

### **Taxonomic notes**

Izawa (1996) reported the presence of a transverse sternal suture apparently separating the maxilliped-bearing somite from the first pedigerous somite. The significance of this sternal suture is difficult to ascertain since the sternal area is rarely examined closely and comparative data on other relatively primitive families, such as the Eudactylinidae, are not readily available. Dorsally the first pedigerous somite is fully incorporated into the cephalothorax and there is a unitary dorsal cephalothoracic shield. The retention of a distinct genital somite, separate from both the enlarged fifth pedigerous somite and the first abdominal somite, is also a primitive feature.

The antennae of both sexes are described as 5-segmented by Izawa (1996). Comparison with the basic antennal structure in other siphonostomatoids, such as the Asterocheridae, suggests that the long, unarmed penultimate segment is the first endopodal segment, since this segment is typically elongate and never armed in any siphonostomatoid, and that the apical segment represents the fused second and third endopodal segments. The terminal claw is probably homologous with one of the apical elements originating on the third endopodal segment. If this interpretation is correct, then the presumed homology of the proximal parts of the limb requires revision. It seems probable that the first "segment" represents a well defined pedestal upon which the true limb is located, the second segment is thus the coxa and the third, the basis. The antennae are 4-segmented according to this interpretation. Examination of the antennal musculature will resolve this problem. The only species, *Archidactylina myxinicola* Izawa, is parasitic in the gill pouches of two species of hagfish (Agnatha, Myxiniformes) taken in Japanese waters.

### **Brazilian species and records**

None.

Family **Caligidae** Burmeister, 1835  
(Figs. 3.29 - 3.43)

Podoplea, Siphonostomatoida. Body dorsoventrally flattened comprising caligiform anterior cephalothorax, incorporating first to third pedigerous somites, a free pedigerous somite (bearing leg 4), a genital complex consisting of fused fifth pedigerous and genital somites (and possibly first abdominal somite in female), and a free abdomen of 1 to 3 somites. Genital complex and abdomen may be elongated, flattened with wing-like expansions, or provided with posterolateral processes in some genera. Abdomen suppressed in some genera. Genital apertures ventral, near posterior margin of genital complex. Caudal rami with 6 setae.

Rostrum absent; paired frontal plates usually present between antennules; lunules present or absent. Nauplius eye present. Antennule 2-segmented in both sexes; first segment with up to 27 setae, second with 14 setae. Segmental homologies indeterminate, probably I-XX and XXI-XXVIII. Male antennule non-geniculate, as in female. Antenna uniramous, comprising coxa, basis and

laterally directed subchela formed by partial or complete fusion of endopod and distal claw; exopod absent. Postantennal process present, sometimes absent. Oral cone with opening formed by both labrum and labium. Mandible reduced to a stylet bearing teeth (usually 12) on one side near apex; palp absent. Maxillule bilobed, with basal portion incorporated into body wall; anterior lobe (palp) papillate, bearing 3 setae; posterior lobe (endite) an unarmed spinous process; one or both lobes occasionally absent. Maxilla brachiform, comprising syncoxa (lacertus) and basis (brachium) bearing calamus and canna distally. Maxilliped 2-segmented, comprising massive protopod (corpus) and distal subchela representing fused endopodal segments plus terminal claw. Sternal furca present or absent.

Swimming leg 1 with coxa and basis slightly offset; exopod 2-segmented; endopod reduced to papilla or absent. Inner seta on basis of leg 1 present. Leg 2 biramous, with protopod comprising coxa and basis; both rami typically 3-segmented, rarely 2-segmented, as in *Arrama*. Leg 3 with coxa and basis fused into flattened sympod; leg pair typically connected by expanded intercoxal sclerite and forming broad plate sealing rear margin of cephalothorax. Exopod 2 to 3-segmented, endopod 2 to 3-segmented, absent in *Kabataella*. First exopodal segment with large outer spine reflexed over ramus. Leg 3 reduced to simple lobe in *Arrama*. Fourth leg uniramous, comprising sympod formed by fused coxa and basis, and 1 to 3-segmented exopod; leg 4 sometimes reduced to single segment, or absent. Intercoxal sclerites present on legs 1 to 3. Spine and seta formula typically as follows:

	coxa	basis	exopodal segments	endopodal segments
leg 1	0-0	1-1	I-1; III, I, 3	-
leg 2	0-1	1-0	I-1; I-1; III, 5	0-1; 0-1; 1, 2, 3
leg 3	0-1	1-0	I-1; I-1; III, 4	0-1; 0-2; 4
leg 4	0-0	1-0	I-0; I-0; III	-

Leg 5 represented by papilla on margin of genital complex; armed with 3 setae and 1 on body surface representing outer seta of incorporated protopodal segment. Leg 6 represented by unarmed genital operculum in female; by papilla bearing up to 3 setae in male. Egg sacs uniseriate.

**Type-genus:** *Caligus* Müller, 1785.

#### Included genera:

*Abasia* C.B. Wilson, 1908, *Anchicaligus* Stebbing, 1900, *Anuretes* Heller, 1865, *Arrama* Dojiri & Cressey, 1991, *Belizia* Cressey, 1990, *Caligodes* Heller, 1865, *Caligopsis* Markevich, 1940, *Caligus* Müller, 1785, *Caritus* Cressey, 1967c, *Dartevellia* Brian, 1939, *Diphyllogaster* Brian, 1899, *Echetus* Krøyer, 1864, *Heniochophilus* Yamaguti & Yamasu, 1959, *Hermilius* Heller, 1865,



*Kabataella* Prabha & Pillai, 1984, *Lepeophtheirus* von Nordmann, 1832, *Mappates* Rangnekar, 1958, *Metacaligus* Thomsen, 1949, *Paralebion* C.B. Wilson, 1911, *Parapetalus* Steenstrup & Lütken, 1861, *Parechetus* Pillai, 1961, *Pseudanuretes* Yamaguti, 1936, *Pseudechetus* Prabha & Pillai, 1979, *Pseudocaligus* A. Scott, 1901, *Pseudolepeophtheirus* Markevich, 1940, *Pupulina* van Beneden, 1892, *Scienophilus* van Beneden, 1852, *Sinocaligus* Shen, 1957, *Synestius* Steenstrup & Lütken, 1861.

### **Taxonomic notes**

The family Caligidae is characterised by the flattened form of the cephalothorax which functions as a sucker and is provided with membrane around its margins. The posterior wall of the sucker is completed by the flattened third swimming legs which are typically joined by an extensive, apron-like intercoxal sclerite. The anterior wall of the sucker is completed by expanded frontal plates located between the antennules. The cephalothorax incorporates the first, second and third pedigerous somites. The main body articulation lies between the cephalothorax and the fourth pedigerous somite which resembles a narrow waist. The posterior part of the body comprises an enlarged genital complex incorporating at least the fifth pedigerous and genital somites and, according to Boxshall (1990), the first abdominal somite as well.

Kabata (1979a) listed 23 valid genera in the Caligidae, one of which, *Alicalgus*, was recognized as a synonym of *Abasia* by Cressey & Cressey (1979). Another of Kabata's listed genera *Caligulina* Heegaard, 1972, is clearly a synonym of *Anchicaligus*, as indicated by Ho (1980). *Lamarckina* Quidor, 1913 is recognized here as a senior synonym of *Parechetus* Pillai, 1961 but is preoccupied. *Parechetus* is therefore retained as the replacement name. *Sinocaligus* and *Pseudopetalus* Pillai, 1962 are synonymous, as recognized by Pillai (1962), but *Sinocaligus* is the oldest available name for this taxon and takes priority. *Dentigryps* Wilson, 1913 is generally treated as a synonym of *Lepeophtheirus* although Ho & Dojiri (1977) argued for its continued recognition as a valid genus. The genus *Charlesia*, established by Oliveira (1945) in the Caligidae, belongs to the Bomolochidae but is unrecognizable beyond family and is here treated as a genus inquirendum.

Four new genera have been described since 1979, *Arrama*, *Belizia*, *Kabataella* and *Pseudechetus*, and *Caritus* is also a valid genus. Prabha (1983) reexamined the types of *Paralebion elongatus* Wilson and could not find any dorsal plates on the free pedigerous somite. Prabha transferred this genus from the Euryphoridae to the Caligidae. Finally, *Metacaligus* is treated as a valid genus here, after Ho & Bashirullah (1977). Twenty nine genera are accepted as valid in the following key.

Caligids are predominantly external parasites of fishes, especially teleosts. They inhabit the outer surface, the mouth, the gills and opercular cavity of their hosts. They feed on epithelial tissue which is scraped into their erectable oral cone by the rake-like action of their mandibles (Kabata, 1974). Their flattened profile and sucker-like anterior tagma enable them to cling to their hosts, but they are able to move rapidly over the surface (Kabata & Hewitt, 1971). Many

species parasitize commercially important fishes, some (e.g. the salmon louse, *Lepeophtheirus salmonis* (Krøyer)) can cause severe economic losses in fish farming. Data on the biology and morphology of caligids and on methods of controlling infestations by caligids in aquaculture facilities can be found in Boxshall & Defaye (1993).

