogenean specimens collected and studied: 8
No. of monogenean specimens measured: 7

Body size 420 (378-462) x 76 (67-84). Four eye spots. Haptor size 67 (58-72) x 109 (84-134). Dorsal anchors: inner length 28 (27-30); outer length 20 (18-23); inner root 8 (6-9); stumpy outer root 2; recurved point 14 (12-14). Patches trapezoid, size 8 (7-9) x 4 (4-5). Ventral anchors: massive, almost the same size to dorsal anchors, inner length 29 (28-31); outer length 31 (30-33); inner root 8 (7-8); outer root 2; short recurved point 10 (8-12). Dorsal bar slightly V-shaped, size 21 (20-22) x 2 (2-3). Ventral bar V-shaped, length of one side 29 (28-30). Seven pairs of marginal hooks, length 13 (12-14).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form an ovoid seminal vesicle ovoid. Copulatory organ consists of coiled copulatory tube (6-7 coils) and small clipper-like accessory piece, size 12 (10-14) x 6 (6-7). Vaginal opening sinistral, guarded with sclerotised piece, size 20 (19-22) x 10 (8-13), Vaginal tube highly coiled.

Differential diagnosis: The present species is similar to the other five new *Thaparocleidus* species obtained from the present four *Kryptopterus* species examined (*Thaparocleidus* n. sp. 39, *Thaparocleidus* n. sp. 41, *Thaparocleidus* n. sp. 42, *Thaparocleidus* n. sp. 43 and *Thaparocleidus* n. sp. 44; see Figs. A87, A89, A90, A91, A92) in having highly coiled copulatory tube and coiled vaginal tube, but differs from them in having massive ventral anchor and trapezoid patch. The morphology of ventral anchors of the present species is similar to that of *Thaparocleidus* n. sp. 41 from *K. bicirrhis* (Figs. A88). However, the ventral anchor of the present species is massive and almost the same size to the ventral anchor. The present species is also different from the other known *Thaparocleidus* species in having massive ventral anchor. It is thus a new species and considered a new species and identified as *Thaparocleidus* n. sp. 45.

12. *Thaparocleidus* n. sp. 46 (Fig. A94)

Type host: *Ompok bimaculatus* (Bloch, 1797) (22 individuals examined, 9 infected from sites 1, 2, 3 & 4)
Localities: Khog-kram subdistrict, Nakornsithammarat (type locality) (site 1); Trang River, Trang (site 2); Chonburi Fishery Station, Chonburi (site 3); Muang district, Pattanee (site 4); Ubonratana Reservoir, Khon-kean (site 5); Yhom River, Sukhothai (site 6); Nong-haan, Sakol-nakorn) (site 7)

No. of monogenean specimens collected and studied: 18
No. of monogenean specimens measured: 10

Body size 512 (420-756) x 106 (84-151). Four eye spots. Haptor size 108 (84-126) x 118 (84-168). Dorsal anchors: inner length 58 (55-62); outer length 48 (16-50); inner root 10 (10-11); stumpy outer root; recurved point 28 (26-30). Patches massive knee-shaped, size 22 (21-22) x 5 (4-5). Ventral anchors: inner length 17 (16-18); outer length 14 (14-15); inner root 6 (4-6); outer root 2; recurved point 8 (8-9). Dorsal bar slightly V-shaped broader at the middle, size 24 (22-26) 4 (3-4). Ventral bar V-shaped, length of one side 14 (14-16). Seven pairs of marginal hooks, 2 types: 6 pairs length 16 (15-17); one thin pair near ventral anchors, length 15 (14-16).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of curved copulatory tube, length along the tube, 89 (80-96), widening at initial part, diameter 2 and large clipper-like accessory piece, size 25 (24-26) x 11 (10-12). Vaginal opening sinistral, sclerotised funnel-like, diameter 10 (9-11), connected to ovoid seminal receptacle with long vaginal tube.

Differential diagnosis: The present species is similar to *Thaparocleidus devaraji* (Gussev, 1976) Lim, 1996 from Indian *Ompok pubda* (see Gussev, 1976; Lim, 1996b) in having similar types of haptoral armaments (except ventral anchor) and copulatory organ. The roots of ventral anchors of the present species are developed, while in *T. devaraji* the ventral anchors are without root. The present species is also different from the other known *Thaparocleidus* species in the morphology of copulatory organ. This species is considered a new species and identified as *Thaparocleidus* n. sp. 46.

13. *Thaparocleidus* n. sp. 47 (Fig. A95)

Type host: *Ompok bimaculatus* (Bloch, 1797) (22 individuals examined, 13 infected from sites 1, 2, 3 & 6)
Localities: Trang River, Trang (type locality) (site 1); Khog-kram, Nakornsi-thammarat (site 2); Chonburi Fishery Station, Chonburi (site 3); Muang district, Pattanee (site 4); Ubonratana Reservoir, Khon-kean (site 5); Yhom River, Sukhothai (site 6); Nong-haan, Sakol-nakorn (site 7)
No. of monogenean specimens collected and studied: 32
No. of monogenean specimens measured: 12

Body size 431 (252-546) x 95 (67-118). Four eye spots. Haptor size 70 (42-84) x 92 (59-168). Dorsal anchors: inner length 31 (27-36); outer length 26 (23-32); inner root 7 (6-8); stumpy outer root; recurved point 17 (14-18). Patches massive, triangular, size 16 (14-18) x 5 (4-6). Ventral anchors: without root, total length 22 (20-24); short recurved point 4 (2-4). Dorsal bar slightly V-shaped broader at the middle, size 26 (24-28) x 3 (2-4). Ventral bar V-shaped, length of one side 22 (20-24). Seven pairs of marginal hooks, length 13 (12-14).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ

consists of coiled copulatory tube (2-3 coils), widening at initial part, diameter 2 and grooved accessory piece, size 14 (10- 20) x 8 (6-8). Sclerotised, rounded vaginal opening sinistral, diameter 14 (12-17). Vaginal tube coiled.

Differential diagnosis: The present species is very similar to *Thaparocleidus malabaricus* (Gussev, 1976) Lim, 1996 from *O. malabaricus* in India (see Gussev, 1976; Lim, 1996b) in having similar types of haptoral armaments (except ventral bar) and copulatory organ. The present species differs from *T. malabaricus* in having V-shaped ventral bar and sclerotised rounded vaginal opening, while paired ventral bars and thin curved vaginal opening are observed in *T. malabaricus*. This species is also different from the other known *Thaparocleidus* species in the morphologies of patch and copulatory organ. This species is considered a new species and identified as *Thaparocleidus* n. sp. 47.

14. *Thaparocleidus* n. sp. 48 (Figs. A96 & A97)

Type host: *Ompok bimaculatus* (Bloch, 1797) (22 individuals examined, 16 infected from sites 1, 2, 3, 5 & 7)
Localities: Trang River, Trang (type locality) (site 1); Khog-kram, Nakornsi-thammarat (site 2); Chonburi Fishery Station, Chonburi (site 3); Muang district, Pattanee (site 4); Ubonratana Reservoir, Khon-kean (site 5); Yhom River, Sukhothai (site 6); Nong-haan, Sakol-nakorn (site 7)
No. of monogenean specimens collected and studied: 82
No. of monogenean specimens measured: 12

Body size 523 (437-672) x 98 (67-118). Four eye spots, posterior pair larger. Haptor size 92 (67-109) x 125 (84-168). Dorsal anchors: inner length 44 (37-56); outer length 35 (30-46); inner root 10 (10-12); stumpy outer root; recurved point 16 (12-18). Patches knee-shaped, size 17 (15-20) x 6 (5-6). Ventral anchors; inner length 19 (16-20); outer length 17 (15-18); inner root 5 (4-6); outer root 2; recurved point 10 (10-11). Dorsal bar slightly V-shaped narrow at the middle, size 25 (26-30) x 4 (3-6). Ventral bar V-shaped, length of one side 22 (20-26). Seven pairs of marginal hooks, 3 types: 2 large pairs, one pair anterior to dorsal anchors, and one pair near the point of dorsal anchors, length 15 (13-18); 4 pairs short near haptoral margin, length 12 (12-16), one thin pair near ventral anchors, length 13 (12-14).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form ovoid seminal vesicle. Copulatory organ consists of coiled copulatory tube (2 coils), length, length along the tube 77 (60-92), diameter of initial part 2 and clipper-like accessory piece, size 18 (16-20) x 8 (6-12). Prostatic reservoir ovoid. Sclerotised rounded vaginal opening sinitral, diameter 18 (16-19), connected to round seminal receptacle with long twisted vaginal tube.

Differential diagnosis: The present species is different from previously described *Thaparocleidus* species from *Ompok* species and the other three new *Thaparocleidus* species from *O. bimaculatus* in this study in having different forms of marginal hooks and rounded sclerotised vaginal opening. This species is

also different from the other known *Thaparocleidus* species in the morphologies of marginal hooks and copulatory organ. It is thus a new species and identified as *Thaparocleidus* n. sp. 48 in the present study.

15. *Thaparocleidus* n. sp. 49 (Figs. A98 & 99)

Type host: *Ompok bimaculatus* (Bloch, 1797) (22 individuals examined, 20 infected from sites 1, 2, 3, 4, 5 & 6)
Localities: Trang River, Trang (type locality) (site 1) Khog-kram, Nakornsi-thammarat (site 2); Chonburi Fishery Station, Chonburi (site 3); Muang district, Pattanee (site 4); Ubonratana Reservoir, Khon-kean (site 5); Yhom River, Sukhothai (site 6); Nong-haan, Sakol-nakorn (site 7)
No. of monogenean specimens collected and studied: 230
No. of monogenean specimens measured: 12

Body size 326 (265-403) x 83 (60-109). Four eye spots, posterior pair larger Haptor size 62 (39-84) x 93 (78-109). Dorsal anchors: small, inner length 26 (22-28); outer length 21 (19-22); inner root 6 (5-10); stumpy outer root; recurved point 13 (11-14). Small triangular patches, size 6 (5-8) x 2 (2-3). Ventral anchors: inner length 13 (13-14); outer length 12 (12-14); inner root 3 (2-5); outer root 2 (2-3); recurved point 5 (5-6). Dorsal bar slightly V-shaped narrower at the middle, size 19 (18-24) x 2 (1-3). Ventral bar V-shaped, length of one side 20 (18-22). Seven pairs of marginal hooks, 2 types: 6 pairs length 12 (10-12); one pair near ventral anchors, length 13 (12-14).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of long curved copulatory tube (1 turn), length along the tube 56 (48-74), widening at initial part, diameter 2 (1-2) and clipper-like accessory piece with expanded base, size 17 (14-18) x 12 (8-14). Vaginal opening dextral, funnel-like, connected to ovoid seminal receptacle with long vaginal tube.

Differential diagnosis: The present species is very similar to *Thaparocleidus octotylus* (Kulkarni, 1969) Lim, 1996 from *O. pubda* from India in having similar types of haptoral armaments (except the dorsal anchor) and copulatory tube, but differs from it in having dorsal anchor with well-developed roots and clipper-like accessory piece with expanded base. This species is also different from the other known *Thaparocleidus* species in the morphology of accessory piece. This species is considered a new species and identified as *Thaparocleidus* n. sp. 49 in this study.

16. *Thaparocleidus* n. sp. 50 (Fig. A100)

Type host: *Silurichthys* sp. (3 individuals examined, 2 infected)
Type locality: Yong Waterfall National Park, Nakornsithammarat
No. of monogenean specimens collected and studied: 17
No. of monogenean specimens measured: 8

Body size 415 (361-546) x 121 (92-143). Four eye spots. Haptor size 60 (50-76) x 88 (67-118). Dorsal anchors: inner length 30 (30-32); outer length 21

(20-22); inner root 10 (9-10); stumpy outer root and recurved point 15 (14-16). Triangular patches, size 7 (6-8) x 2. Ventral anchors: fenestrated at mainpart, without root, total length 14 (14-16); short, recurved point 5 (4-6). Dorsal bar slightly V-shaped broader at the both ends, size 22 (20-24) x 2. Ventral bar V-shaped, length of one side 19 (18-20). Seven pairs of marginal hooks, 2 types: 6 pairs, length 12 (11-12); one pair near ventral anchor, length 11 (10-11).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form pyriform seminal vesicle. Copulatory organ consists of coiled copulatory tube (2-3 coils), widening at initial part, diameter 4 (3-4) and clipper-like accessory piece, size 16 (14-16) x 8 (6-8). Vaginal opening midbody slightly dextral, funnel-like, guarded with sclerotised flower-like piece, diameter 16 (12-20). Vaginal tube long curved.

Differential diagnosis: The present species is similar to *Thaparocleidus* n. sp. 49 in having similar types of haptoral armaments (except ventral anchor) and copulatory organ, but differs from it in having fenestrated ventral anchor, sclerotised flower-like piece of vaginal opening and very long vaginal tube. This species is also different from the other known *Thaparocleidus* species in the morphologies of ventral anchor and vaginal opening. This species is considered a new species and identified as *Thaparocleidus* n. sp. 50.

Discussion

In this study two monogenean genera were found on Thai silurid species, *Mizelleus* Jain, 1957 and *Thaparocleidus* Jain, 1952. *Mizelleus* was only collected from *Wallago attu*, while *Thaparocleidus* was found on all the other nine silurid species examined (see Table 4.1: Chapter 4).

***Mizelleus* Jain, 1957**

. Thus far, *Mizelleus* is recorded only from Indian and Thai *W. attu* (see Lim & Lerssutthichawal, 1996). To date six *Mizelleus* species were recorded from *W. attu* in India (five species) and Thailand (one species) (see Table 4.8: Chapter 4). This suggests that *Mizelleus* is highly specific to *Wallago attu*.

***Thaparocleidus* Jain, 1952**

Thaparocleidus is found on silurid fishes of India, Malaysia, China, Japan, Russia and Thailand (see Appendix 1 & present data). A total of 18 *Thaparocleidus* species were obtained from nine silurid species in this study.