### Key to genera

1. Lunules present on frontal plates.....2  
Lunules absent.....16
2. Genital complex and/or abdomen with processes.....3  
Genital complex and abdomen without processes.....6
3. Genital complex with 4 processes.....4  
Genital complex with 2 processes.....5
4. Post-cephalothoracic region (fourth pedigerous somite) not elongated.....*Synestius*  
Post-cephalothoracic region (fourth pedigerous somite) elongated.....*Pseudechetus*
5. Abdomen not winged.....*Caligodes*  
Abdomen winged.....*Parechetus*
6. Post-cephalothoracic region (fourth pedigerous somite) elongated.....*Echetus*  
Post-cephalothoracic region (fourth pedigerous somite) not elongated.....7
7. Genital complex and abdomen flattened or winged, broader than cephalothorax.....8  
Genital complex and abdomen not flattened, not broader than cephalothorax.....9
8. Genital complex and abdomen with broad wings.....*Parapetalus*  
Genital complex and abdomen flattened but not winged....*Sinocaligus*
9. Cephalothorax with rostral lobe.....*Abasia*  
Cephalothorax without rostral lobe.....10

10. Cephalothorax with large lenses in front of nauplius eye...*Anchicaligus*  
Cephalothorax without such lenses in front of nauplius eye.....11
11. Abdomen as long as or longer than rest of body.....*Scienophilus*  
Abdomen shorter than rest of body.....12
12. Fourth leg 2 to 4-segmented.....13  
Fourth leg a 1-segmented vestige.....*Pseudocaligus*  
Fourth leg absent.....*Caligopsis*
13. Endopod of third leg two-segmented, armed with 4 to 6 setae.....14  
Endopod of third leg plate-like, without setae.....*Caritus*
14. Endopod of third leg with 6 setae.....15  
Endopod of third leg with 4 setae.....*Belizia*
15. Sternal furca present.....*Caligus*  
Sternal furca absent.....*Metacaligus*
16. Endopod of first leg a large flattened segment.....*Pupulina*  
Endopod of first leg a small lobe.....17
17. Leg 3 flattened, forming ventral apron with large intercoxal sclerite;  
leg 2 typically with 3-segmented rami.....18  
Leg 3 lobate, with intercoxal sclerite absent, not forming ventral apron;  
leg 2 with 2-segmented rami.....*Arrama*
18. Cephalothorax folded lengthwise along midline.....*Hermilius*  
Cephalothorax not folded lengthwise along midline.....19
19. Frontal plates absent.....20  
Frontal plates present.....21
20. Abdomen short, without lobes, third leg without endopod...*Kabataella*  
Abdomen long, with lobes, third leg with endopod.....*Dartevellia*
21. Genital complex with posterolateral lobes or processes.....22  
Genital complex without posterolateral lobes or processes.....23



22. Exopod of fourth leg bilaterally armed.....*Diphylllogaster*  
 Exopod of fourth leg unilaterally armed.....*Paralebion*
23. Posteromedian lobe of cephalothorax not produced backwards.....24  
 Posteromedian lobe of cephalothorax produced backwards.....25
24. Fourth leg 4-segmented.....*Lepeophtheirus*  
 Fourth leg a 1-segmented vestige.....*Pseudolepeophtheirus*  
 Fourth leg 3-segmented.....*Anuretes*
25. Posteromedian lobe of cephalothorax covering more than half of the  
 genital complex.....*Mappates*  
 Posteromedian lobe of cephalothorax covering less than half of the  
 genital complex.....26
26. Posterior sinuses obliterated, sternal furca present, distal segment of  
 antenna without accessory process; posterior process of maxillule  
 forming postoral process.....*Heniochophilus*  
 Posterior sinuses not obliterated, sternal furca absent, distal segment  
 of antenna with accessory process; posterior process of maxillule  
 forming "maxillary" whip.....*Pseudanuretes*

### Brazilian species and records

#### Genus *Anuretes*

##### *Anuretes heckelii* (Krøyer, 1863)

Description (Fig. 3.29): Body length of female about 2.8mm. Cephalothorax typical of family, lacking lunules on frontal plates. Genital complex with deeply concave posterior margin and rounded postero-lateral lobes bearing the fifth legs. Abdomen absent.

Host: On wall of branchial cavity of *Ephippus gigas* (Wilson, 1905).

#### Genus *Caligodes*

##### *Caligodes laciniatus* (Krøyer, 1863)

Description (Fig. 3.30): Adult female body length ranging from 2.3 to 7.1mm. Cephalothorax typical for family, lunules present on frontal plates. Fourth pedigerous somite elongate, genital complex greatly enlarged with paired posterolateral processes almost as long as elongate abdomen. Sternal furca small, with spatulate tines. Leg 4 uniramous with 2-segmented exopod; first exopodal segment with outer spine, second with 1 large and 2 tiny spines apically.

Host: Attached to ventral body wall beneath oral valve of *Ablennes hians* (Cressey & Collette, 1970).

Genus *Caligus*

*Caligus balistae* Steenstrup & Lütken, 1861

Description (Fig. 3.31): Female body length about 4.5mm. Genital complex about as long as wide. Abdomen 1-segmented, about as long as wide. Postantennal process sickle-shaped. Sternal furca with linear, divergent tines. Outer margins of first and second endopodal segments of leg 2 setulate. Exopod of fourth leg 2-segmented, with spine formula I, III.

Hosts: On body surface and wall of branchial cavity of *Aluterus scripta*, *Canthidermis sobaco*, *C. maculatus*, *Coryphaena hippurus* and *Monacanthus hispidus* (Cressey, 1991).

*Caligus bonito* Wilson, 1905

Description (Fig. 3.32): Female body length about 5.0 to 8.0mm. Genital complex markedly longer than thoracic zone of dorsal cephalothoracic shield; twice as long as wide. Abdomen elongate, unsegmented, about as long as or slightly longer than genital complex; more than 3 times longer than wide. Sternal furca with linear, slightly divergent tines. Outer margin of first and second endopodal segments of leg 2 spinulate. Exopod of fourth leg 2-segmented, with spine formula I, I+III. Male with 2-segmented abdomen. Claw of antenna bifid.

Hosts: Parasitic on gills and wall of oral-branchial cavity of *Katsuwonus pelamis*, *Sarda sarda* and *Mugil platanus* (Carvalho, 1951; Cressey & Cressey, 1980; Knoff et al., 1994).

*Caligus chorinemi* Krøyer, 1863

Description (Fig. 3.33): Female body length about 5.1mm, male 2.9mm. Genital complex just longer than wide, about 1.2 times longer than abdomen. Abdomen unsegmented, nearly 3 times longer than wide. Lunules widely spaced. Process of maxillule with small accessory process. Sternal furca with recurved tines. Leg 1 with 3 short plumose setae along posterior margin of distal exopodal segment. Outer margin of second endopodal segment of leg 2 setulate. Exopod of fourth leg 2-segmented, with spine formula I, I,III. Male with indistinctly 2-segmented abdomen. Claw of antenna short, sharply recurved.

Hosts: On body surface and wall of branchial cavity of *Caranx carangus*, *C. hippos*, *Carangoides bartholomaei* and *C. crysos* (Cressey, 1991).

*Caligus coryphaenae* Steenstrup & Lütken, 1861

Description (Fig. 3.34): Female body length 5.5 to 8mm. Genital complex longer than thoracic zone of dorsal cephalothoracic shield; longer than wide; posterolateral angles rounded or produced into small lobes. Abdomen indistinctly 3-segmented, about as long as genital complex. Pair of small lobate processes present on ventral surface either side of sternal furca. Exopod of fourth leg 3-segmented, with spine formula I, I, III. Male with 2-segmented abdomen. Claw of antenna simple, with prominent secondary tine near base.

Hosts: On body surface and gills of *Katsuwonus pelamis*, *Thunnus albacares* and *T. obesus* (Cressey & Cressey, 1980).

*Caligus haemulonis* Krøyer, 1863

Description (Fig. 3.35): Female body length about 3.6mm. Genital complex just longer than wide, about 1.5 times longer than abdomen. Abdomen indistinctly 2-segmented. Lunules prominent. Sternal furca with linear, slightly recurved tines. Leg 1 lacking plumose setae along posterior margin of distal exopodal segment. Outer margin of second endopodal segment of leg 2 strongly spinulate. Exopod of fourth leg 2-segmented, with spine formula I, I+III. Male with 2-segmented abdomen. Claw of antenna short, bifid. Maxilliped with pointed process on syncoxa, opposing tip of claw.

Hosts: On body surface of *Orthopristis ruber* and *Haemulon steindachneri* (Luque & Takemoto, 1996).

*Caligus irritans* Heller, 1865

Description (Fig. 3.36): Female genital complex 1.3 times longer than wide, about 1.4 times longer than abdomen. Abdomen indistinctly 2-segmented. Lunules prominent. Sternal furca with recurved tines. Exopod of fourth leg 2-segmented, with spine formula I, I+III. Male with 2-segmented abdomen. Maxilliped with complex myxal process on syncoxa, opposing tip of claw.

Host: *Serranus* sp. (Heller, 1865).

*Caligus mutabilis* Wilson, 1905

Description (Fig. 3.37): Female body length about 2.8mm. Genital complex about 1.4 times longer than wide; widest posteriorly; posterior angles rounded and only slightly produced. Abdomen indistinctly 2-segmented, shorter (0.7:1.0) than genital complex; about twice as long as wide. Sternal furca with slightly divergent, blunt tipped tines. Outer margins of first and second endopodal segments of leg 2 with dense patches of spinules. Exopod of fourth leg 2-segmented, with spine formula I, I+III. Male with 2-segmented abdomen. Claw of antenna trifid.

Host: On gills and wall of branchial cavity of *Scomberomorus brasiliensis* (Cressey & Cressey, 1980).

*Caligus oligoplitisi* Carvalho, 1956

Description (Fig. 3.38): Female body length about 6.2 to 6.6mm. Genital complex small, tapering anteriorly, about 1.2 times longer than wide. Abdomen 2-segmented, slightly longer than genital complex. Sternal furca with linear, tapering tines. Maxilliped with pointed myxal process opposing tip of terminal claw. Leg 1 with 3 long plumose setae on posterior margin of distal exopodal segment. Outer margin of first and second endopodal segment of leg 2 finely spinulate. Exopod of fourth leg 3-segmented, with spine formula I, I, III.