Except for *Thaparocleidus* n. sp. 41, *Thaparocleidus* n. sp. 43, *Thaparocleidus* n. sp. 45 and *Thaparocleidus* n. sp. 50, the ventral anchors of the other 14 *Thaparocleidus* spp. found on the silurids in this study are similar. The ventral anchors of *Thaparocleidus* n. sp. 41 and *Thaparocleidus* n. sp. 45 probably function like a pair of forceps (see Gussev, 1976). The ventral anchors of *Thaparocleidus* n. sp. 43 and *Thaparocleidus* n. sp. 50 are fenestrated at the mainpart (see Figs. A91 & A100).

The 18 *Thaparocleidus* species obtained from silurids in this study can be divided into two groups based on their copulatory organ: Group I consists of *Thaparocleidus* with curved copulatory tube and grooved stick-like accsessory piece (as exemplified by *Thaparocleidus* n. sp. 35, *Thaparocleidus* n. sp. 43; see Figs. A82 & A91) (six species); Group II consists of the 12 *Thaparocleidus* species with coiled copulatory tube and clipper-like or grooved accessory piece (see Figs. A85 & A87, for examples).

There are the four species of *Thaparocleidus* on *Ompok bimaculatus* which are morphologically similar to the *Thaparocleidus* species from Indian *O. pubda* and *O. malabaricus* (see Gussev, 1976). The *Thaparocleidus* species from Malaysian *O. hypophthalmus* are more similar to the *Thaparocleidus* species from *Kryptopterus* species, *B. dinema* and *H. mekongensis* of Thailand.

Although *Bychowskyella* was recorded from Malaysian and Indian silurids (see Lim, 1991b; Gussev, 1977), no *Bychowskyella* species was found on Thai silurids thus far.

In this study three monogenean species were found on Thai *W. attu*, compared to 27 species recorded from the same host species in India (see Lim & Lerssutthichawal, 1996). Lim and Lerssutthichawal (1996) suggest that the large number of monogenean species of Indian *W. attu* could probably be due to misidentifications.

The presence of *Hamatopeduncularia*, *Neocalceostoma* and *Heteronchocleidus* are probably due to misidentifications: *Hamatopeduncularia* and *Neocalceostoma* are found on ariids (see Lim, 1995a, 1996a), while *Heteronchocleidus* is a genus found on anabantoids (see Lim, 1986b).

Table A5 Distribution of monogenean genera on the silurids (including present data)

Fish host species	Monogenean genera							Total No. of species
	Ancylo-discoides	*Bychows-kyella*	*Hamatope-duncularia*	*Heteron-chocleidus*	*Neocal-ceostoma*	*Mizelleus*	*Thaparo-cleidus*	
Belodontichthys dinema	-	-	-	-	-	-	2	2
*Kryptopterus apogon**	-	-	-	-	-	-	2	2
*K. bicirrhis**	-	-	-	-	-	-	2	2
*K. bleekeri**	-	-	-	-	-	-	4	4
*K. cryptopterus**	-	-	-	-	-	-	3	3
Hemisilurus mekongensis	-	-	-	-	-	-	2	2
Ompok bimaculatus	-	-	-	-	-	-	4	4
O. hypophthalmus	-	-	-	-	-	-	5	5
O. malabaricus	-	-	-	-	-	-	1	1
O. pubda	-	**1**	-	-	-	-	**1**	3
Silurichthys hasselti	-	**1**	-	-	-	-	**1**	1
Silurichthys sp.	-	-	-	-	-	-	1	1
Silurus asotus	1	-	-	-	-	-	**25**	26
S. glanis	-	-	-	-	-	-	**3**	3
*S. soldatovi**	1	-	-	-	-	-	**7**	8
Wallago attu	-	**2**	**2**	**1**	**1**	**6**	**17**	29
Total 16 host species	1	4	2	1	1	6	73	88

**S. soldatovi* shares *Ancylodiscoides* species and 3 *Thaparocleidus* species with *S. asotus*

**Kryptopterus* species share together some *Thaparocleidus* species

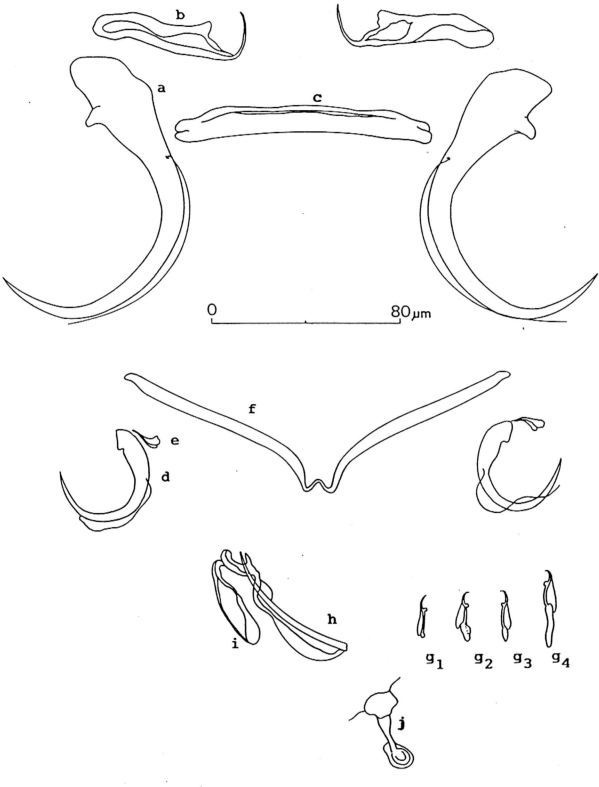


Fig. A78. Hard parts of *Mizelleus siamensis* Lim & Lerssutthichawal, 1996: a, dorsal anchor; b, dorsal patch; c, dorsal bar; d, ventral anchor; e, ventral patch; f, ventral bar; g_1, g_2, g_3, g_4, marginal hooks; h, copulatory tube; i, accessory piece; j, vaginal system. Scale-bar in micrometres

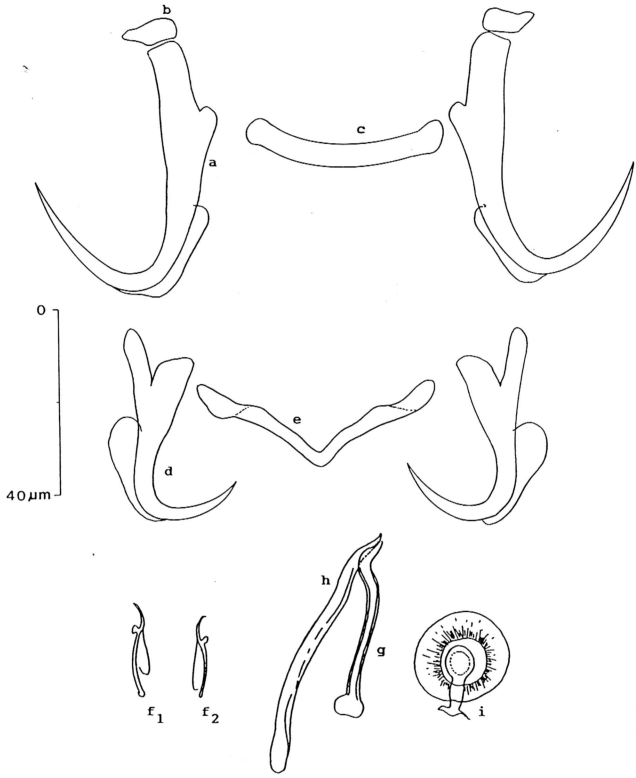


Fig. A79. Hard parts of *Thaparocleidus indicus* (Kulkarni, 1969) Lim, 1996: a, dorsa
anchor; b, patch; c, dorsal bar; d, ventral bar; e, tube; h, accessory piece;
vaginal system. Scale-bar in micrometres

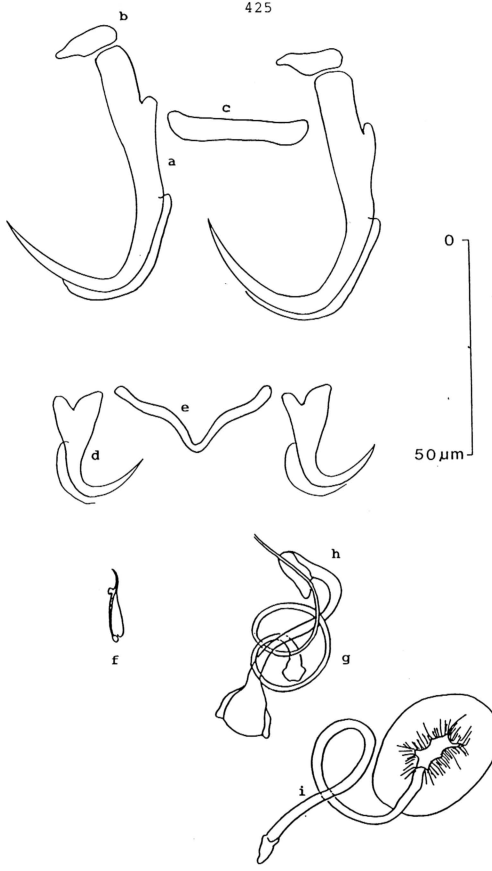


Fig. A80. Hard parts of *Thaparocleidus kao* Lim & Lerssutthichawal, 1996: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece; i, vaginal system. Scale-bar in micrometres

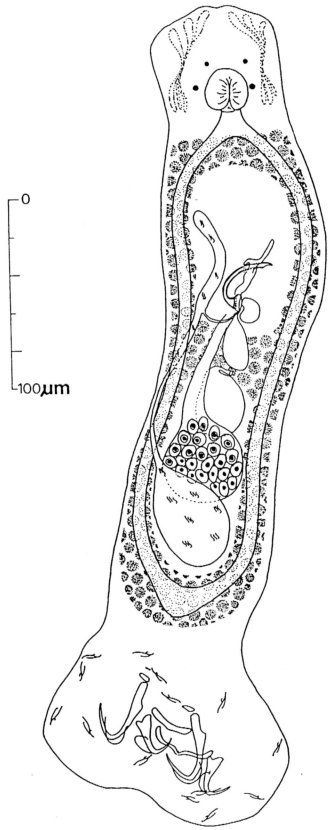


Fig. A81. Composite illustration of *Thaparocleidus* n. sp. 35 (dorsal view). Scal bar in micrometres

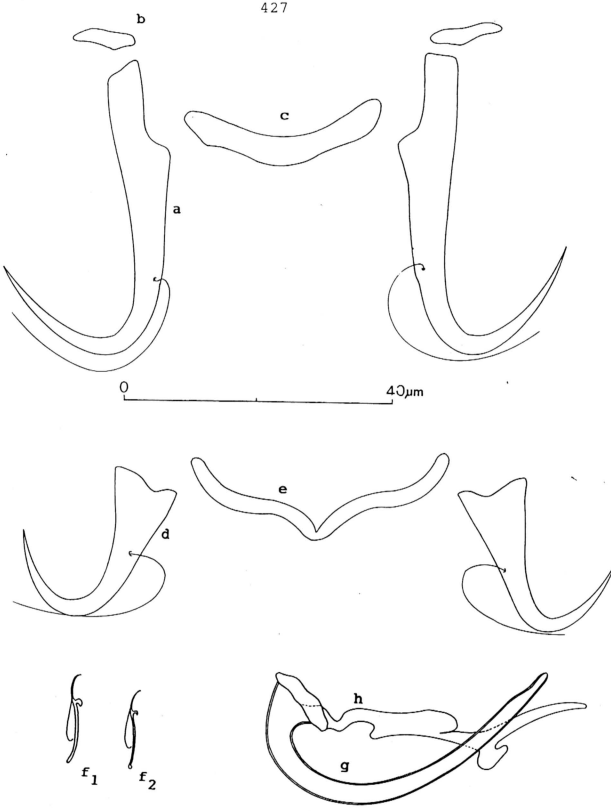


Fig. A82. Hard parts of *Thaparocleidus* n. sp. 35: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

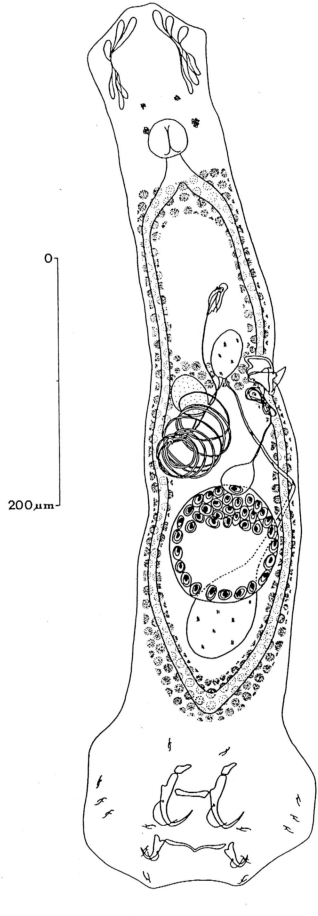


Fig. A83. Composite illustration of *Thaparocleidus* n. sp. 36 (ventral view
Scale-bar in micrometres

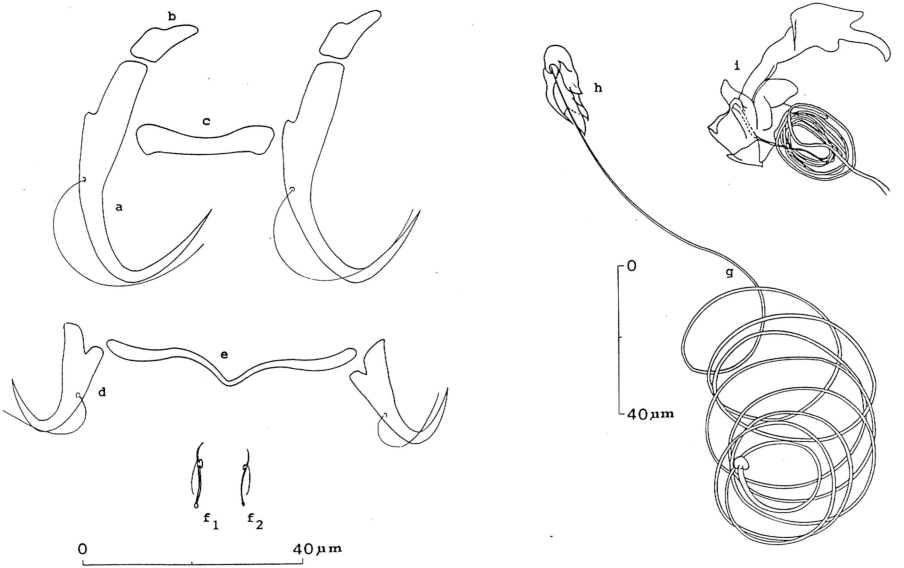


Fig. A84. Hard parts of *Thaparocleidus* n. sp. 36: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system. Scale-bar in micrometres

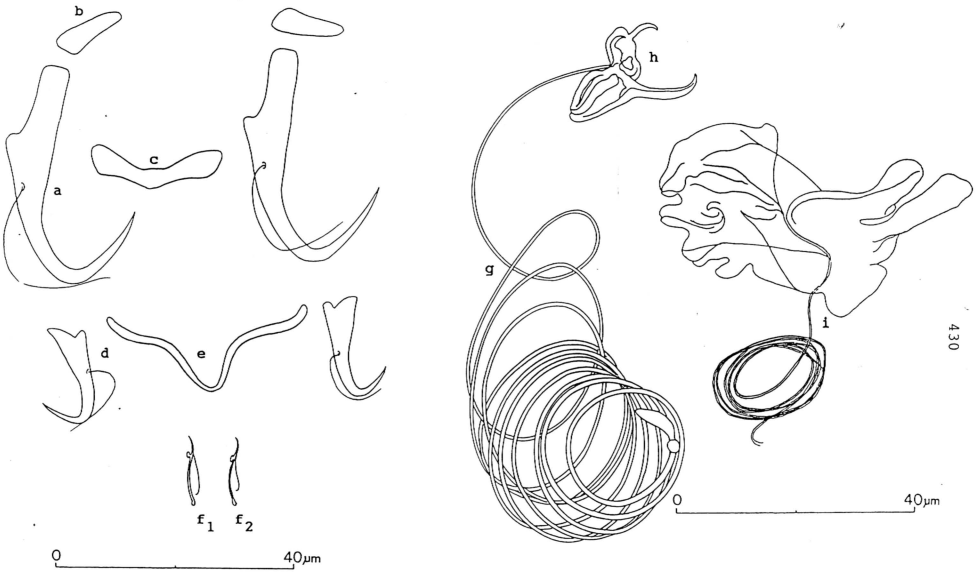


Fig. A85. Hard parts of *Thaparocleidus* n. sp. 37: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal

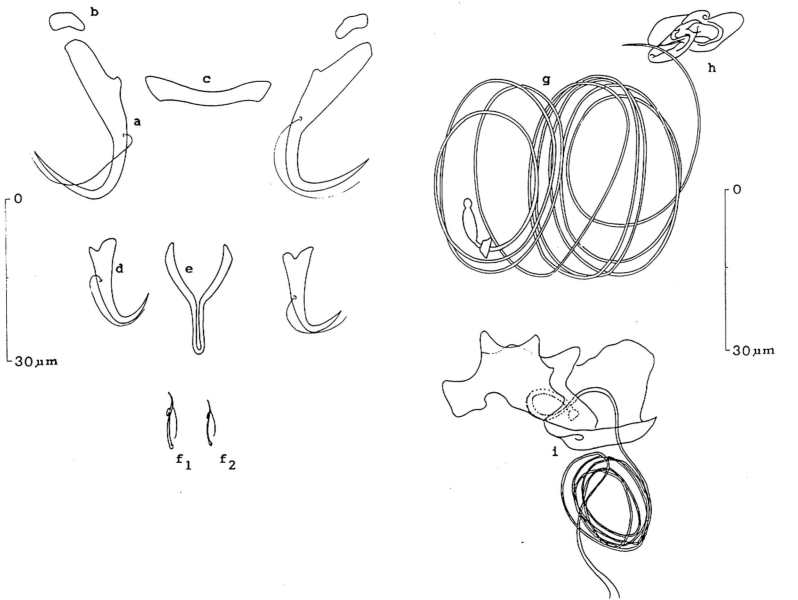


Fig. A86. Hard parts of *Thaparocleidus* n. sp. 38: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system. Scale-bar in micrometres

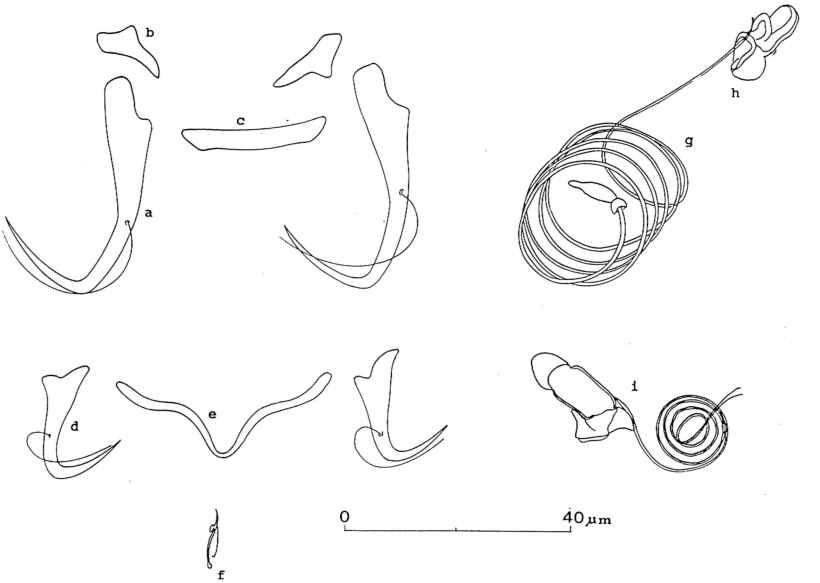


Fig. A87. Hard parts of *Thaparocleidus* n. sp. 39: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system.

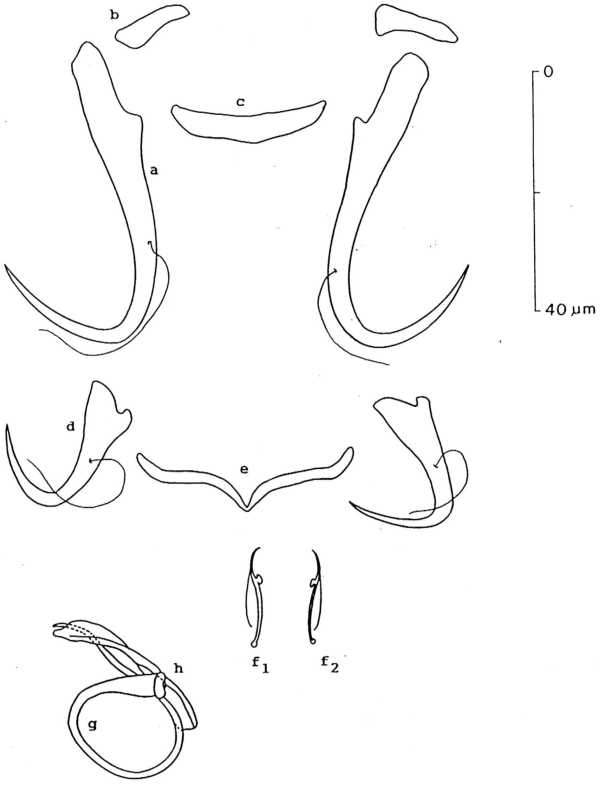


Fig. 488. Hard parts of *Thaparocleidus* n. sp. 40: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

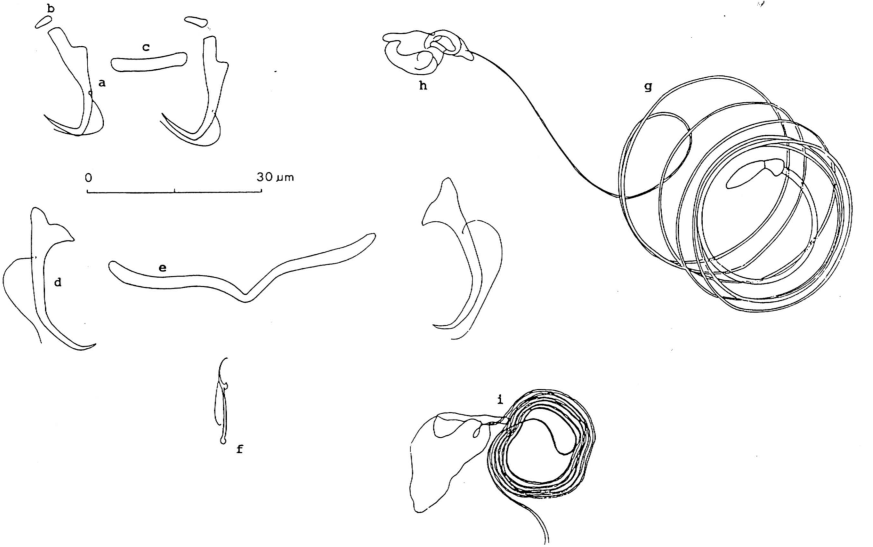


Fig. A89. Hard parts of *Thaparocleidus* n. sp. 41: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece; i, genital atrium

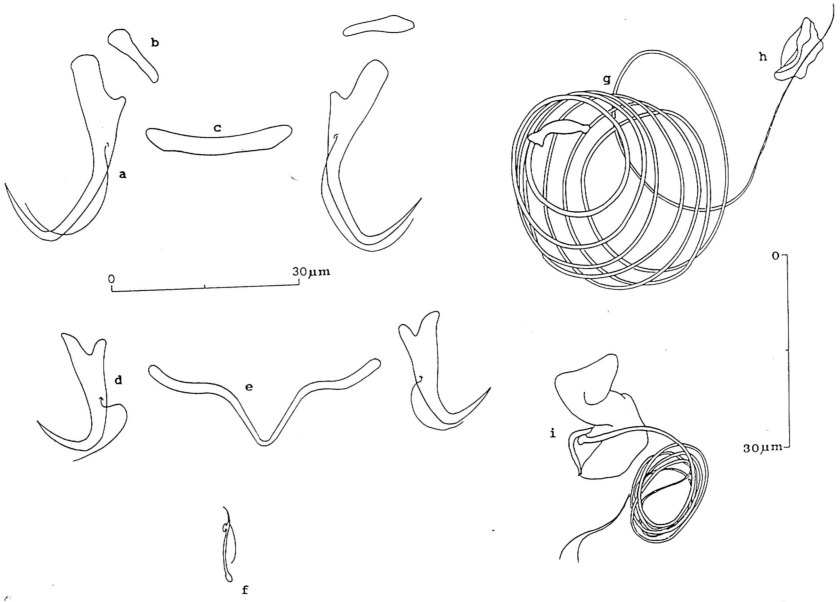


Fig. A90. Hard parts of *Thaparocleidus* n. sp. 42: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece; i, vaginal system. Scale-bar in micrometres

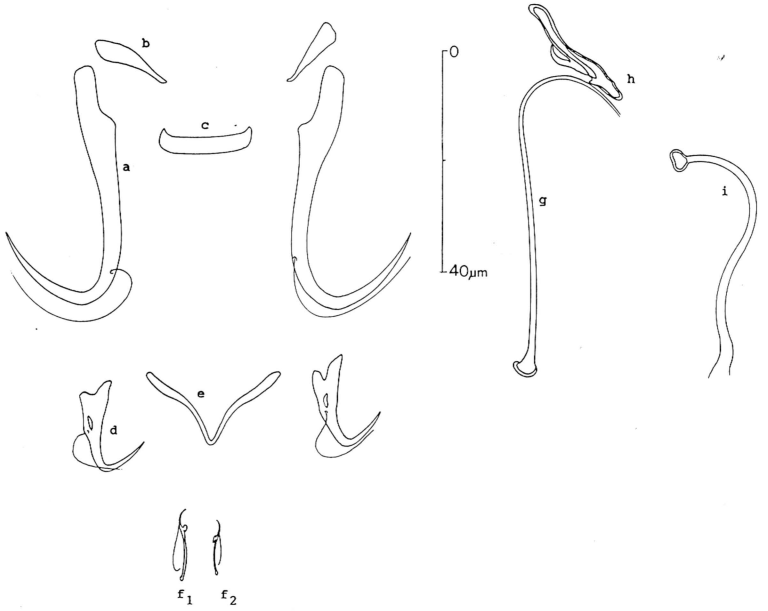


Fig. A91. Hard parts of *Thaparocleidus* n. sp. 43: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventra bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system.