Host: On body surface and wall of branchial cavity of *Oligoplitis saliens* (Carvalho, 1956).

*Caligus productus* Dana, 1852

Description (Fig. 3.39): Female body length about 3.8 to 5.5mm. Genital complex about 1.3 times longer than wide; posterolateral corners of complex



produced into rounded lobes. Abdomen 1-segmented, slightly shorter than genital complex. Sternal furca with linear, divergent tines. Leg 1 lacking plumose setae on posterior margin of distal exopodal segment. Outer margin of first and second endopodal segment of leg 2 strongly spinulate. Exopod of fourth leg 2-segmented, with spine formula I, I+III. Male with 2-segmented abdomen. Antenna with short claw and 2 prominent ridged areas on basal part.

Hosts: On body surface and wall of branchial cavities of *Katsuwonus pelamis* and *Thunnus albacares* (Cressey & Cressey, 1980).

*Caligus sepetibensis* Luque & Takemoto, 1996

Description (Fig. 3.40): Female body length about 2.0 to 2.3mm. Genital complex about 1.3 times wider than long. Abdomen 1-segmented, 0.8 times as long as genital complex. Sternal furca with linear tines terminating in slightly spatulate tips. Leg 1 with 3 long plumose setae on posterior margin of distal exopodal segment. Outer margin of first and second endopodal segment of leg 2 finely spinulate. Exopod of fourth leg 3-segmented, with spine formula I, I, III. Male unknown.

Hosts: On body surface of *Orthopristis ruber* and *Haemulon steindachneri* (Luque & Takemoto, 1996).

*Caligus tenax* Heller, 1865

Description (Fig. 3.41): Female body length about 4.5mm, male body length 3.0mm. Genital complex large, about 1.4 times longer than wide. Abdomen about twice as long as wide, 1-segmented, about half as long as genital complex. Posterior process of maxillule with accessory process. Sternal furca with spatulate tines. Leg 1 with 3 long plumose setae on posterior margin of distal exopodal segment. Outer margin of first and second endopodal segments of leg 2 spinulate. Exopod of fourth leg 3-segmented, with spine formula I, I, III. Male with elongate genital complex and slender 1-segmented abdomen.

Host: *Caranx hippos* (Heller, 1865).

*Caligus tetrodontis* Barnard, 1948

Description (Fig. 3.42): Female body length about 4 to 5mm, male body length 4.2mm. Genital complex about as long as wide. Abdomen short, indistinctly 2-segmented, about one third as long as genital complex. Sternal furca with linear, divergent tines. Leg 1 with 3 long plumose setae on posterior margin of distal exopodal segment. Exopod of fourth leg 3-segmented, with spine formula I+III in female, apparently 1-segmented with I+III formula in male. Male with slender 2-segmented abdomen. Claw of antenna blunt. Maxilliped with strong myxal process opposing tip of claw.

Hosts: Found free in plankton (Montú, 1982).

*Caligus trachynoti* Heller, 1865

Description (Fig. 3.41): Inadequately described. Genital complex slender about 1.6 times longer than wide. Abdomen elongate, 1-segmented, only just over half as long as genital complex.

Host: On *Trachynotus* sp. (Heller, 1865)

*Caligus undulatus* Shen & Li, 1959

Description (Fig. 3.43): Female body length about 4.2mm, male about 3.1mm. Frontal plates produced medially, so lunules directed anterolaterally. Genital complex longer than wide, with distinctive wrinkled appearance. Abdomen 1-segmented, shorter than genital complex. Sternal furca with parallel tines. Leg 1 with 3 long plumose setae on posterior margin of distal exopodal segment. Exopod of fourth leg 2-segmented, with spine formula I, I+III. Male with elongate genital complex and 2-segmented abdomen. Antenna compact, with 3 claws at tip and large ridged areas on basal part. Posterior process of maxillule with adhesion pad. Maxilliped with myxal process opposing tip of terminal claw.

Hosts: Found free in plankton (Montú, 1982).

Genus *Lepeophtheirus*

*Lepeophtheirus monacanthus* Heller, 1865

Description (Fig. 3.44): Female body length about 3.3mm. Genital complex about 1.2 times longer than wide, about 1.7 times longer than abdomen. Abdomen 1-segmented. Frontal plates small, lacking lunules. Posterior process of maxillule simple. Sternal furca with slender linear tines. Leg 1 with 3 long plumose setae on posterior margin of distal exopodal segment. Outer margin of second endopodal segment of leg 2 lacking spinules. Exopod of fourth leg 2-segmented, with spine formula I, I+III. Male with slender genital complex and indistinctly 2-segmented abdomen. Maxilliped without any myxal process.

Hosts: On body surface and wall of branchial cavity of *Arius heudeloti*, *Bagre marina*, *Felichthys marinus*, *Galeichthys felis*, *Hexanemathichthys felis* and *Pimelodus maculatus* (Heller, 1865).

Genus *Metacaligus*

*Metacaligus uruguayensis* Thomsen, 1949

Description (Fig. 3.45): Female body length about 4.1 to 5.6mm, male about 4.7mm. Genital complex about 1.4 times longer than wide, nearly twice as long as abdomen. Abdomen 1-segmented. Frontal plates well developed, lunules present. Posterior process of maxillule simple. Sternal furca absent. Leg 1 with 3 very short plumose setae on posterior margin of distal exopodal segment. Outer margin of second endopodal segment of leg 2 with fine setules. Leg 4 relatively large and robust, exopod 2-segmented, with spine formula I, I+III. Male with elongate genital complex and slender 2-segmented abdomen. Antenna with broad distal claw in form of ridged plate, ridged areas present on basal part.

Host: On *Trichiurus* sp. at Rio Grande (unpublished record).



Family **Cecropidae** Dana, 1849  
(Fig. 3.46)

Podoplea, Siphonostomatoida. Body dorsoventrally flattened, comprising caligiform anterior cephalothorax, incorporating first pedigerous somite only, 3 free pedigerous somites, a genital complex consisting of fused fifth pedigerous and genital somites (and possibly first abdominal somite in female), and a free abdomen of 1 somite. First and third free pedigerous somites each with a pair of dorsolateral plates. First and second free pedigerous somites fused in some genera. Genital complex with plate-like posterior expansions covering abdomen, in female only. Genital apertures ventral in both sexes. Caudal rami with 6 setae.

Rostrum absent; paired frontal plates present between antennules; lunules absent. Nauplius eye present. Antennule 2-segmented in both sexes; first segment with 27 setae, second with 13 setae; sometimes reduced. Segmental homologies indeterminate. Male antennule non-geniculate; as in female. Antenna uniramous, comprising coxa, basis and laterally directed subchela formed by fusion of endopod and distal claw; exopod absent. Postantennary process present. Oral cone with opening formed by both labrum and labium. Mandible reduced to a stylet bearing teeth on one side near apex; palp absent. Maxillule bilobed: inner lobe (endite) a spinous process; outer lobe (palp) reduced to small swelling bearing 2 spines on margin of endite. Maxilla comprising syncoxa (lacertus) and basis (brachium) typically bearing 3 distal elements, calamus, canna and clavus; clavus absent in *Cecrops*. Maxilliped 3-segmented, comprising powerful, tapering protopod (corpus) and distal subchela consisting of a free endopodal part and the apical claw. Myxal area on corpus located in proximal half of median margin. Sternal furca absent.

Swimming legs 1 to 4 biramous, rami of legs 1 to 3 typically 2-segmented, sometimes 1-segmented in leg 3; rami of leg 4 typically 1-segmented. All rami broad and paddle-like. Intercoxal sclerites (interpodal bar) present in legs 1 to 3. Inner seta on basis of leg 1 present; absent in *Cecrops*. Inner coxal seta present in legs 1 to 3. Spine and seta formula (based on *Philorthagoriscus serratus* (Krøyer)):

	coxa	basis	exopodal segments	endopodal segments
leg 1	0-1	1-1	I-0; IV,3	0-0; 3
leg 2	0-1	1-0	I-1; IV,5	0-1; 7
leg 3	0-1	1-0	I-0; III,4	0-1; 4
leg 4	0-0	1-0	6/7	2/3

Setation sometimes further reduced. Fifth leg represented by unsegmented lobe, partly fused to somite at base, bearing 4 setae; sometimes absent. Leg 6 represented by unarmed genital operculum in female; operculum armed with 2 spines or setae in male. Egg sacs uniseriate; straight or convoluted beneath extensive margins of genital complex.



**Type-genus:** *Cecrops* Leach, 1816.

**Included genera:**

*Cecrops* Leach, 1816, *Entepherus* Bere, 1936, *Luetkenia* Claus, 1864, *Orthagoriscicola* Poche, 1902, *Philorthagoriscus* Horst, 1897.

**Taxonomic notes**

Kabata (1979a) reviewed the relationship between the Cecropidae and Pandaridae and concluded that the only consistent character distinguishing between them is the structure of the protopodal part (corpus) of the female maxilliped. It is slender in Cecropidae and squat in Pandaridae with its myxal region displaced distally. The Cecropidae has only the first pedigerous somite incorporated into the cephalothorax, but the second and third pedigerous somite are fused together. The main articulation of the body lies between the third and fourth pedigerous somites as typical for the caligiform families.

The six valid species of the Cecropidae are all parasitic on epipelagic fishes. The three closely related, monotypic genera, *Cecrops*, *Orthagoriscicola* and *Philorthagoriscus*, are all found on the ocean sunfish (*Mola mola*). *Luetkenia* comprises two species known from the luvar (*Luvar imperialis*). The monotypic *Entepherus* is a parasite of the manta ray and other mobulid elasmobranchs (Benz & Deets, 1988).