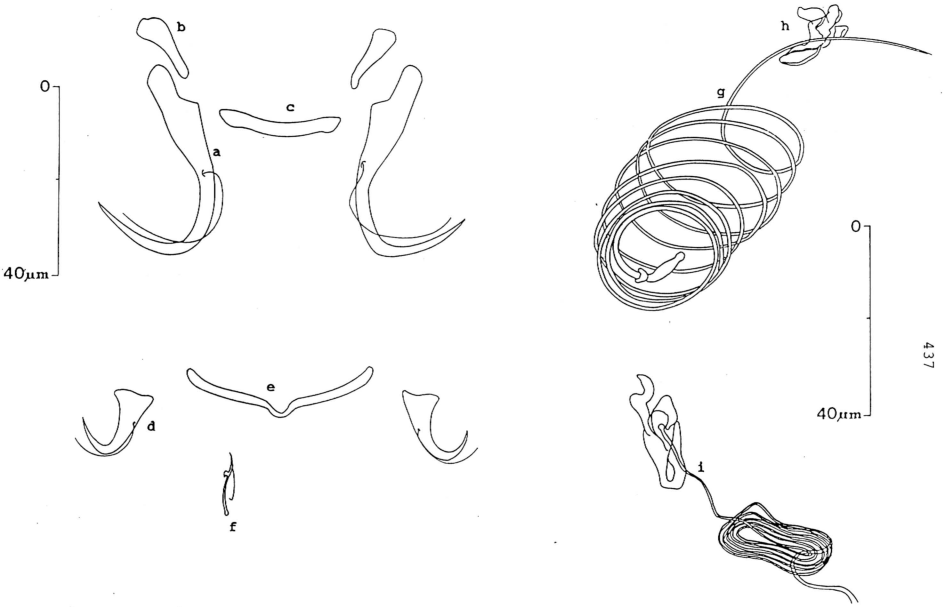


Fig. A92. Hard parts of *Thaparocleidus* n. sp. 44: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece; i, vaginal system. Scale-bar in micrometres

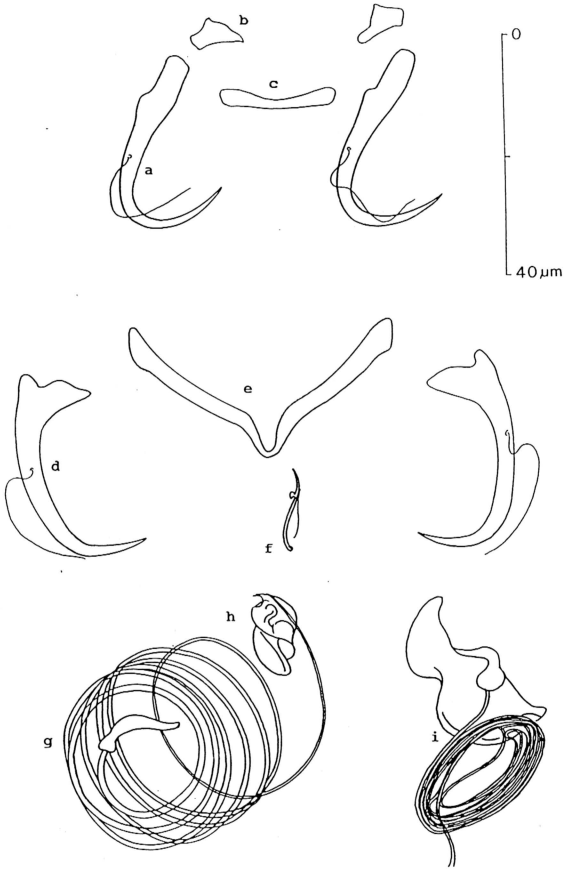


Fig. A93. Hard parts of *Thaparocleidus* n. sp. 45: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece; i, vaginal system. Scale-bar in micrometres

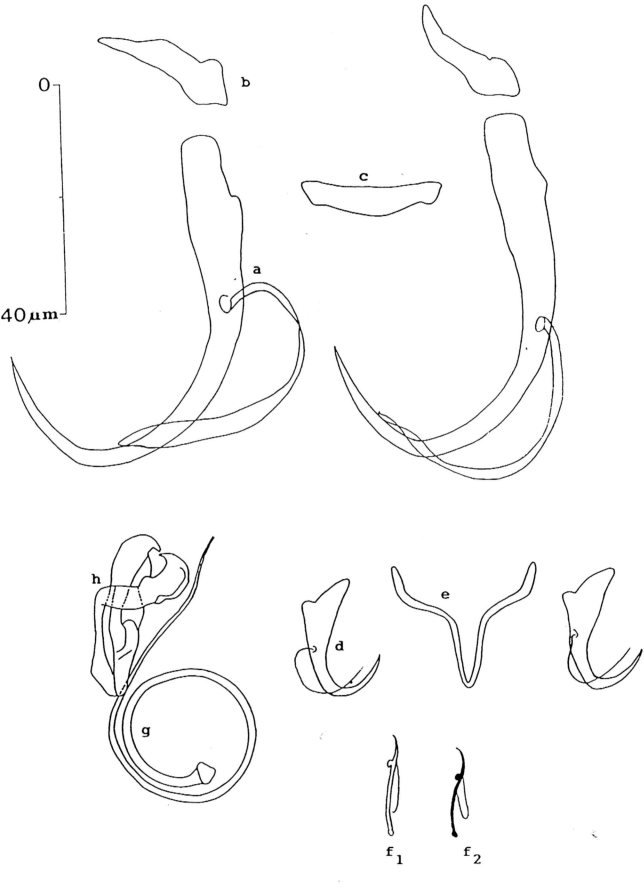


Fig. A94. Hard parts of *Thaparocleidus* n. sp. 46: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hook; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

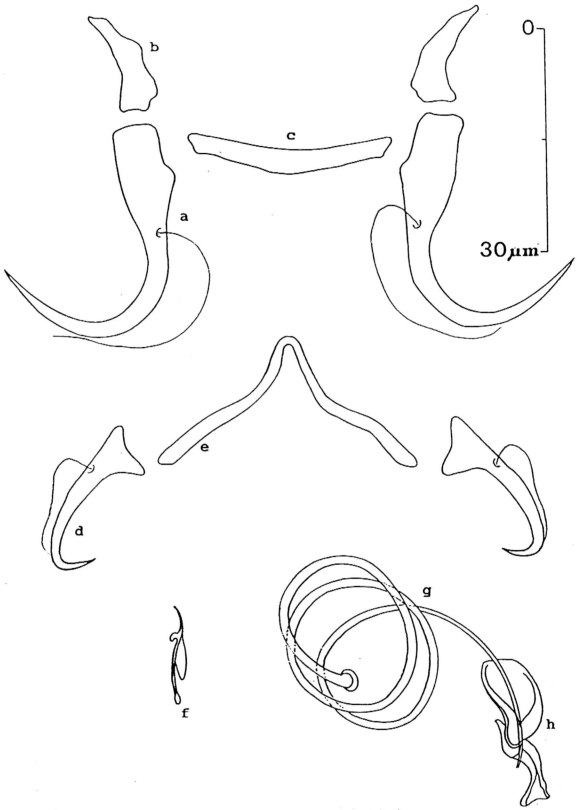


Fig. A95. Hard parts of *Thaparocleidus* n. sp. 47: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, marginal hook; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

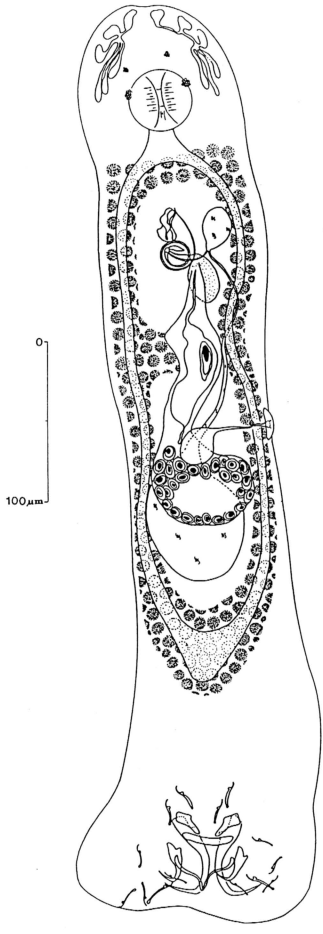


Fig. A96. Composite illustration of *Thaparocleidus* n. sp. 48 (ventral view). Scale-bar in micrometres.

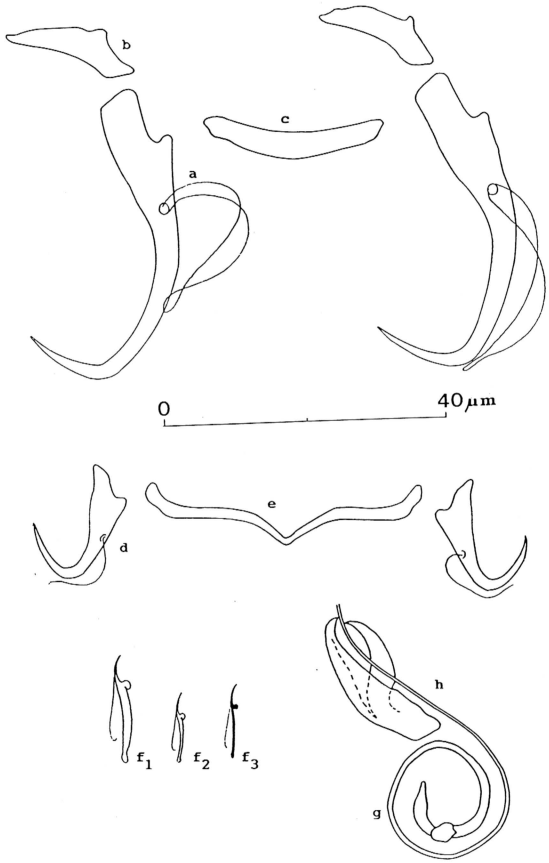


Fig. A97. Hard parts of *Thaparocleidus* n. sp. 48: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, f_3, marginal hooks; g, copulatory tube; h, accessory piece. Scale-bar in micrometres

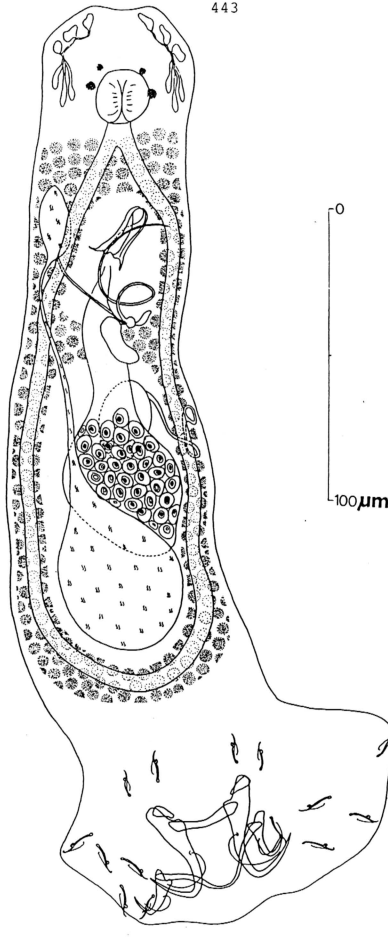


Fig. A98. Composite illustration of *Thaparocleidus* n. sp. 49i (dorsal view). Scale-bar in micrometres

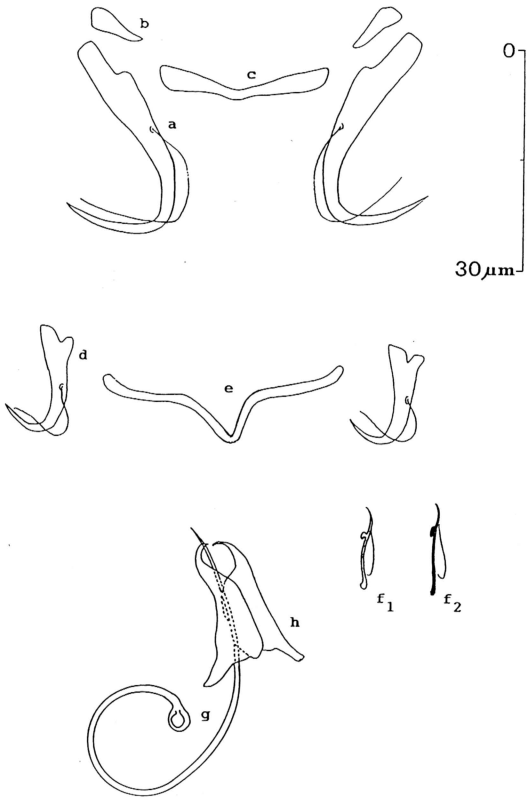


Fig. A99. Hard parts of *Thaparocleidus* n. sp. 49; a, dorsal anchor; b, patch; dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; copulatory tube; h, accessory piece. Scale-bar in micrometres

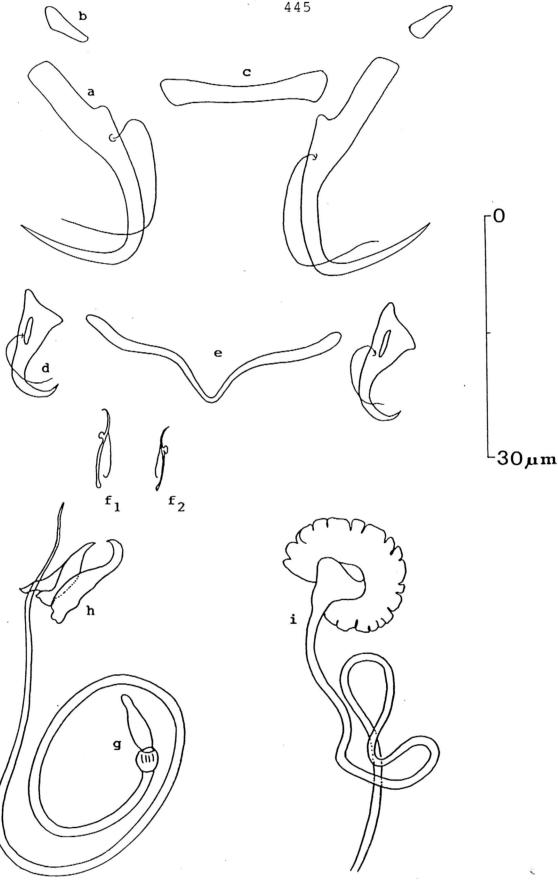


Fig. A100. Hard parts of *Thaparocleidus* n. sp. 50: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g, copulatory tube; h, accessory piece; i, vaginal system. Scale-bar in micrometres

Appendix 3.7: Monogeneans of Sisoridae

Introduction

Fourteen species of Sisoridae belonging to four genera were recorded in Thailand. The four genera are *Bagarius* Bleeker, 1853 (three species), *Glyptothorax* Blyth, 1860 (nine species), *Gagata* Bleeker, 1858 (one species) and *Oreoglanis* Smith, 1933 (one species) (Smith, 1945; Roberts, 1983; Kottelat, 1989).