**Key to genera**

1. First and second free pedigerous somites fused.....2  
First and second free pedigerous somites separate.....4
2. Fused first and second free pedigerous somites with a small dorsal plate.....*Cecrops*  
Fused first and second free pedigerous somites without dorsal plate.3
3. Lateral margin of cephalothoracic shield and margin of dorsal plates coarsely serrated.....*Philorthagoriscus*  
These margins smooth.....*Luetkenia*
4. Dorsal plate covering genital complex deeply indented (to half length of complex) on posterior midline.....*Orthagoriscicola*  
Dorsal plate covering genital complex slightly indented on posterior midline.....*Entepherus*

**Brazilian species and records**

None.

Family **Dichelesthidae** Milne Edwards, 1840  
(Fig. 3.47)

Podoplea, Siphonostomatoida. Body moderately transformed; comprising cephalothorax, incorporating first pedigerous somite, and 4 free pedigerous somites, a genital double-somite in female representing the fused genital and first abdominal somites, and 1 to 3 free abdominal somites. Free pedigerous somites poorly defined, fused in *Anthosoma*. Female with dorsal elytra on second pedigerous somite in *Anthosoma*, on third and fourth pedigerous somites in *Kabatarina*, lacking in *Dichelesthium* and in males. Genital apertures paired, ventral in both sexes. Caudal rami lobate, unarmed.

Nauplius eye present. Antennule 6-segmented in female *Anthosoma* and *Dichelesthium*, 21-segmented in female *Kabatarina*; segmental homologies indeterminate. Male antennule non-geniculate, as in female; unknown in *Kabatarina*. Antenna subchelate, indistinctly 2-segmented. Proximal segment representing protopod, typically slender and retractile in *Anthosoma*, *Dichelesthium* and possibly in male *Kabatarina*; robust in female *Kabatarina*. Distal segment representing endopod, bearing apical claw; exopod absent. Oral cone well developed, with distal opening formed by labrum and labium. Mandible reduced to a stylet with 10 to 18 teeth on one side near apex; palp absent. Maxillule bilobed: inner lobe (endite) large, bearing 2 setae; outer lobe (palp) apparently 2-segmented, bearing 3 setae (1-segmented with 2 setae in *Kabatarina*). Maxilla comprising syncoxa (lacertus) and slender basis (brachium) bearing at its tip an opposable claw or bulbous structure delimited from segment by proximal groove. Maxilliped 2-segmented in *Anthosoma* and *Dichelesthium*, comprising massive protopod (corpus) and distal subchela representing fused endopod and terminal claw. Maxilliped of *Kabatarina* apparently comprising separate praecoxa, coxa and basis, and 3-segmented endopod bearing terminal claw.

Swimming legs 1 to 4 biramous with segmented rami in *Kabatarina*; legs 1 and 2 biramous with 1-segmented rami, leg 3 foliaceous and without separate rami in *Dichelesthium*; legs 1 to 3 foliaceous, without separate rami in *Anthosoma*. Leg 4 absent in *Dichelesthium* and *Anthosoma*. Inner seta on basis of leg 1 present. Inner coxal setae absent. Fifth leg absent. Leg 6 represented by unarmed genital opercula in both sexes. Egg sacs uniseriate.

**Type-genus:** *Dichelesthium* Hermann, 1804.

**Included genera:**

*Anthosoma* Leach, 1816, *Dichelesthium* Hermann, 1804, *Kabatarina* Cressey & Boxshall, 1989.

**Taxonomic notes**

Kabata (1979a) recognized the close affinity of *Dichelesthium* and *Anthosoma*. These two genera share several apomorphic characters including 6-segmented antennules, foliaceous third leg, the loss of the fourth leg, the

"prehensile" apex of the maxilla and the retractile antennae. The fossil *Kabatarina* has an opposable structure on the tip of the maxilla and the antenna of the male may be retractile. It retains many plesiomorphic characters (Cressey & Boxshall, 1989). The dichelesthids are all parasites of fishes: *Anthosoma* typically parasitizes sharks, *Dichelesthium* parasitizes acipenserid fishes (sturgeons) in the North Atlantic region, and the Lower Cretaceous fossil *Kabatarina* parasitized a teleost, *Cladocyclus*, from Brazil.

### Key to genera

1. Antennule at least 21-segmented in female; leg 4 present (fossil).....*Kabatarina*  
Antennule 6-segmented; leg 4 absent.....2
2. Legs 1 and 2 biramous with 1-segmented rami; second pedigerous somite without dorsal elytra.....*Dichelesthium*  
Legs 1 and 2 foliaceous, without separate rami; second pedigerous somite with dorsal elytra.....*Anthosoma*

### Brazilian species and records

#### Genus *Anthosoma*

*Anthosoma crassum* (Abildgaard, 1794)

Description (Fig. 3.47): Female body length 8 to 15mm. Dorsal cephalothoracic shield with dark pigmented central part. Dorsolateral plates of second pedigerous somite, together with aliform sympods of legs, forming skirt-like cover around posterior part of body. Sympods of legs modified into large subcircular plates, with rami absent or reduced to small unarmed lobes. Genital complex and caudal rami subcylindrical. Male similar to female in body form but smaller, 7 to 10mm.

Host: Lives with anterior end embedded in skin of hosts, recorded from *Isurus oxyrinchus* in Brazilian waters (Montú, 1996).

Family **Dissonidae** Yamaguti, 1963  
(Fig 3.48)

Podoplea, Siphonostomatoida. Body dorsoventrally flattened, comprising caligiform anterior cephalothorax, incorporating first pedigerous somite only, 3 free pedigerous somites, genital complex consisting of fused fifth pedigerous and genital somites (and possibly first abdominal somite in the female), and free abdomen of 1 or 2 somites. Genital apertures ventral, near posterior margin of genital complex. Caudal rami with 6 setae.

Rostrum absent; paired frontal plates present between antennules; lunules absent. Nauplius eye present. Antennule 2-segmented in both sexes; first segment with 27 setae, second with 13 setae. Segmental homologies



indeterminate. Male antennule non-geniculate; as in female. Antenna uniramous, comprising coxa, basis and laterally directed subchela formed by fusion of endopod and distal claw; exopod absent. Postantennal process absent. Oral cone with opening formed by both labrum and labium. Mandible reduced to a stylet bearing teeth on one side near apex; palp absent. Maxillule bilobed: anterior lobe (palp) papillate, bearing 3 setae; posterior lobe (endite) a spinous process. Maxilla comprising syncoxa (lacertus) and basis (brachium) bearing calamus and canna distally. Maxilliped 3-segmented, comprising massive protopod (corpus) and distal subchela made up of a free endopodal segment and a claw incorporating at least one other endopodal segment and the claw. Sternal furca commonly absent, present in 3 species.

Swimming legs 1 to 4 biramous; rami of first leg 2-segmented; rami 3-segmented in legs 2 to 4. Intercoxal sclerite present in legs 1 to 4. Inner seta on basis of leg 1 present. Inner coxal seta present in legs 2 to 4. Spine and seta formula typically as follows:

	coxa	basis	exopodal segments	endopodal segments
leg 1	0-0	1-1	I-1; III,I,3/4	0-0; 3
leg 2	0-1	1-0	I-1; I-1; I/II,I,5	0-1; 0-2; 1,2,3
leg 3	0-1	1-0	I-1; I-1; II,I,5	0-1; 0-2; 1,2,3
leg 4	0-1	1-0	I-1; I-1; II,I,5	0-1; 0-2; I,3

Fifth leg reduced to a lobe representing exopod; bearing 4 setae; outer seta of incorporated protopodal segment absent. Leg 6 represented by unarmed genital operculum in female; by 1 seta on genital operculum in male. Egg sacs uniseriate.

**Type and only included genus:** *Dissonus* C.B. Wilson, 1906.

#### **Taxonomic notes**

This is the most plesiomorphic of the caligiform families. It is distinguished by possession of a flattened caligiform cephalothorax that incorporates only the first pedigerous somite, the second and third pedigerous somites being free. This family also exhibits a biramous condition in the fourth leg, as in the Trebiidae but unlike the Caligidae in which this leg is uniramous due to loss of the endopod. The known species of *Dissonus* parasitize a range of fishes including elasmobranchs and teleosts of the families Balistidae and Serranidae (Kabata, 1966; Deets & Dojiri, 1990). All species have been reported only from the Indo-Pacific region, off India, Sri Lanka, Madagascar and Australia.

#### **Brazilian species and records**

None.

Family **Eudactylinidae** C.B. Wilson, 1922  
(Fig. 3.49)

Podoplea, Siphonostomatoida. Body robust, slightly transformed, without distinct tagma boundary separating prosome and urosome: comprising cephalothorax, incorporating first pedigerous somite, 4 free pedigerous somites, genital somite and up to four free abdominal somites. Somites typically well defined, first to third free pedigerous somites usually with conspicuous tergites. Somite bearing leg 5 fused to genital somite in some genera, forming a genital complex. Genital apertures lateral or dorsolateral in female, ventral in male. Caudal rami with 6 setae.