In this study three species of sisorids were examined for monogeneans; *Bagarius bagarius* (Hamilton-Buchanan, 1823), *Bagarius yarrelli* Sykes, 1841, and *Glyptothorax major* (Boulenger, 1894). Only *B. bagarius* and *G. major* were infected with one species of monogeneans each.

Thus far, three species of *Bifurcohaptor* Jain, 1958 and three species of *Bychowskyella* Achmerow, 1952, were recorded from three sisorid species; *Bagarius bagarius* (see Agarwal & Kumar, 1977; Kumar & Agarwal, 1982; Sharma, 1983; 1989; Tripathi, 1957), *Glyptothorax major* (see Lim, 1991b) and *Glyptothorax sinense* (see Ma, Wang & Li, 1983) (Table A5).

Results

Bychowskyella sisoris Lim, 1991 was obtained from *G. major*, while *Thaparocleidus* n. sp. 51 was found on *Bagarius bagarius*. No monogenean was found on *B. yarrelli*.

1. *Bychowskyella sisoris* Lim, 1991 (Fig. A101)

Type host: *Glyptothorax major* Boulenger, 1894
Type locality: Pahang, Peninsular Malaysia
Present host: *Glyptothorax major* (2 individuals examined, one infected)
Locality: Yong Waterfall National Park, Nakornsithammarat
No. of monogenean specimens collected and studied: 10

Remark: *Bychowskyella sisoris* Lim, 1991 was first found on *G. major* in Peninsular Malaysia. *B. sisoris* was also found on the same fish species from Thailand in the present study.

2. *Thaparocleidus* n. sp. 51 (Fig. A102)

Type host: *Bagarius bagarius* (Hamilton, 1823)(6 individuals examined, 2 infected from sites 1 & 2)
Localities: Me-kong River, Ubonratchathanee (type locality) (site 1); Ping River, Tak (site 2); Chao-praya River, Chinat (site 3)
No. of monogenean specimens collected and studied: 29
No. of monogenean specimens measured: 12

Body size 1617 (1176-2184) x 218 (143-336). Four eye spots. Haptor size 173 (143-252) x 226 (168-294). Dorsal anchors: inner length 66 (62-70);

outer length 54 (48-58); massive inner root 20 (18-22); stumpy outer root; recurved point 38 (34-40). Patches small, triangular, size 8 (6-10) x 4 (3-4). Ventral anchors: fenestrated, without root, total length 36 (34-38) and recurved point 24 (22-26). Dorsal bar massive slightly V-shaped, knob-like at both ends, size 52 (46-56) x 9 (8-10). Ventral bar broad V-shaped, size of one side 41 (34-46) x 4. Seven pairs of larval type marginal hooks, 2 types: 6 pairs, length 12 (11-12); one thin pair near ventral anchors, length 14 (13-14).

Vas deferens arises from anterior region of testis to loop round left intestinal caecum, ascends to form long blind seminal vesicle. Copulatory organ consists of large cylindrical sac-like copulatory tube, length 122 (100-130), diameter 33 (28-40) and elongate grooved plate-like accessory piece, size 71 (66-80) x 10 (8-10). Vaginal armaments not observed in all specimens studied.

Differential diagnosis: The present species is unique in having a large cylindrical sac-like copulatory tube. It is thus a new species and identified as *Thaparocleidus* n. sp. 51.

Discussion

There are currently six monogenean species (belonging to *Bifurcohaptor* and *Bychowskyella*) on sisorid fish hosts (Table A6). Three species of *Bifurcohaptor* and one species of *Bychowskyella* were recorded from Indian *B. bagarius*. Thus far, in this study no *Bifurcohaptor* and *Bychowskyella* were found on Thai *B. bagarius*, and the only monogenean species present on the Thai *B. bagarius* is a *Thaparocleidus* species. This is the first record of a *Thaparocleidus* on sisorid.

Bychowskyella was recorded from sisorid fishes in India, China and Peninsular Malaysia (see Sharma, 1983, 1989; Ma *et al.*, 1983; Lim, 1991b). *Bychowskyella bagariusi* was found on *Bagarius bagarius* in India, *B. glyptothoraci* on *Glyptothorax sinense* from China and *B. sisoris* on *G. major* of Peninsular Malaysia. *Bychowskyella sisoris* was also found on *G. major* in Thailand (Table 4.1: Chapter 4). Besides the Sisoridae, *Bychowskyella* was also recorded from the Bagridae, Clariidae, Heteropneustidae, Schilbeidae and Siluridae (see also Table 4.7: Chapter 4).

Morphologically, *Bychowskyella* from sisorids are different from *Bychowskeylla* of clariids in possessing onchium (two onchia in *B. sisoris*), onchium is absent in the *Bychowskyella* species from Clariidae. *Bychowskyella* from sisorids are also different from the *Bychowskyella* from schilbeids and silurids in the number of onchium. *Bychowskyella* species from sisorids have two onchia, while the species from schilbeids and silurids have one onchium (except *B. asiatica* from *Pseudeutropius garua* (Schilbeidae) which have no onchium) (see Gussev, 1977; Jain, 1959; Lim, 1991b; Tripathi, 1957). Lim (1991b) suggested that the presence or absence of onchia may indicate the evolutionary status of *Bychowskyella*. *Bychowskyella* with two onchia could be the most primitive group, while the *Bychowskyella* with have no onchium could be the advanced group. This could imply that the sisorids, as exemplified by *Glyptothorax* species could be more primitive than the clariids (see Lim 1991b & Chapter 6).

Table A6 Monogeneans of the sisorids (PM: Peninsular Malaysia)

Fish host species	Monogenean species	Localities	References
Bagarius			
B. bagarius	*Bifurcohaptor gorakhnathai*	India	Kumar & Agarwal, 1982
	Bifurcohaptor son	"	Tripathi, 1957; Kulkarni, 1969b
	Bifurcohaptor vishwanathai	"	Agarwal & Kumar, 1977
	Bychowskyella bagariusi	"	Sharma, 1983; 1989
Glyptothorax			
G. sinense	*Bychowskyella glyptothoraci*	China	Ma, Wang & Li, 1983
G. major	*Bychowskyella sisoris*	PM	Lim, 1991b
		Thailand	present study

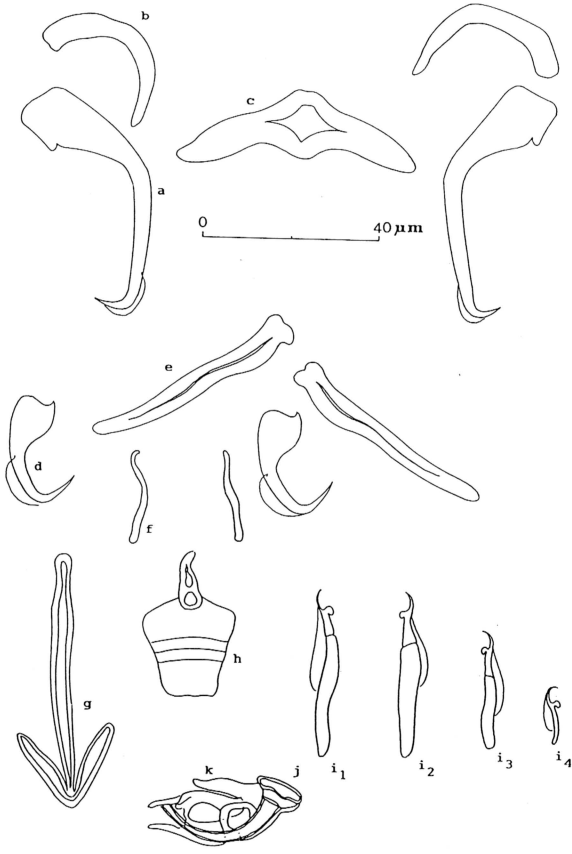


Fig. A101. Hard parts of *Bychowskyella sisoris* Lim, 1991: a, dorsal anchor; b, patch; c, dorsal bar; d, ventral anchor; e, ventral bar; f, sclerotised rod; g, dorsal onchium; h, ventral onchum; i_1, i_2, i_3, i_4, marginal hooks; j, copulatory tube; k, accessory piece. Scale-bar in micrometres

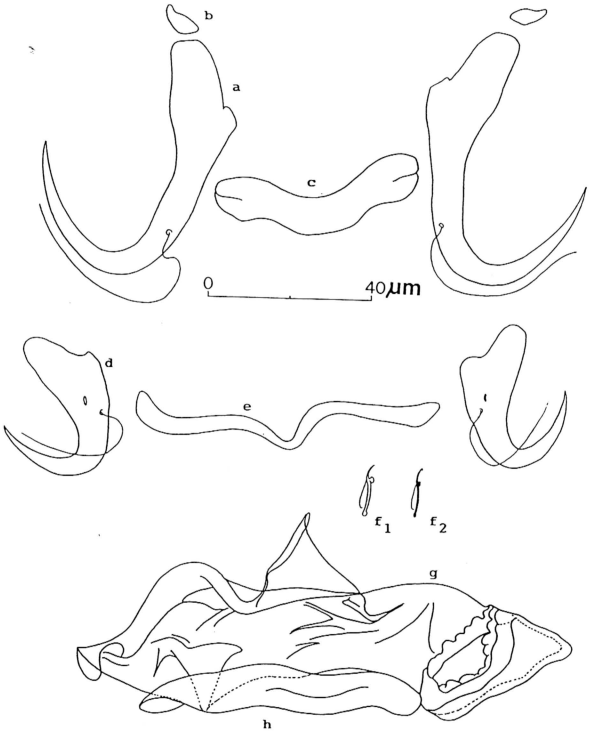


Fig. A102. Hard parts of *Thaparocleidus* n. sp. 51: a, dorsal anchor; b, patch
c, dorsal bar; d, ventral anchor; e, ventral bar; f_1, f_2, marginal hooks; g,
copulatory tube; h, accessory piece. Scale-bar in micrometres

Appendix 3.8

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MONOGENEANS FROM *WALLAGO ATTU* (BLOCH & SCHNEIDER, 1802) OF THAILAND

L.H.S. Lim and **T. Lerssutthichawal**

ABSTRACT. - Three species of monogeneans, *Mizelleus siamensis*, new species, *Thaparocleidus indicus* (Kulkarni, 1969) Lim, 1996, and *Thaparocleidus kao*, new species, were found on *Wallago attu* in Thailand. *M. siamensis*, new species, differs from *Mizelleus indicus* Jain, 1957, in having a sclerotised vaginal tube and in lacking prominent spines on the dorsal patches. *M. siamensis*, new species, is further characterised by patches on the ventral anchors and two dactylogyrid-type seminal vesicles, similar to those found in *Bychowskyella* and *Quadriacanthus*. *Thaparocleidus kao*, new species, differs from other *Thaparocleidus* found on *W. attu* by having a short twisted vaginal tube and a coiled copulatory tube with a stick-like accessory piece which is expanded at the distal end.

INTRODUCTION

This is part of a study to document the monogeneans on freshwater siluriformes of Thailand. In this study, three species of monogeneans were found on the gills of *Wallago attu* obtained from four localities in Thailand (Table 1). Of the three species obtained, two are new and are described herein. According to Ng (1992), there are only three valid species for the genus *Wallago* Bleeker, 1851, viz., *Wallago attu, W. leerii* and *W. maculatus*.

Table 1: Distribution of *Mizelleus* and *Thaparocleidus* species on *Wallago attu* in Thailand.

Localities	*M. siamensis*	*T. kao*	*T. indicus*
Pitsanulok	43	25	0
Sukhothai	3	11	13
Tak	3	10	4
Ayuttaya	1	6	5
Total	50	52	22

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MATERIALS AND METHODS

Wallago attu were obtained from four localities in Thailand: the Nan River [Menam Nan] in Pitsanulok, Northern Thailand, the Ping River, in Tak, the Yhoa River, in Sukhothai and the Chao Praya River, in Ayuttaya. The fishes were caught using long lines. The methods used to collect, prepare, preserve, study and measure the monogeneans were as outlined by Lim (1991). The measurements of the monogeneans are given to the nearest whole number in micrometers; averages are followed by the ranges in parentheses. In order to reduce redundancy in the descriptions, an amended diagnosis of *Mizelleus* is given first.

Holotypes and some paratypes are kept in the Zoological Reference Collection (ZRC), Department of Zoology, National University of Singapore; while other paratypes are kept at the Institute of Advanced Studies (IPT), University of Malaya, Kuala Lumpur and Aquatic Animal Health Research Institute (AAHRI), Bangkok, Thailand.

TAXONOMY

Two species of *Thaparocleidus* Jain, 1952 (one new species) and one new species of *Mizelleus* Jain, 1957 were obtained from *Wallago attu* in Thailand. [*Silurodiscoides* Gussev, 1976 is a junior subjective synonym of the senior valid name *Thaparocleidus* Jain, 1952 (see Lim, 1996)]. The presence of the two dactylogyrid-type of seminal vesicles and patches on the ventral anchors in the species of *Mizelleus* make it necessary to amend its generic diagnosis. Kritsky and Boeger (1989) reduced the family Ancyrocephalidae to a subfamily within the Dactylogyridae Bychowsky, 1933 (see also Boeger & Kritsky, 1993). We would like to place *Mizelleus* into the subfamily Ancyrocephalinae Bychowsky, 1937 along with *Bychowskyella* and *Quadriacanthus* (see Lim. 1991); and to retain *Thaparocleidus* in the subfamily Ancylodiscoidinae Gussev, 1961 (see Discussion).

SUBFAMILY ANCYROCEPHALINAE BYCHOWSKY, 1957

Mizelleus Jain, 1957

Emended diagnosis. - Ancyrocephalinae. Three pairs of head organs. Two pairs of eyespots with anterior pair smaller. Haptor armed with two pairs of anchors, two pairs of (dorsal and ventral) patches, two connective bars, 14 marginal hooks. Dorsal anchors with spines ('beak') on mainpart. Intestine bifurcate; caeca reuniting just posterior to testis. Vas deferens arises from anterior of testis in the dorsal region, to loop round left intestinal ceacum, onto ventral region, ascending, distending twice to form distal seminal vesicle and smaller proximal seminal vesicle, narrowing to form ductus ejaculatorius prior to entering initial part of copulatory tube. Copulatory organ consists of tube and accessory piece. Vaginal opening dextral. Ovary anterior to testis.

Type species: *Mizelleus indicus* Jain, 1957

Type host species: *Wallago attu* (Bloch & Schneider, 1802)

Type locality: Lucknow, India

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***Mizelleus siamensis*, new species**
(Figs. 1, 2)

Type-host: *Wallago attu* (Bloch & Schneider, 1802)

Localities (no. of fish examined): River Nan (Menam Nan), Pitsanulok, Northern Thailand (type locality) (1); Ping River, Tak (1); Yhom River, Sukhothai (1); Chao Praya River, Ayuttaya (1)

No. of specimens collected and studied: 50

No. of specimens measured: 15

No. of host sampled (% prevalence): 4 (100%)

Host specimens: Nakornsithammarat Campus, Rajamangala Insitute of Technology.

Type-specimens: Holotype and paratype in ZRC. Paratypes in IPT and AAHRI

Description. - With the characters of the genus. Body size 1047(672-1260) x 169(134-210). Haptor triangular, length 155(126-210), greatest width 329(252-378). Dorsal anchors: without roots, total length 94(86-100), mainpart with beak-like spine, gently curving point 29(26-30); two dorsal patches of *Mizelleus*-type. Ventral anchors: without roots, total length 35(32-36), gently curving point 23(20-24). Two small ventral patches. Dorsal bar: size 14(10-16) x 62(56-70), fenestrated, protuberances at each end for articulation with spine on dorsal anchor. Ventral bar: v-shape, thining at mid-region, size of one side 6(6-8) x 82(76-90). 14 hooks: one pair larval-type, length 16(15-17), near ventral anchors; other 4 pairs have handles: 1 pair long, 29(28-30); 1 pair medium, 24(24-26); 4 pairs small, 18(18-20), along lateral edges of haptor, of which 3 pairs have protrusions on handles. Vaginal tube, length 18(12-24). Copulatory tube tapering distally, length 49(40-52); proximal region of accessory piece shield-like with a bifurcated piece, ending distally as a process, length 56(40-60). Two glands entering initial part of copulatory organ separately.

Etymology. - This species is named after Siam.

Remarks. - The present species is similar to *Mizelleus indicus* Jain, 1957 as described by Gussev (1976) except that *M. indicus* has a non-sclerotised vaginal tube, lacks patches on the ventral anchors and lacks protrusions on the handles of the small marginal hooks (Fig. 2). It is possible that the latter two characteristics are not present in *M. indicus*. But the absence of these two characteristics could be apparent in that these structures were not noticed by Gussev (1976) and Jain (1957). Aside from these differences *M. siamensis*, new species does not have a prominent spine on the dorsal patches as depicted by Jain (1957) and Gussev (1976) for *M. indicus*. A few specimens in the present collection have such spines although not as sharp as those found in *M. indicus*. The copulatory organ of the present species and *M. indicus* (see Gussev, 1976) are only slightly different, although Jain (1957) noted the shield-like structure (which he referred to as a 'bag-like' structure) on the proximal part of the accessory piece.

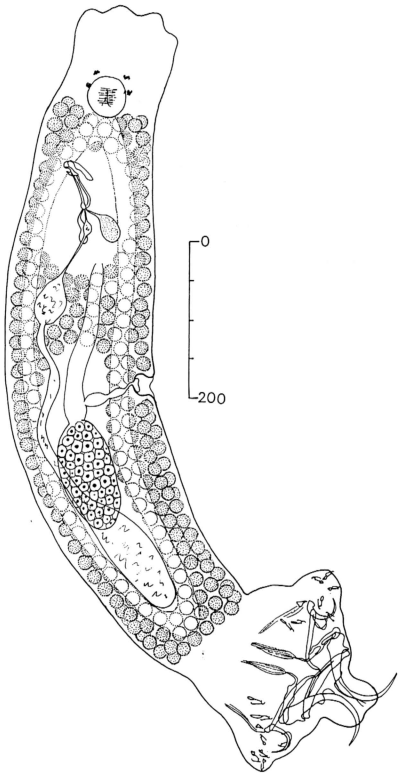

Fig. 1: Composite illustration of *Mizelleus siamensis*, new species (dorsal view) (scale in µm.)

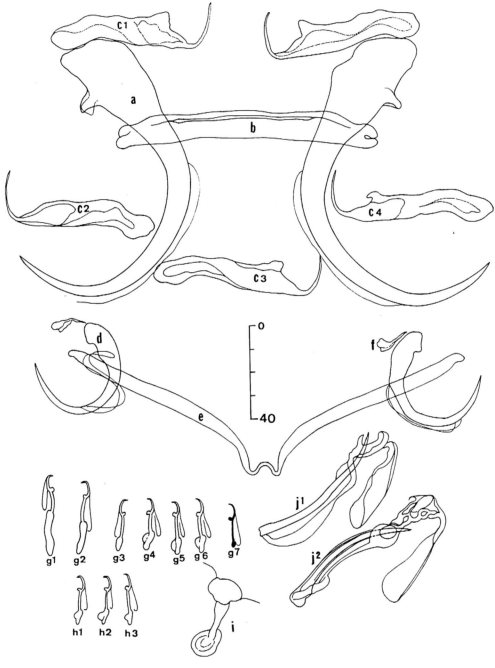

Fig. 2: Hard sclerotised parts of *Mizelleus siamensis*, new species. A= dorsal anchor; B= dorsal bar; C1, C2, C3, C4= different views of dorsal patch; D= ventral anchor; E= ventral bar; F= ventral patch; G1, G2, G3, G4, G5, G6, G7= different hooks; H1, H2, H3= variations of lateral hooks with protrusions; I= vaginal system; J1, J2=different views of copulatory organ (scale in µm.)

SUBFAMILY ANCYLODISCOIDINAE GUSSEV, 1961

***Thaparocleidus indicus* (Kulkarni, 1969) Lim, 1996**
(Fig. 3)

Host: *Wallago attu* (Bloch & Schneider, 1802)

Localities (No. of fish examined): River Nan (Menam Nan), Pitsanulok Northern Thailand (1 fish); Yhom Ping River, Tak (1); Yhom River, Sukhothai (1); Chao Praya River, Ayuttaya (1)

No. of specimens collected and studied: 22

No. of specimens measured: 10

Host specimens: Nakornsithammarat Campus, Rajamangala Insitute of Technology.

Type-specimens: Types in ZRC. Paratypes in author's collection.

Description. - Body size (860-1400) x 171(150-190). Haptor demarcated from body size: 217(150-260) x 255 (160-300). Dorsal anchor: inner length 50(48-50), outer length 39(36-40), inner root 15(13-18), stumpy outer root, recurved point 28(25-30). Patches trapezoid, size 9(8-13) x 5. Ventral anchors: inner length 32(30-38), outer length 37(35-40), inner root 9(6-13), outer root 12(10-15), recurved point 18(15-20). Dorsal bar broad, size 5(5-6) x 39(38-43). Ventral bar, v-shape size 3(3-4) x 24(21-28). 14 marginal hooks, total length 17(16-17). Vaginal opening, round sclerotised, with short tube. Copulatory tube 36(30-40), accessory piece long 49(45-53). Soft parts as given in Gussev (1976).

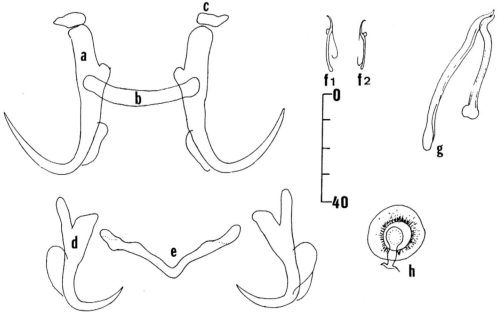

Fig. 3: Hard sclerotised parts of *Thaparocleidus indicus* (Kulkarni, 1969) Lim, 1996. A= dorsal anchor; B= dorsal bar; C= dorsal patch; D= ventral anchor; E= ventral bar; F1, F2= hooks; G= copulatory organ; H= vaginal system (scale in µm.)

Table 2: *Thaparocleidus indicus* (Kulkarni, 1969) Lim, 1996

	Kulkarni (1969)	Gussev (1976)	present data
No. measured	-	3	10
Hook length	(13-20)	14	17(16-17)
Dorsal anchor			
inner length	53	43-45	50(48-50)
outer length	-	-	39(36-40)
inner root	16	12	15(13-18)
outer root	-	2	
point	28	29-30	28(25-30)
Ventral anchor			
inner length	-	-	32(30-38)
outer length	42	45-46	37(35-40)
inner root	8	8	9(6-13)
outer root	14	15	12(10-15)
point	16	17-19	18(15-20)

Remarks. - This species is identified as *Thaparocleidus indicus* (Kulkarni, 1969) Lim, 1996, based on the morphology of the ventral anchors (where the outer roots are noticeably longer than the inner roots) and of the copulatory organ. The round sclerotised vaginal openings in the present specimens are different from those in the 3 specimens observed by Gussev (1976). The vaginal system is located almost at body midline displaced slightly to the left. The morphmetric data of *T. indicus* from the present study falls within the ranges of those from Kulkarni (1969) and Gussev (1976) (Table 2).

***Thaparocleidus kao*, new species**
(Fig. 4)

Type-host: *Wallago attu* (Bloch & Schneider, 1802)

Localities (no. of fish examined): River Nan (Menam Nan), Pitsanulok Northern Thailand (type locality) (1); Ping River, Tak (1); Yhom River, Sukhothai (1); Chao Praya River, Ayuttaya (1)

No. of specimens collected and studied: 25

No. of specimens measured: 13

No. of host sampled (% prevalence): 4 (100%)

Host specimens: Nakornsithammarat Campus, Rajamangala Insitute of Technology.

Type-specimens: Holotype and paratypes in ZRC, and in author's collection.

Description. - Body size 711(546-966) x 143(118-185). Haptor size 101(67-159) x 149(100-294). Dorsal anchors: inner length 50(48-52); inner root 13(10-16); outer length 41(38-44); recurving point 28(26-30). Two dorsal patches, 12(10-14) x 6(4-8). Ventral

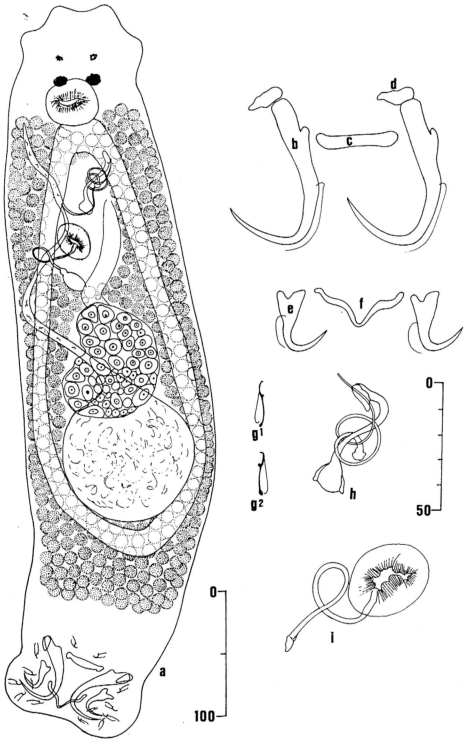

Fig. 4: *Thaparocleidus kao*, new species. A= Composite illustration of *T. kao*, new species (dorsal view). B= dorsal anchor; C= dorsal bar; D= dorsal patch; E= ventral anchor; F= ventral bar; G1, G2= hooks; H= copulatory organ; I= vaginal system (scales in μm.)

anchors: inner length 22(22-24); inner root 6(4-8); outer length 22(22-24); stumpy outer root, recurved point 14(14-16). Dorsal bar: 29(26-30) x 4(3-6). Ventral bar: v-shape bar, thinly connected at mid-length, length of one side 19(18-20). 14 hooks, larval-type, 1 pair near ventral anchors, 14(14-16); 6 pairs, 16(14-17). Vaginal opening sclerotised, almost midregion slightly to left side, short twisted vaginal tube, lightly sclerotised. Seminal vesicle a thin elongate blind sac. Copulatory tube coiled with small initial part. Accessory piece stick-like with expanded distal end length 41(36-46). Two glands entering initial part of copulatory organ separately.

Etymology. - Specific name *kao* refers to the native name of *W. attu*, *kao kau* [*kao* = *Wallago*]

Remarks. - The present species is similar to *Thaparocleidus wallagonius* Jain, 1952 (see Lim, 1996) found on Indian *W. attu* in having coiled copulatory tube with a simple stick-like accessory piece and a coiled vaginal tube. However, in the present species the vaginal tube does not have as many coils as the vaginal tube of *T. wallagonius*. The present species is also different from *T. wallagonius* in having a less coiled copulatory tube, a longer accessory piece with expanded distal end and the proximal end not forked (as in *T. wallagonius*). The present species is also different from *T. gomtius* (Jain, 1952) Lim, 1996, because the copulatory tube and vaginal tube are not coiled in the latter. *T. kao*, new species is different from *T. sudhakari* (Gussev, 1976) Lim, 1996 in the morphology of the copulatory tube, accessory piece, and the vaginal tube.