Nauplius eye present. Antennule 8 to 18-segmented in female, typically with aesthetasc on penultimate segment. Male antennule bilaterally geniculate; geniculation between segments 13 and 14 of 15-segmented antennule; geniculation secondarily lost in some genera. Segmental homologies (based on male of *Eudactylinella alba* Wilson): segments 1 (I) to 3 (III) free, segment 4 (IV-VI) triple, segments 5 (VII) and 6 (VIII) free, segment 7 (IX-XIII) compound, segments 8 (XIV) and 9 (XV) free, segment 10 (XVI-XVII) double, segment 11 (XVIII) free, segment 12 (XIX-XX) double, segment 14 (XXI-XXIII) triple, apical segment (XXIV-XXVIII) compound. Antenna comprising coxa, basis and 1 free endopodal segment; basis bearing 1 or 2 setae; second endopodal segment fused to terminal claw and bearing 2 proximal setae; exopod represented by isolated seta in *Eudactylinella*, usually absent. Oral cone well developed. Mandible reduced to stylet bearing teeth on one margin near apex. Maxillule bilobed: inner lobe (endite) large, bearing 2 apical setae; outer lobe (palp) small, with 2 or 3 setae. Maxilla comprising syncoxa (lacertus) and basis (brachium) with a short apical claw (calamus) and fringe of long pinnules. Maxilliped 3-segmented, comprising syncoxa, muscular basis (corpus), and a terminal subchela derived from more or less fused endopodal segments plus terminal claw. Syncoxa unarmed; basis with proximal myxal area bearing a spine, sometimes modified into large spiniform or elaborate process.

Swimming legs 1 to 4 biramous, with 2 or 3-segmented rami. Intercoxal sclerites present in legs 1 to 4. Leg 2 typically with modified, elongate exopod in female *Eudactylina*. Spine and seta formula typically as follows (based on male *Eudactylina oliveri* Laubier):

	coxa	basis	exopodal segments	endopodal segments
leg 1	0-0	1-I	I-0; IV	0-0; 0-0; 2
leg 2	0-0	1-0	I-1; I-1; I,1,4	0-1; 0-1; 5
leg 3	0-0	1-0	I-1; I-1; II,1,4	0-1; 0-1; I,3
leg 4	0-0	1-0	I-1; I-1; II,1,4	0-1; 0-1; I,2

Inner seta on basis of leg 1 present or, sometimes, secondarily absent. Inner coxal seta present in legs 2 to 4 of *Protodactylina*, absent in other genera.

Endopodal segment 2 with 2, 2, 2, 2 inner setae in male *Bariaka* and female *Protodactylina*, typically reduced or absent in other genera. Exopodal segment 3 setation often reduced. Endopod of leg 4 armature varying from 0-1; 0-2; 1, 2 in male *Eudactylinella*, to 0-1; 5 in *Nemesis* and 0-0; 0-0; 1 in female *Bariaka*. Fifth leg reduced to a single free exopod segment bearing 3 setae. Seta of incorporated proximal segment located on surface of somite; endopod absent. Fifth legs located laterally on somite; free segment lacking in *Carnifossorius*. Leg 6 represented by unarmed genital opercula in female; armed with up to 3 setae in male. Egg sacs typically uniseriate; multiseriate in *Jusheyus*.

**Type-genus:** *Eudactylina* van Beneden, 1853.

**Included genera:**

*Bariaka* Cressey, 1966, *Carnifossorius* Deets & Ho, 1988, *Eudactylina* van Beneden, 1853, *Eudactylinella* C.B. Wilson, 1932, *Eudactylinodes* C.B. Wilson, 1932, *Eudactylinopsis* Pillai, 1968, *Heterocladius* Deets & Ho, 1988, *Jusheyus* Deets & Benz, 1987, *Nemesis* Risso, 1826, *Protodactylina* Laubier, 1967.

**Taxonomic notes**

*Jusheyus* possesses dorsal styliform projections located on a distinct dorsal plate just behind the dorsal cephalothoracic shield. Deets & Benz (1987) tentatively interpret the presence of this plate as indicating that the first pedigerous somite is separate from the cephalosome. The position of the first legs relative to the rear margin of the dorsal cephalothoracic shield is the same as in other eudactylinid genera, excluding *Carnifossorius*, all of which possess a cephalothorax incorporating the first pedigerous somite. It seems, therefore, more likely that the dorsal plate represents a secondarily separated section of the dorsal cephalothoracic shield and is not homologous with the tergite of the first pedigerous somite. The separation is perhaps functionally part of an indirect mechanism for moving the styliform projections. The antenna is located on a pedestal in *Eudactylina* and this is often misinterpreted as an extra basal segment.

Deets & Ho (1988) present an excellent analysis of phylogenetic relationships between the genera of Eudactylinidae and Deets (1994) comprehensively revised the genus *Eudactylina*. There are at least 53 valid species of eudactylinids, most of which are parasites of elasmobranch fishes, living on the gills and nasal lamellae of their hosts. Two genera, *Heterocladius* and *Jusheyus*, have independently colonized teleost hosts, belonging to the Salmoniformes and Perciformes respectively (Deets & Ho, 1988).

**Key to genera**

1. Inner seta present on coxa of legs 2 to 4.....*Protodactylina*  
     Inner coxal setae absent.....2



2. Female antennule with at least 13 segments.....3  
 Female antennule with at most 11 segments.....5
3. Dorsal styliform projections present on plate behind shield.....*Jusheyus*  
 Dorsal projections absent.....4
4. Female antennule 18-segmented; tergites on free pedigerous  
 somites not distinct.....*Bariaka*  
 Female antennule 13 to 14-segmented; tergites of free pedigerous  
 somites well defined and ornamented.....*Nemesis*
5. Female abdomen with 3 free somites.....*Eudactylinodes*  
 Female abdomen with 1 or 2 free somites, or with somites fused.....6
6. Abdominal somites fused forming elongate cylinder; leg 5 without free  
 segment.....*Carnifossorius*  
 Abdominal somites short; fifth leg with free segment.....7
7. Second segment of female antennule armed with 1 or 2 large claws....  
 .....*Eudactylina*  
 Second segment of female antennule armed with typical setae.....8
8. Exopod of fourth leg 2-segmented.....*Heterocladius*  
 Exopod of fourth leg 3-segmented.....9
9. Female antennule 11-segmented; myxal process on maxilliped small.  
 .....*Eudactylinella*  
 Female antennule 8-segmented; myxal process on maxilliped large,  
 forming part of chelate mechanism.....*Eudactylinopsis*

### Brazilian species and records

None.

Family **Euryphoridae** C.B. Wilson, 1905  
 (Figs. 3.50 - 3.53)

Podoplea, Siphonostomatoida. Body dorsoventrally flattened comprising caligiform anterior cephalothorax, incorporating first to third pedigerous somites, a free pedigerous somite, the fourth, bearing a pair of wing-like dorsal plates, a genital complex consisting of fused fifth pedigerous and genital somites (and possibly first abdominal somite in female), and a free abdomen of 1 or 2 somites. Genital complex often with posterolateral processes. First

abdominal somite sometimes with posterolateral processes. Genital apertures ventral, near posterior margin of genital complex in both sexes. Caudal rami with 6 setae.

Rostrum absent; paired frontal plates present between antennules; lunules present or absent. Nauplius eye present. Antennule 2-segmented in both sexes; first segment with up to 29 setae, second with 14 setae. Segmental homologies indeterminate. Male antennule non-geniculate, as in female. Antenna uniramous; comprising coxa, basis and laterally directed subchela formed by partial or complete fusion of endopod and distal claw; exopod absent. Oral cone with opening formed by both labrum and labium. Mandible reduced to a stylet bearing teeth on one side near apex; palp absent. Maxillule bilobed, with basal portion incorporated into body wall; anterior lobe (palp) papillate, bearing 3 setae; posterior lobe (endite) an unarmed, spinous process. Maxilla brachiform, comprising syncoxa (lacertus) and basis (brachium) bearing calamus and canna distally. Maxilliped 2-segmented, comprising massive protopod (corpus) and distal subchela representing fused endopodal segments plus terminal claw. Sternal furca present or absent.

Swimming leg 1 with coxa and basis slightly offset; exopod 2-segmented, endopod small and 2-segmented or reduced to papilla. Inner seta on basis of leg 1 present. Inner coxal seta present on legs 2 and 3. Leg 2 biramous, with protopod comprising coxa and basis; both rami 3-segmented. Leg 3 with coxa and basis fused with flattened sympod; leg pair connected by expanded intercoxal sclerite and forming broad plate sealing rear margin of cephalothorax. Both rami 3-segmented. Fourth leg biramous with 2 or 3-segmented rami. Intercoxal sclerites present on legs 1 to 3; accessory furca sometimes present on intercoxal sclerite of first leg. Spine and seta formula typically as follows (based on *Euryphorus brachypterus* (Gerstaecker)):

	coxa	basis	exopodal segments	endopodal segments
leg 1	0-0	1-1	I-1; I-1; III,1,3	0-0; 3
leg 2	0-1	1-0	I-1; I-1; III,5	0-1; 0-2; 6
leg 3	0-1	1-0	I-1; I-1; III,5	0-1; 0-2; 5
leg 4	0-0	1-0	I-0; I-1; III,4	0-1; 0-1+3

Fifth leg represented by papilla on margin of genital complex; armed with 3 setae and one on body surface representing outer seta of incorporated protopodal segment. Leg 6 represented by genital operculum in female; by papilla bearing up to 3 setae in male. Egg sacs uniseriate.

**Type-genus:** *Euryphorus* Milne Edwards, 1840.

**Included genera:**

*Alebion* Krøyer, 1863, *Euryphorus* Milne Edwards, 1840, *Gloiopotes* Steenstrup & Lütken, 1861, *Tuxophorus* C.B. Wilson, 1908.