DISCUSSION

Two *Thaparocleidus* species (*T. indicus* and *T. kao*, new species) and one *Mizelleus* species (*M. siamensis*, new species) were collected from *W. attu* in Thailand. The vaginal opening of *T. indicus* and *T. kao*, new species, from the Thai *W. attu* are situated at body length slightly displaced to the left side and in the anterior half of the worm. The same is observed for *T. indicus* and *T. sudhakari* collected from *W. attu* of India (see Gussev, 1976).

To date, a total of 24 species of monogeneans from 13 genera have been recorded from Indian *W. attu* (Table 3). The present two new species increases the number of species described from *Wallago attu* to 26. Many of these species and genera have already been synonymised although there are disputes about the validity of some of these synonymised genera. *Wallagotrema* Tripathi, 1957 was considered a synonynm of *Silurodiscoides* by Gussev (1976) and of *Mizelleus* by Ventakanrasaiah & Kulkarni (1981). To resolve this issue, the type specimens of *Wallagotrema* species should be re-examined for the morphology of their seminal vesicle(s). The seminal vesicle of *Silurodiscoides* (a junior subjective synonym of *Thaparocleidus*: see Lim, 1996) is blind and sac-like; whilst in *Mizelleus* there are two seminal vesicles of the dactylogyrid type.

The existence of some genera (Table 3) could be due to misidentifications of the monogeneans or of the host species. *Hamatopeduncularia* and *Neocalceostoma* are thus far found on only the ariids (Kearn & Whittington, 1994; Lim, 1995, 1996; Lim, 1996). *Heteronchocleidus* are usually parasites of anabantoids (see Lim, 1986); and *Dactylogyrus* are monogeneans of cyprinids, with a few exceptions (Gussev, 1976; Lim, 1987). So far, there is only one valid species of *Dactylogyrus* from a catfish: *D. cranoglanis* Gussev, 1966 collected from catfish from China (Gussev, 1976). *Urocleidus ramalingami* Pandey & Mehta,

Table 3: Monogeneans recorded from *Wallago attu* in India and Thailand

Species	Synonyms	References
Ancylodiscoides Yamaguti, 1937:		
A. indicus Kulkarni, 1969	*S. indicus* (Kulkarni, 1969) Gussev, 1976	Kulkarni, 1969 Gussev, 1976
	Parancylodiscoides indicus (Kulkarni, 1969) Dubey, Gupta & Agarwal, 1992	Dubey, Gupta & Agarwal, 1992
	T. indicus (Kulkarni, 1969) Lim & Gusev, 1996	Lim, 1996
Bychowskyella Achmerov, 1952:		
B. singhi Rajeswari & Kulkarni, 1983		Rajeswari & Kulkarni, 1983
Dactylogyrus Diesing, 1850:		
D. kontii Tripathi, 1959	*S. kontii* (Tripathi, 1959) Gussev, 1976 *T. kontii* (Tripathi, 1959) Lim, 1996	Tripathi, 1959 Gussev, 1976 Lim, 1996
Hamatopeduncularia Yamaguti, 1953:		
H. lucknowensis Agrawal & Sharma, 1988		Agrawal & Sharma, 1988
H. yongendrai Pandey & Mehta, 1986		Pandey & Mehta, 1986
Haplocleidus Mueller, 1937:		
H. gomtius Jain, 1952	*S. gomtius* (Jain, 1952) Gussev, 1976 *T. gomtius* (Jain, 1952) Lim, 1996	Jain, 1952a Gussev, 1976 Lim, 1996
Heteronchocleidus Bychowsky, 1957:		
H. athari Pandey & Mehta, 1986		Pandey & Mehta, 1986
Mizelleus Jain, 1957:		
M. chauhani Agrawal & Sharma, 1989		Agrawal & Sharma, 1989
M. hindanensis Tewari & Agrawal, 1986		Tewari & Agrawal, 1986
M. indicus Jain, 1957	*M. linorchis* Kulkarni, 1969	Jain, 1957; Kulkarni, 1969; Gussev, 1976
M. lucknowensis Agrawal & Sharma, 1986		Agrawal & Sharma, 1986
M. siamensis new species		present data
M. wallagonius Singh, Kumari & Agrawal, 1992		Singh, Kumari & Agrawal, 1992
Neocalceostoma Tripathi, 1957:		
N. chauhani Pandey & Mehta, 1986		Pandey & Mehta, 1986

Species	Synonyms	References
Silurodiscoides Gussev, 1976:	*Thaparocleidus* Jain, 1952	Gussev, 1976; Lim, 1996
S. dayali Pandey & Agarwal, 1988	*T. dayali* (Pandey & Agarwal, 1988) Lim, 1996	Pandey & Agarwal, 1988 Lim, 1996
S. sudhakari Gussev, 1976	*T. sudhakari* (Gussev, 1976) Lim, 1996	Gussev, 1976 Lim, 1996
Thaparocleidus Jain, 1952:	*Silurodiscoides* Gussev, 1976	Gussev, 1976; Lim, 1996
T. jaini Agrawal, 1981		Agrawal, 1981
T. guptai Pandey & Mehta, 1986		Pandey & Mehta, 1986
T. kao new species		present data
T. saharanpurensis Pandey & Agrawal, 1990		Pandey & Agrawal, 1990.
T. sharmae Lim, 1996	*Wallagotrema indicus* Singh Singh & Sharma, 1992	Singh & Sharma, 1992 Lim, 1996
T. sohani Pandey & Mehta, 1986		Pandey & Mehta, 1986
T. surendrai Pandey & Agrawal, 1990		Pandey & Agrawal, 1990
T. wallagonius Jain, 1952	*S. wallagonius* (Jain, 1952) Gussev, 1976	Jain, 1952b Gussev, 1976; Lim, 1996
	Thaparocleidus isostylus Kulkarni, 1969	Kulkarni, 1969b; Gussev, 1976
	Parancylodiscoides wallagonius Dubey, (Jain, 1952) Dubey, Gupta & Agarwal, 1992	Gupta & Agarwal, 1992
T. yogendrai Agrawal, 1981		Agrawal, 1981
Wallagotrema Tripathi, 1959:	*Silurodiscoides* Gussev, 1976	Gussev, 1976
	Thaparocleidus Jain, 1952	see Lim, 1996
W. longicirrus Tripathi, 1959	*S. longicirrus* (Tripathi, 1959) Gussev, 1976	Tripathi, 1959 Gussev, 1976
	T. longicirrus (Tripathi, 1959) Lim, 1996	Lim, 1996
W. chauhani Agrawal & Pandey, 1981	*T. chauhani* (Agrawal & Pandey, 1981) Lim, 1996	Agrawal & Pandey, 1981 Lim, 1996
Urocleidus Mueller, 1934:		
U. ramalingami Pandey & Mehta, 1986		Pandey & Mehta, 1986
Parancylodiscoides Achmerow, 1964:	*Thaparocleidus* Jain, 1952	Achmerow, 1964; Lim, 1996
	Silurodiscoides Gussev, 1976	Gussev, 1976; Lim, 1996
P. gussevi Dubey, Gupta & Agarwal, 1992	*T. gussevi* (Dubey, Gupta & Agarwal, 1992) Lim, 1996	Dubey, Gupta & Agarwal, 1992 Lim, 1996

1986, should also be re-examined since the presence of *Urocleidus* (a monogenean of North American fishes) is unlikely on an old world catfish. There should be a concerted effort by Indian scientists to resolve the identities of the monogeneans found on Indian *W. attu*. Until this is done, it is not possible to ascertain the actual number of species and genera of monogeneans found on the *W. attu*. It is probable that there are only two genera, *Mizelleus* and *Thaparocleidus*, on *W. attu* in India as in Thailand.

The presence of spines/beaks on the mainpart of the dorsal anchors and patches on the ventral anchors neccessitated the amendment of the generic diagnosis of *Mizelleus*. The beaks on the main part of the anchors found on *Mizelleus* species could also be found in *Chauhanellus* Bychowsky & Nagibina, 1969 (see Lim, 1994).

Currently there are seven recorded *Mizelleus* species (see Table 3). *Mizelleus postorchoidis* Kulkarni, 1969 from *Mystus aor* was transferred to *Silurodiscoides* by Gussev (1976) and to *Thaparocleidus* by Lim (1996) [since *Mizelleus ramalingami* Agrawal & Sharma, 1988 is from *Clupiosoma garua* it will not be discussed in this paper]. *M. linorchis* Kulkarni, 1969 was considered a junior synonym of *M. indicus* by Gussev (1976). It is necessary to re-examine *M. lucknowensis* Agrawal & Sharma, 1986, *M. wallagonius* Singh, Kumari & Agrawal, 1992, *M. chauhani* Agrawal & Sharma, 1989, and *M. hindanensis* Tewari & Agrawal, 1986, for synonyms. It is difficult to ascertain the validity of these species without thorough examinations of the type specimens and attempts to obtain type specimens from India were unsuccessful. It will be no surprise if future studies should reveal that there is only one valid *Mizelleus* species.

Mizelleus as exemplified by *M. siamensis*, new species has two dactylogyrid-type seminal vesicles, similar to those found in *Bychowskyella* and *Quadriacanthus* (see Lim, 1991). The anchors of *Mizelleus* are similar to that of *Bychowskyella*. *Bychowskyella* differs from *Mizelleus* in lacking a pair of ventral patches and in having ventral bar in two parts. Although both *Mizelleus* and *Quadriacanthus* have a pair of ventral patches, *Quadriacanthus* differs from *Mizelleus* in the morphologies of the dorsal and ventral bars. The presence of two dactylogyrid-type seminal vesicles, the morphology of the anchors and their presence on freshwater siluriforms suggest that *Mizelleus*, *Bychowskeylla* and *Quadriacanthus* are closely related.

Mizelleus was included in the subfamily Ancylodiscoidinae Gussev, 1961 by Gussev (1976) but the presence of the two dactylogyrid-type seminal vesicles in *Mizelleus*, as well as in *Bychowskyella* and *Quadriacanthus* suggest that this placement should be reconsidered or at least the significance of the seminal vesicles should be elucidated. *Mizelleus* is placed within the subfamily Ancyrocephalinae until more studies could be done.

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LITERATURE CITED

Agrawal, N., 1981. On two unknown and one known monogenetic trematodes from the gills of *Wallago attu* Schneider. *Proc. Indian Acad. of Sci. (Animal Sci.)*, **50**: 565-565.

Agrawal, N. & K.C. Pandey, 1981. On a new monogenean, *Wallagotrema chauhani* n. sp. from *Wallago attu* Schneider. *Indian J. Parasit.*, **5**:75-76.

Agrawal, N. & R. Sharma, 1988. A rare monogenean, *Hamatopeduncularia lucknowensis* n. sp. from a silurid fish, *Wallago attu* (Bloch) at Lucknow. *Jap. J. Parasit.*, **37**: 373-375.

Agrawal, N. & R. Sharma, 1986. *Mizelleus lucknowensis* n. sp., a new monogenean from district Lucknow, Uttar Pradesh. *Proceedings of the 2nd. National Convention of young scientists*. Zoology Department, Meerut University, Meerut, 23-27.

Agrawal, N. & R. Sharma, 1989. *Mizelleus chauhani* n. sp., a branchial parasite of *Wallago attu* (Bloch). *Folia Morphologica*, Prague, **37**: 329-332.

Agrawal, N. & H.S. Singh, 1984. On a rare monogenean, *Mizelleus ramalingami* n. sp. at Lucknow, India. *Indian J. Helminthology (New Series)*, Meerut, **1**: 13-163.

Agrawal, N. & B. Mishra, 1992. Peculiarities in distribution of *Mizelleus indicus* Jain, 1957, on the gills of a freshwater catfish *Wallago attu* (Bloch & Schneider). *Uttar Pradesh J. Zool.*, **12**: 25-27.

Boeger, W.A. & D.C. Kritsky, 1993. Phylogeny and a revised classification of the Monogenoidea Bychowsky, 1937 (Platyhelminthes). *Syst. Parasit.*, **26**: 1-32.

Dubey, A., A.K. Gupta & S.M. Agarwal, 1992. Studies on monogenean *Ancylodiscoides* Achmerow, 1964 (*Silurodiscoides* Gussev, 1976) and two new species from Raipur. *Indian J. Helminthology*, **44**: 9-16.

Dubey, A., A.K. Gupta & S.M. Agarwal, 1992. Studies on monogenean parasites in fresh water fishes at Raipur VII. A report on the occurrence of the genus *Mizellus* Jain, 1957 and a taxonomic discussion on species included in it. *Indian J. Helminthology*, **44**: 51-57.

Gussev, A.V., 1976. Freshwater Indian Monogeneoidea. Principles of systematics, analysis of the world faunas and their evolution. *Indian J. Helminthology*, **25** & **26**: 1-241.

Gussev, A. V., 1978. Monogenoidea of freshwater fishes. Principles of systematics, analysis of world fauna and its evolution. *Parazitologia Sbornik*, **38**: 96-198. (In Russian.)

Jain, S.L., 1952a. Monogenea of Indian fresh-water fishes. 1. *Haplocleidus gomtius* n. sp. (subfamily:Tetraonchinae) from the gills of *Wallagonia attu* (Bloch) from Lucknow. *Indian J. Helminthology*, **4**: 37-42.

Jain, S.L., 1952b. Monogenea of Indian freshwater fishes II *Thaparocleidus wallagonius* n.g, n. sp., (subfamily:Tetraonchinae) from the gills of *Wallagonia attu* (Bloch) from Lucknow. *Indian J. Helminthology*, **4**: 43-48.

Jain, S.L., 1957. *Mizelleus indicus* n. g., n. sp. (subfamily Tetraonchinae), from the gill filaments of *Wallagonia attu* (Bloch). *Ann. Zoo.*, **2**: 57-62.