### Taxonomic notes

Kabata (1979a) recognized five valid genera in the Euryphoridae, containing a total of 21 species. Kabata's tentative proposal to treat *Caligeria* Dana, 1852 as a synonym of *Euryphorus* is adopted here. The transfer of *Paralebion elongata* to the Caligidae by Prabha (1983) reduces this to four genera and 20 species. *Calina* van Beneden, 1892 is here tentatively treated as a synonym of *Gloiopotes*. The biramous condition of the first 3 pairs of legs and the uniramous leg 4 conform to the diagnosis of *Gloiopotes* and it appears that the dorsal plates of the free pedigerous somite have been mistakenly interpreted and figured as an apron-like structure as found in the third legs of caligids. Pillai (1985) erected *Tuxophoropsis* to accommodate two species of *Tuxophorus*, basing the new genus on the following characters: the simple rather than forked tines of the sternal furca and the rod-like caudal rami. Neither of these characters appears significant as a generic level discriminant and *Tuxophoropsis* is here treated as a synonym of *Tuxophorus*. Cressey (1972b) revised the genus *Alebion* and provided a key to valid species. Cressey (1967b) also revised *Gloiopotes*, recognizing a number of synonyms and reducing the number of valid species to five.

Euryphorids are external parasites of teleost and elasmobranch fishes. Their biology is similar to that of caligids. The two species of *Euryphorus* utilize large scombrid fishes, the tunas, as hosts and have a ubiquitous distribution concomitant with that of their hosts (Kabata, 1979a).

### Key to genera

1. Lunules present; genital complex without posterolateral processes....*Tuxophorus*  
Lunules absent; genital complex with paired posterolateral processes.....2
2. Leg 4 biramous.....*Euryphorus*  
Leg 4 uniramous or rudimentary.....3
3. Leg 4 rudimentary; sternal furca absent.....*Alebion*  
Leg 4 uniramous, 4-segmented; sternal furca present.....*Gloiopotes*

### Brazilian species and records

#### Genus *Alebion*

*Alebion carchariae* Krøyer, 1863

Description (Fig. 3.50): Body length of female about 7.6 to 8.7mm, of male about 6.0mm. Cephalothorax as in Caligidae. Frontal plates lacking lunules. Fourth pedigerous somite with bilobed dorsal plate. Genital complex with paired posterior processes extending beyond caudal rami and with lateral swellings. Abdomen 2-segmented, first somite with long posterolateral processes



extending to base of anal somite. Male with modified spine on second exopodal segment of leg 2 extending only to middle of modified spine on third segment.

Host: On unidentified species of shark (Carvalho, 1940; 1951 as *Alebion fuscus* Wilson, 1921).

Genus *Euryphorus*

*Euryphorus brachypterus* (Gerstaecker, 1853)

Description (Fig. 3.51): Body length of female from 7 to 10mm. Cephalothorax as in Caligidae. Frontal plates well developed, lacking lunules. Fourth pedigerous somite with bilobed dorsal plate, lobes overlapping anterior part of genital complex. Genital complex with paired rounded plates posterolaterally. Abdomen 2-segmented, without processes. Male about 5 to 7mm long, small genital complex devoid of rounded plates.

Hosts: On wall of oral-branchial cavities of *Thunnus alalunga*, *T. albacares* and *T. obesus* (Cressey & Cressey, 1980).

Genus *Gloiopotes*

*Gloiopotes hygomianus* Steenstrup & Lütken, 1861

Description (Fig. 3.52): Body length of female varying from 13.6 to 15.2mm, of male from 9.4 to 10.4mm. Cephalothorax as in Caligidae. Frontal plates well developed, lacking lunules. Fourth pedigerous somite with bilobed dorsal plate, lobes overlapping genital complex as far as origin of abdomen. Genital complex with complex paired processes posterolaterally, extending to tip of anal somite. Abdomen slender, 2-segmented, without processes. Male with shorter bilobed dorsal plate of fourth pedigerous somite. Processes on genital complex not reaching to end of anal somite.

Host: On *Acanthocybium solandri* (Cressey & Cressey, 1980).

Genus *Tuxophorus*

*Tuxophorus caligodes* Wilson, 1908

Description (Fig. 3.53): Body length of female about 3.0mm. Cephalothorax as in Caligidae. Frontal plates with well developed lunules. Fourth pedigerous somite with bilobed dorsal plate, lobes just overlapping anterior part of genital complex. Genital complex with slight rounded lobes at posterolateral corners. Abdomen 1-segmented, without processes. Sternal furca with bifid tines. Leg 4 with 3-segmented exopod, formula I, I, III.

Host: On gills of *Mugil platanus* (Knoff et al., 1994).

Family **Hatschekiidae** Kabata, 1979

(Fig. 3.54)

Podoplea, Siphonostomatoida. Body transformed, typically cylindrical; comprising cephalothorax, incorporating first pedigerous somite, 1, 2 or 3 free pedigerous somites, large trunk consisting of the genital complex and sometimes the third and/or the fourth pedigerous somite, and small unsegmented abdomen. Trunk often elongate in female, dorsoventrally

flattened in *Laminohatschekia*. Genital apertures ventrolateral in female, ventral in male. Caudal rami with 6 setae, or with reduced setation.

Rostrum absent. Nauplius eye present. Antennule with up to 7 segments in both sexes, often indistinct; segmental homologies indeterminate. Male antennule non-geniculate. Antenna comprising partly or completely fused coxa and basis, plus distal subchela formed from endopod plus terminal claw; exopod absent. Oral cone small, with distal opening formed by labrum and labium. Mandible reduced to a stylet with or without marginal teeth on one side near apex; palp absent. Maxillule bilobed: inner lobe (endite) with 1 seta; outer lobe (palp) with 2 setae. Maxilla comprising syncoxa and basis; basis terminating in bifid claw, with up to 2 accessory setae. Maxilliped absent in both sexes.

Swimming legs 1 to 4 highly variable according to genus; legs 1 to 3 biramous with 2-segmented rami in leg 1 and 2 or 3-segmented rami in legs 2 and 3. Leg 3 sometimes reduced to a small setose lobe. Leg 4 represented by a bilobed process, small conical process, a single seta, or absent. Intercoxal sclerite present on legs 1 to 3, or absent. Inner seta on basis of leg 1 typically present, sometimes absent. Inner coxal setae absent. Fifth leg represented by 2 setae on surface of somite, or absent. Egg sacs typically uniseriate; multiseriate in *Laminohatschekia* and *Pseudocongericola*.

**Type-genus:** *Hatschekia* Poche, 1902.

#### Included genera:

*Bassettithia* C.B. Wilson, 1922, *Brachihatschekia* Castro Romero & Baeza Kuroki, 1989, *Congericola* van Beneden, 1854, *Hatschekia* Poche, 1902, *Laminohatschekia* Boxshall, 1989, *Prohatschekia* Nunes-Ruivo, 1954, *Pseudocongericola* Yü, 1933, *Wynnoweria* Boxshall, 1987.

#### Taxonomic notes

The generic name *Pseudoclavella* Bassett-Smith (1898) predates *Hatschekia* Poche, 1902. Jones (1985a) submitted a case for the suppression of *Pseudoclavella* to the International Commission on Zoological Nomenclature.

Jones (1985b) revised the genus *Hatschekia*, recognized about 70 valid species and provided a key to species. Since that revision about 15 new *Hatschekia* species have been described, 10 of these by Kabata (1991) from fish in Australian waters. Hatschekiids are gill parasites of teleost fishes. Six of the genera parasitize eels: *Congericola*, *Bassettithia* and *Wynnoweria* on conger eels; *Pseudocongericola* on a pike conger; *Laminohatschekia* on a deep-sea synphobranchid eel, and *Brachihatschekia* on a cusk eel. Species of the more derived genera, *Hatschekia* and *Prohatschekia* are found on a wide range of teleost hosts including moray eels.

## Key to genera

1. Legs 1 to 3 biramous.....2  
    Legs 1 and 2 biramous, leg 3 reduced.....6  
    Legs 1 to 3 reduced to lobe-like processes.....*Bassettithia*
2. Legs 2 and 3 with 3-segmented endopods; leg 4 a bilobed process.....  
    .....*Congericola*  
    Legs 2 and 3 with 2-segmented endopods; leg 4 a simple conical  
    process, represented by a single seta, or absent.....3
3. Trunk extremely long and dorsoventrally flattened; egg sacs  
    multiseriate.....*Laminohatschekia*  
    Trunk more or less cylindrical; egg sacs uniseriate.....4
4. Leg 4 a conical process bearing 2 setae.....*Wynnoweria*  
    Leg 4 represented by a single seta or absent.....5
5. Second free pedigerous somite expanded into lateral lobes bearing  
    leg 3 ventrally.....*Brachihatschekia*  
    Second free pedigerous somite not expanded laterally.....*Prohatschekia*
6. Leg 3 a simple lobe bearing 2 setae; egg sacs multiseriate.....  
    .....*Pseudocongericola*  
    Legs 3 and 4 vestigial, represented by 1 or more setae; egg sacs  
    uniseriate.....*Hatschekia*

## Brazilian species and records

None.

Family **Hyponeoidae** Heegaard, 1962

(Fig. 3.55)

Podoplea, Siphonostomatoida. Female body highly transformed, divisible into cephalothorax incorporating first pedigerous somite, neck consisting of second pedigerous somite, trunk comprising remaining pedigerous somites and genital complex, and an unsegmented tail-like abdomen. Cephalothorax rectangular with weakly developed lateral expansions and ventral processes. Neck with a pair of lateral processes. Trunk with 1 to 4 pairs of lateral processes. Abdomen with a pair of anterolateral processes. Genital apertures dorsal in female. Caudal rami absent.

Rostrum tapering, posteroventrally directed. Antennule 6-segmented in female, with up to 14 elements on apical segment; segmental homologies



indeterminate. Antenna 3-segmented, comprising separate coxa and basis bearing heavily recurved terminal claw derived from endopod and apical claw; exopod absent. Oral cone short and stout; opening formed by both labrum and labium. Mandible reduced to a stylet bearing teeth on one side near apex. Maxillule bilobed: inner lobe (endite) with 3 apical elements; outer lobe (palp) with 2 apical elements; lobes carried on swollen base. Maxilla comprising syncoxa and basis bearing claw-like calamus and spiniform canna. Maxilliped 2 or 3-segmented, comprising separate syncoxa and basis (in *Tautochondria*) and distal subchela derived from fused endopod plus terminal claw. Syncoxa and basis fused in *Hyponeo*.

Swimming legs 1 and 2 biramous, with inflated protopod and reduced, unsegmented rami; leg 1 exopod with 3 elements, endopod with 2; leg 2 exopod with 2 elements, endopod with 1. Inner seta on basis of leg 1 present. Inner coxal seta on legs 1 and 2 absent. Legs 3 and 4 absent. Fifth leg represented by single seta at posterolateral angle of trunk, or absent. Leg 6 represented by single seta on lobe adjacent to genital aperture. Egg sacs paired, uniseriate.

**Type-genus:** *Hyponeo* Heegaard, 1962.

**Included genera:**

*Hyponeo* Heegaard, 1962, *Tautochondria* Ho, 1987.

**Taxonomic notes**

The gross body morphology of hyponeoids resembles that of the poecilostomatoid family Chondracanthidae but their mouthparts are distinctively siphonostomatoidan. According to Ho (1987) the affinities of the Hyponeoidae lie with the eudactylinid/lernanthropid/pseudocycnid grouping of families. The two monotypic genera that comprise this family are both gill parasites of bathypelagic fishes (Ho, 1987). *Tautochondria dolichoura* Ho is found on the gills of the ogrefish, *Anoplogaster cornuta*, in the western North Atlantic. *Hyponeo australis* Heegaard was found on the gills of *Paralepis rissoi* taken off the Kuril Islands and on unidentified host fish taken in the Sea of Okhotsk and during the Australian Antarctic Expedition in 1911-1914.

**Key to genera**

1. Posterolateral processes present on trunk of adult female....*Hyponeo*  
Such processes absent.....*Tautochondria*

**Brazilian species and records**

None.

Family **Kroyeriidae** Kabata, 1979  
(Fig. 3.56)

Podoplea, Siphonostomatoida. Body comprising anterior caligiform cephalothorax, incorporating first pedigerous somite, 3 free pedigerous somites, each with a well developed tergite, genital complex formed by partial or complete fusion of elongate fifth pedigerous and genital somites, and 3 free abdominal somites. Cephalothorax somewhat dorsoventrally flattened, covered by dorsal shield marked with oblique sutures. Dorsal stylets present on posterior margin of shield in *Kroyeria*. Caudal rami with 6 setae.

Rostrum well developed, sometimes with anteriorly directed processes. Nauplius eye present. Antennule 7 to 9-segmented in female, aesthetasc located subapically on terminal segment; segmental homologies indeterminate. Male antennule non-geniculate; as in female. Antenna strongly developed, chelate, with separate coxa and basis; 2-segmented endopod forming chelate mechanism, with large spinous process on first endopodal segment opposing movable claw incorporating second segment; claw with 1 to 3 proximal setae; exopod absent. Oral cone well developed, with distal opening formed by both labrum and labium. Mandible reduced to a slender stylet with a dentiferous margin; palp absent. Maxillule bilobed: large inner lobe (endite) with 2 apical setae; small outer lobe (palp) with 2 or 3 setae. Maxilla comprising syncoxa (lacertus) and distal basis (brachium) bearing apical claw (calamus), a patch of long pinnules and a raised rugose pad. Maxilliped 3-segmented, comprising syncoxa, basis (corpus) and distal subchela formed by fusion of endopodal segments and claw; subchela with 2 setae (in *Prokroyeria*) or unarmed.

Swimming legs 1 to 4 biramous with 3-segmented rami. Intercoxal sclerites present in legs 1 to 4, typically bearing posteriorly directed interpodal stylets in *Kroyeria*. Inner seta on basis of leg 1 present. Inner coxal seta present on legs 2 to 4 in *Prokroyeria*, absent in other genera. Spine and seta formula typically as follows (based on male *Kroyeria*):

	coxa	basis	exopodal segments	endopodal segments
leg 1	0-0/1	1-1	I-1; 0/I-1; I/II,1,4	0-1; 0-0/2; I,5
leg 2	0-0/1	1-0	I-1; I-1; II,1,4/5	0-1; 0-0/2; I,5
leg 3	0-0/1	1-0	I-1; I-1; II,1,4/5	0-1; 0-0/1; 1,1,3
leg 4	0-0	1-0	I-1; I-1; I/II,4/5	0-1; 0-0/1; 1,1,2

Endopodal segment 2 with 2, 1, 1, 1 inner setae in *Prokroyeria*; 1, 1, 1, 1 or further reduced in other genera. Endopod of leg 4 armature sometimes 0-1; 0-1; I, 2 or 0-1; 0-0; 1,1,2. Fifth leg reduced to a lobe bearing 4 setae. Leg 6 represented by 2 setae on small protuberance at genital aperture. Egg sacs uniseriate.

**Type-genus:** *Kroyeria* van Beneden, 1853.

**Included genera:**

*Kroyeria* van Beneden, 1853, *Kroeyerina* C.B. Wilson, 1932, *Prokroyeria* Deets, 1987.

**Taxonomic notes**

The known species of kroyeriids are all parasites of chondrichthyan fishes (Deets, 1987). The monotypic *Prokroyeria* is found on the gill lamellae of a holocephalan. Most of the 28 species of *Kroyeria* are found on the secondary gill lamellae of elasmobranchs (primarily sharks of the families Triakidae, Carcharhinidae and Sphyrnidae). One species, *K. caseyi* Benz & Deets is mesoparasitic, living with its anterior end deeply embedded in the host's interbranchial septum. This is by far the largest kroyeriid, with some females reaching a body length of over 60 mm (Benz & Deets, 1986). The 7 species of *Kroeyerina* occur on the nasal lamellae of a wide range of elasmobranch hosts.

**Key to genera**

1. Inner setae present on coxa of legs 2 to 4; spinous projections present on syncoxa of maxilliped.....*Prokroyeria*  
Inner coxal setae absent; syncoxa of maxilliped unarmed.....2
2. Dorsal stylets present on cephalothoracic shield.....*Kroyeria*  
Dorsal stylets absent.....*Kroeyerina*

**Brazilian species and records**

None.

Family **Lernaeopodidae** Olsson, 1869  
(Figs. 3.57 - 3.65)

Podoplea, Siphonostomatoida. Body highly transformed. Female body comprising cephalothorax, usually covered by dorsal shield, incorporating first pedigerous somite, and an unsegmented trunk; attached to host by well developed maxillae. Trunk retaining internal indication of original segmentation; divisible into 3 thoracic somites (pedigerous somites 2 to 4) and a genito-abdominal complex derived from fifth pedigerous somite, genital double somite and abdomen. Genital apertures typically at posterolateral angles of trunk. Anal slit present in centre of posterior surface. Genital process bearing paired copulatory pores (ducts leading to seminal receptacles) present just ventral to anal slit. Trunk with simple or fimbriate posterior processes in some genera. Distinct, unsegmented free abdomen present in *Clavellistes*. Caudal rami modified as large processes; often reduced or absent. Male body small,



divided into large cephalothorax and posterior trunk. Genital apertures ventral. Caudal rami usually small and retaining some setation.

Nauplius eye present. Antennule indistinctly segmented, with a maximum of 4 segments discernible; segmental homologies indeterminate. Male antennule non-geniculate; as in female. Antenna biramous, comprising separate coxa and basis, 1-segmented exopod and 2-segmented endopod (as in *Lernaeopoda*); segmentation often indistinct. Exopod bearing 3 setae in copepodid, armature modified in adult. Endopod armed with terminal claw and 2 setae (as in *Tracheliastes*); armature often reduced or modified. Oral cone short, with distal opening formed by labrum and labium. Mandible reduced to a stylet bearing teeth on one side near apex; palp absent. Teeth on mandibular stylet of uniform size (as in *Salmincola*) or, more commonly, differentiated into primary, secondary and basal teeth. Maxillule bilobed: large inner lobe (endite) bearing 2 or 3 setae, each with a swollen papillate base; outer lobe (palp) small, bearing 1 to 3 setae; often reduced, sometimes absent. Female maxillae modified as pair of unsegmented cylindrical appendages (maxillary arms) meeting apically where their tips are permanently attached to the bulla which is implanted in host. Maxilla unarmed; papilla-like opening of maxillary gland present proximally. Maxillary arms sometimes with processes at mid-length (as in *Thysanote*) or at apex (as in *Schistobranchia*). Bulla lost in *Naobranchia* and maxillae fused apically to form loop. Maxillae variable in length, medially fused in some species. Male maxillae subchelate, comprising syncoxa (corpus) and distal claw representing basis; maxillae sometimes linked by cuticular tympanum. Maxilliped displaced, located between or anterior to maxillae; comprising robust corpus (protopod) and distal subchela. Corpus with partial suture making line of fusion between syncoxa and basis in *Salmincola*. Corpus typically with myxal process. Subchela representing fused endopod segments plus distal claw.

Swimming legs 1 to 4 absent in female. Fifth leg absent in both sexes. Leg 6 represented by unarmed opercula closing genital apertures in both sexes. Egg sacs multiseriate.