Kearn, G. & I.D. Whittington, 1994. Ancyrocephalinae monogeneans of the genera *Chauhanellus* and *Hamatopeduncularia* from the gills of the Blue catfish, *Arius graeffei*, in the Brisbane River and Moreton bay, Queensland, Australia, with descriptions of four new species. *Int. J. Parasit.*, **24**: 569-588.

Kritsky, D.C. & W.A. Boeger, 1989. The phylogenetic status of the Ancyrocephalidae Bychowsky, 1937 (Monogenea: Dactylogyroidea). *J. Parasit.*, **75(2)**: 207-211.

Kulkarni, T., 1969. On a new species of *Ancylodiscoides* Yamaguti, 1937 from the fish *Wallagonia attu* (Bloch) in Hyderabad, A.P. *Zool. Anz.*, **182**: 461-465.

Lim, L.H.S., 1986. New species of *Trianchoratus* Price and Berry 1966 (Ancyrocephalidae) from Malayan Anabantoid and Ophicephaloid fishes. *Parasitologica Hungurica*, **19**:31-42.

Lim, L.H.S., 1987. Distribution and diversity of monogeneans in freshwater fishes of Peninsular Malaysia (unpublished Ph.D. thesis of the University of Malaya, Kuala Lumpur).

Lim, L.H.S., 1991. Three new species of *Bychowskyella* Achmerow, 1952 from Malaysia. *Syst. Parasit.*, **19**:33-41.

Lim, L.H.S., 1994. *Chauhanellus* Bychowsky & Nagibina, 1969 (Monogenea) from ariid fishes (Siluriformes) of Peninsular Malaysia. *Syst. Parasit.*, **28**:99-124.

Lim, L.H.S., 1995. *Neocalceostoma* Tripathi, 1957 and *Neocalceostomoides* Kritsky, Mizelle & Bilqees, 1978 (Monogenea: Neocalceostomatidae n. fam.) from ariid fishes of Peninsular Malaysia. *Syst. Parasit.*, **30**: 141-157.

Lim, L.H.S., 1996. Eight new species of *Hamatopeduncularia* Yamaguti, 1953 (Monogenea: Ancyrocephalidae) from Ariidae of Peninsular Malaysia. *Syst. Parasit.*, **33**:53-71.

Lim, L.H.S., 1996. *Thaparocleidus* Jain, 1952, the senior synonym of *Silurodiscoides* Gussev, 1976 (Monogenea: Ancylodiscoidinae Gussev, 1961). *Syst. Parasit.* (in press).

Ng, P.K.L., 1992. The giant Malayan catfish *Wallago leerii* Bleeker, 1851, and the identities of *Wallagonia tweediei* Hora & Misra, 1941, and *Wallago maculatus* Inger & Chin, 1959 (Teleostei: Siluridae). *Raffles Bull. Zool.*, **40**(2): 245-263.

Pandey, K.C. & A. Agrawal, 1990. Studies of some new monogenetic parasites of freshwater fishes. *Folia Morphologica*, Prague, **38**: 19-23.

Pandey, K.C. & T. Mehta, 1986. Studies on some new monogenetic trematodes of *Wallago attu* (Bloch) at Meerut, Uttar Pradesh, India. **In** Pandey, K.C. (ed.) ***Proceedings of 2nd National Convenction of Young Scientists.*** Zoology Department, Meerut University, Meerut, June 1986. 114-132.

Rajeswari, T.S. & T. Kulkarni, 1983. On a rare species of *Bychowskyella singhi* from the gills of a freshwater fish, *Wallago attu* from Hyderabad, A.P., India. *Proc. Indian Acad. Parasit.*, **4**: 49-53.

Singh, H.S. & M. Sharma, 1992. *Wallagotrema indicus* n. sp., a new monogenean from the freshwater sheat-fish *Wallago attu* Bloch and Schneider. *Functional and Developmental Morphology*, Prague, **2**: 85-88.

Singh, H.S., M. Kumari & S. Agrawal, 1992. On some known and unknown monogeneans from *Wallago attu* (Bloch & Schn.) at Meerut (Uttar Pradesh). *Uttar Pradesh J. Zool.*, **12**: 48-56.

Tewari, S.K. & A. Agrawal, 1986. On a new monogenean *Mizelleus hindanensis* n. sp. from *Wallago attu* (Bloch). *Indian J. Helminthology (New Series)*, Meerut, **3**: 79-82.

Tripathi, Y.R., 1957. Monogenetic trematodes from fishes of India. *Indian J. Helminthology*, **9**: 1-149.

Venkatanarsaiah, J. & T. Kulkarni, 1981. Research notes: New combination of *Wallagotrema longicirrus* Tripathi, 1959. *Proc. Indian Acad. Parasit.*, **2**: 117-119.

Yamaguti, S., 1963. Systema Helminthum. Vol. IV. Monogenea and Aspidocotylea. *Interscience Publishers*, 699 pp.

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Monogeneans of Clariid Fishes in Thailand

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ABSTRACT

Monogeneans of fish in the family Clariidae of Thailand were investigated. Seven species of clariid fishes were collected for monogenean examination from various parts of Thailand. Five of the seven were wild species, while *Clarias gariepinus* and a *Clarias* hybrid (crossbred between *C. gariepinus* and *C. macrocephalus*) were cultured. Nine species of monogeneans from 2 genera were found. The genera were *Quadriacanthus* Paperna, 1961 (2 species) and *Bychowskyella* Achmerow, 1952 (7 species). *Quadriacanthus kobiensis* Ha Ky, 1968 was found on *C. macrocephalus*, *C. batrachus* and *C. cataractus*. *Quadriacanthus bagrae* Paperna, 1979 was found on *C. gariepinus* and the *Clarias* hybrid. *Bychowskyella tchangi* Gussev, 1976 was found on *C. macrocephalus* and *C. batrachus*. Six new species of *Bychowskyella* were found on *C. batrachus* (1 species), *C. meladerma* (2 species) and *C. nieuhofii* (3 species).

INTRODUCTION

Monogeneans of fish normally occur on the gills and skin (Bychowsky 1957). In cases of heavy infestation, they have been proved to be the cause of fish death, especially for fry by both wound infliction and secondary bacterial invasion (Tonguthai *et al.* 1993). To date, many species of monogeneans from potentially economic freshwater fish have been found in Southeast Asia (Chinabut and Lim 1991; 1993; Ha Ky 1968; Lim 1987; Lim and Furtado 1983). However, there are only a few papers concerning the monogeneans of Thai fishes (Chinabut and Lim 1991, 1993). Monogenean species in the Oriental Region have been reported from *Clarias batrachus*, *C. macrocephalus* (Gussev 1976; Ha Ky 1968; Lim and Furtado 1983), *C. teysmanni* (Lim 1991) and *C. lazera* (Molnar and Mossalam 1985; Paperna 1961). Thus far, there is no information on monogeneans of clariids in Thailand.

In this study, fish of the family Clariidae from Thailand were examined for monogeneans because they are economically important. Smith (1945) recorded 2 genera with 7 species belonging to the family Clariidae in Thailand: *Clarias* Scopoli (5 species) and *Prophagorus* Smith, (2 species). *Prophagorus* is now considered a junior synonym of *Clarias*.

MATERIALS AND METHODS

Seven clariid species, *Clarias batrachus* (Linnaeus, 1758), *C. macrocephalus* (Gunther, 1864), *C. nieuhofii* (Val., in Cuv. and Val., 1840), *C. meladerma* (Bleeker 1847), *C. cataractus* (Fowler, 1939), *C. gariepinus* (Burchell, 1822) and *Clarias* hybrid (crossbred between *C. gariepinus* and *C. macrocephalus*) were collected from various parts of Thailand and examined for monogeneans. Gills were removed after the fish were killed by severing the spinal cord. Monogeneans were dislodged using a bent needle, picked up with a fine pipette, and dropped onto a glass slide. The specimens were covered with a coverglass, the corners of which were sealed with nail enamel to prevent the mount from shifting. Ammonium picrate-glycerine was used as a fixative by capillary induction under the coverglass to fix and clear the specimens. All edges of the coverglass were then sealed after excess fixative had dried. The specimens were studied under the phase contrast microscope. Illustrations were made with the aid of a camera lucida.

RESULTS AND DISCUSSION

Nine species of monogeneans (*Gyrodactylus* species not included) were

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Table 1. Monogenean species and their number on *Clarias* species from various parts of Thailand (N=north, S=south, NE=northeast, C=central)

Fish species (location in Thailand)	Monogenean species	No. of fish sampled and number of parasitized hosts (in bracket)	Mean Intensity
Clarias batrachus (N, NE)	*Quadriacanthus kobiensis*	12 (9)	8
	Bychowskyella tchangi	12 (6)	7
	Bychowskyella sp.A	12 (4)	12
Clarias macrocephalus (S, NE)	*Quadriacanthus kobiensis*	16 (9)	6
	Bychowskyella tchangi	16 (9)	8
Clarias nieuhofii (S)	*Bychowskyella* sp.B	11 (7)	11
	Bychowskyella sp.C	11 (7)	8
	Bychowskyella sp.D	11 (4)	3
Clarias meladerma (S)	*Bychowskyella* sp.E	4 (3)	3
	Bychowskyella sp.F	4 (2)	3
Clarias cataractus (S)	*Quadriacanthus kobiensis*	5 (3)	5
Clarias gariepinus (N, S)	*Quadriacanthus bagrae*	4 (2)	38
Clarias hybrid (N, S, NE, C)	*Quadriacanthus bagrae*	27 (9)	13

found on the gills of 7 *Clarias* species from Thailand. *Quadriacanthus kobiensis* Ha Ky, 1968 was found on the gills of *Clarias batrachus, C. macrocephalus* and *C. cataractus. Q. clariadis* Paperna, 1961 was found on *C. gariepinus* and the *Clarias* hybrid and *Bychowskyella tchangi* Gussev, 1976 was found on *C. batrachus* and *C. macrocephalus*. Another 6 species of *Bychowskyella* were new species (see Table 1) and will be described eleswhere (Lerssutthichawal and Lim in prepararation).

Q. kobiensis Ha Ky,1968 was common on the gills of the 3 *Clarias* species (Table 1). This parasite was originally recorded from the gills of *C. batrachus* in Vietnam (Ha Ky 1968). Lim and Furtado (1983) also found it on *C. batrachus* and *C. macrocephalus* in Peninsular Malaysia. *Clarias cataractus* is a new host found in this present study. *Q. bagrae* Paperna, 1961 was originally described from bagrid in Uganda (Paperna 1979) as well as clarids, C. Lazera in Egypt (Kritsky and Kulo 1988).

In this study, *Q. bagrae* was found on *C. gariepinus* (syn. *C. lazera)* and on the *Clarias* hybrid. *C. gariepinus* was imported into Thailand from Laos in 1988 (Tangtrongpairoj *et al.* 1988).

Bychowskyella tchangi Gussev, 1976 was found on *C. batrachus* and *C. macrocephalus*. Six new species of *Bychowskyella* were also observed in *C. batrachus* (1 species), *C. meladerma* (2 species), *C.nieuhofii* (3 species) (see also Table 1). These species will be described elsewhere.

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REFERENCES

Bychowsky, B.E. 1957. Monogenetic trematodes, their systematics and phylogeny. (English translation by P.C. Oustinoff and W J. Hargis, Jr., Eds.). Graphic Art Press, Washington, D. C. 1961, 627 pp.

Chinabut, S. and L.H.S. Lim. 1991. Four new species of dactylogyrids (Monogenea) from *Cirrhinus jullieni* Sauvage, 1878 (Cyprinidae) in Thailand. Raffles Bull. Zool. 40(1): 75-79.

Chinabut, S. and L.H.S. Lim. 1993. Seven new species of *Dactylogyrus* Diesing, 1850 (Monogenea) from *Puntius* Hamilton (Cyprinidae) of Thailand. Raffles Bull. Zool. 41(1): 47-59.

Gussev, A.V. 1976. Freshwater Indian Monogenoidea. Principles of systematics, analysis of the world faunas and their evolution. Indian J. Helminthol. 25-26: 1-241.

Ha Ky. 1968. New species of monogeneans from freshwater fishes of North Vietnam. Pt. I Parazitologiya 2(4): 297-301.

Kritsky, D.C. and S.D. Kulo, 1988. The African species

of *Quadriacanthus* with proposal of *quadriacanthoides* gen. n. (Monogenea: Dactylogyridae) Proc. Helminthol. Soc. Wash. 55(2): 175-187.

Lim, L.H.S. 1991. Three new species of *Bychowskyella* Achmerow, 1952 (Monogenea) from Peninsular Malaysia. Syst. Parasitol. 19: 33-34.

Lim, L.H. and J.I. Furtado. 1983. Ancylodiscoidins (Monogenea: Dactylogyridae) from two freshwater fish species of Peninsular Malaysia. Folia Parasitol. (PRAHA) 30: 377-380.

Paperna, I. 1961. Studies on monogenetic trematodes in Israel. 3. Monogenetic trematodes of the Cyprinidae and Clariidae of the Lake of Galilae. Bamidgeh., Bull. Fish. Culkt. Israel 13(1): 14-29.

Smith, H.M. 1945. The Freshwater Fishes of Siam, or Thailand. Bulletin 188. Smithsonian Institution. Washington, 622 pp.

Tangtronpairoj, M., S. Luanpreeda, S. Nu-kwan, K. Lawanyawut and S. Kaewlaeard. 1988. Breeding and nursing of sharptooth African catfish. Fishery Gazz. 41(6): 535-544 (in Thai).

Teugels, G.G. 1986. A systematic revision of the African species of the genus *Clarias* (Pisces; Clariidae). Koninklijk Museum voor Midden-Afrika, Tervuren, 199 pp.

Tonguthai, K., S. Chinabut, C. Limsuwan, T. Somsiri, P. Chanratchakool, S. Kanchanakhan and I. H. MacRae. 1993. Handbook of hybrid catfish: husbandry and health. Aquatic Animal Health Research Institute, Department of Fisheries. Kasetsart University Campus, Bangkok. 37 pp.