**Type-genus:** *Lernaeopoda* de Blainville, 1822.

**Included genera:**

*Acespadia* Leigh-Sharpe, 1933, *Achtheres* von Nordmann, 1832, *Advena* Kabata, 1979, *Albionella* Kabata, 1979, *Allella* Leigh-Sharpe, 1925, *Anaclavella* Heegaard, 1940, *Basanistes* von Nordmann, 1832, *Brianella* C.B. Wilson, 1915, *Brachiella* Cuvier, 1830, *Cauloxenus* Cope, 1872, *Charopinopsis* Yamaguti, 1963, *Charopinus* Krøyer, 1864, *Clavella* Oken, 1815, *Clavellisa* C.B. Wilson, 1915, *Clavellistes* Shiino, 1963, *Clavellodes* C.B. Wilson, 1915, *Clavellomimus* Kabata, 1969, *Clavellopsis* Wilson, 1915, *Clavellotis* Castro Romero & Baeza Kuroki, 1984, *Coregonicola* Markevich, 1936, *Cryptova* Kabata, 1992, *Dendrapta* Kabata, 1964, *Eobrachiella* Ho & Do, 1984, *Eubrachiella* C.B. Wilson, 1915, *Euclavellisa* Heegaard, 1940, *Lernaeopoda* de Blainville, 1822, *Lernaeopodina* Wilson, 1915, *Mixtio* Kabata, 1986,

*Naobranchia* Hesse, 1863, *Nectobranchia* Fraser, 1920, *Eobrachiella* Neobrachiella Kabata, 1979, *Nudiclavella* Ho, 1975, *Ommatokoita* Leigh-Sharpe, 1926, *Proclavellodes* Kabata, 1967, *Pseudocharopinoides* Castro Romero & Baeza Kuroki, 1987, *Pseudocharopinus* Kabata, 1964, *Pseudolernaeopoda* Castro Romero & Baeza Kuroki, 1986a, *Pseudolernaeopodina* Hogans, 1988, *Pseudomixtio* Kabata, 1990, *Pseudotracheliastes* Markevich, 1956, *Salmincola* C.B. Wilson, 1915, *Schistobranchia* Kabata, 1964, *Sparidicola* Kabata & Tareen, 1987, *Thysanote* Krøyer, 1864, *Tracheliastes* von Nordmann, 1832, *Vanbenedenia* Malm, 1861.

### Taxonomic notes

In his 1979 monograph Kabata recognized 36 genera as valid. Since 1979 nine new genera have been established; *Clavellotis*, *Mixtio*, *Cryptova*, *Pseudocharopinoides*, *Pseudolernaeopoda*, *Pseudolernaeopodina*, *Pseudomixtio*, *Sparidicola* and *Eobrachiella*. On the basis of similarities in male morphology Kabata (1981a) placed the Naobranchiidae, as the sister group of the *Clavella*-branch within the Lernaeopodidae. This placement is accepted here and consequently *Naobranchia* is returned to the Lernaeopodidae. This raises to 45 the number of valid genera in the family.

Yamaguti (1963) used *Entomoda* Lamarck, 1818 as the senior synonym of *Salmincola* but, as indicated by Kabata (1969d), Fowler (1912) had already designated *Lernaea cornuta* Müller as the type of *Entomoda*. The designated type species is a chondracanthid, now in *Acanthochondria* Oakley, 1927, so *Salmincola* is retained as a valid genus. The name *Clavella* Oken, 1815 was conserved and placed on the Official List of Generic Names in Zoology (Bulletin Of Zoological Nomenclature 1995: Opinion, 1817). This was necessary since Oken (1815) is a rejected work.

Members of this family exhibit a unique mode of attachment to their host fish. The females are typically anchored by means of a small chitinous structure, the bulla, which is produced in the frontal region of the cephalothorax. The bulla is firmly implanted within the host tissues and fused at the free end to the maxillary arms of the copepod. In some genera, such as *Schistobranchia*, the bulla has been functionally superseded by a simple or branching holdfast produced at the tips of the maxillae. In *Naobranchia* the maxillary arms are ribbon-like and encircle the gill filaments of the host.

### Key to genera

[The poorly described genus *Cauloxenus* keys out with *Salmincola*]

1. Cephalothorax a well developed, often elongate tagma.....2  
Cephalothorax fused to trunk and represented by extremely reduced conical structure located between bases of maxillae.....*Nectobranchia*
2. Cephalothorax located dorsal to bases of maxillae.....3  
Cephalothorax located ventral to bases of maxillae.....*Vanbenedenia*

3. Parasites of freshwater fishes; antennule peg-like, unsegmented and with reduced apical armature; palp of maxillule reduced to small denticle.....4  
Parasites of marine fishes; antennule typically comprising 2 to 4 segments; palp of maxillule typically with 1 or 2 setae.....9
4. Cephalothorax cylindrical, as long as, or nearly as long as, trunk.....*Tracheliastes*  
Cephalothorax flattened, oval or triangular in outline; much shorter than trunk.....5
5. Prominent swellings present on cephalothorax and trunk.....*Basanistes*  
Trunk and cephalothorax without such prominent swellings.....6
6. Trunk elongate, divided into narrow anterior part and a shorter, broader posterior part.....*Coregonicola*  
Trunk not elongate; narrow anterior part, if present, shorter than posterior part.....7
7. Mandible with 1 secondary tooth.....*Achtheres*  
Mandible without secondary teeth.....8
8. Cephalothorax at least half as long as trunk...*Salmincola/Cauloxenus*  
Cephalothorax less than one third as long as trunk.....*Pseudotracheliastes*
9. Narrow cephalothoracic 'neck' present between broad base of cephalothorax and origin of maxillae.....*Acespadia*  
Cephalothorax without narrow neck region.....10
10. Cephalothorax short; antenna prehensile; palp of maxillule lateral, endite with 3 papillae; posterior processes absent; 3 secondary teeth on mandible.....*Ommatokoita*  
These characters not combined.....11
11. Posterior trunk processes connected by cuticular membrane, forming semicircular enclosure around egg sacs.....*Cryptova*  
Posterior trunk process discrete, not connected by membrane, or absent.....12



12.	Male divided into anterior cephalothorax and posterior trunk; these tagma about equal in size; vestigial thoracic legs present or absent.....	13
	Male with trunk extremely reduced, typically represented by sac-like process; thoracic legs absent.....	28
13.	Single pair of posterior processes located dorsal to oviduct openings on trunk of female.....	14
	Posterior trunk processes present ventral to oviduct openings or absent.....	19
14.	Maxillule with third terminal papilla reduced.....	<i>Lernaeopodina</i>
	Maxillule with 3 well developed terminal papillae.....	15
15.	Cephalothorax cylindrical, more than one quarter length of trunk.....	17
	Cephalothorax short, dorsoventrally flattened.....	16
16.	Tips of maxillae with pair of long processes.....	<i>Schistobrachia</i>
	Tips of maxillae forming mass of branching processes.....	<i>Dendrapta</i>
17.	Maxillae fused, tips with expansions.....	<i>Brianella</i>
	Maxillae separate, tips without expansions.....	18
18.	Maxillipeds located close behind mouth cone.....	<i>Pseudocharopinus</i>
	Maxillipeds located about at middle of cephalothorax.....	<i>Charopinus</i>
19.	Branched processes present on trunk and typically on maxillae.....	<i>Thysanote</i>
	Branched processes absent.....	20
20.	Distinct unsegmented abdominal region present posterior to oviduct openings, about one quarter length of trunk.....	<i>Clavellistes</i>
	Abdominal region not distinct.....	21
21.	Posterior processes absent or minute.....	22
	Posterior processes present.....	24
22.	Maxillule with 3 terminal papillae.....	23
	Maxillule with 2 terminal papillae, third reduced to seta or absent.....	<i>Eubrachiella</i>

23. Cephalothorax short, dorsoventrally flattened, with well developed dorsal cephalic shield; posterior processes absent.....*Pseudolernaeopoda*  
Cephalothorax of medium length, lacking dorsal cephalic shield; minute process (caudal rami) present .....*Pseudolernaeopodina*
24. Cephalothorax short, dorsoventrally flattened.....25  
Cephalothorax cylindrical, elongate.....26
25. Male cephalothorax with dorsal swelling; caudal rami inflated.....*Lernaeopoda*  
Male cephalothorax without dorsal swelling; caudal rami not inflated...*Albionella*
26. Maxillule with 3 terminal papillae.....*Brachiella*  
Maxillule with 2 terminal papillae, third reduced to seta or absent.....27
27. Male maxilliped long and slender, with denticulate pad on clearly delimited subchela.....*Eobrachiella*  
Male maxilliped with subchela poorly delimited from basal segment; subchela unarmed.....*Neobrachiella*
28. Female maxillae ribbon-like, forming loop-like attachment device; bulla absent.....*Naobranchia*  
Female maxillae cylindrical, with bulla at tip.....29
29. Female cephalothorax short, anteriorly directed; male caudal ramus cylindrical, indistinctly annulated and armed with 2 spines laterally and a patch of denticles distally.....*Charopinopsis*  
Female cephalothorax elongate, cylindrical, reflexed back across trunk; male caudal rami weakly developed, often absent.....30
30. Cephalothorax arising from centre of dorsal surface of trunk.....31  
Cephalothorax arising from anterior end of trunk.....32
31. Male with a long, annulated vestige of trunk.....*Euclavellisa*  
Male with small genital tubercle representing trunk.....*Clavellisa*

32. Mandible with 3 or 4 secondary teeth or with 2 secondary teeth in formula P2, S1, P1, S1, B5.....33  
Mandible 0 to 2 secondary teeth; formula not as above .....37
33. Maxillae incorporated into trunk.....*Clavellopsis*  
Maxillae distinct from trunk.....34
34. Mandible with 4 secondary teeth.....*Clavellodes*  
Mandible with 3 secondary teeth.....35
35. More or less developed aliform processes or swelling present laterally at base of cephalothorax; maxillae short; main axis of antenna passing through protopod and exopod.....*Clavellotis*  
No lateral processes present at base of cephalothorax; maxillae of moderate length, about one quarter length of cephalothorax; main axis of antenna through protopod and endopod.....36
36. Pair of short posterior processes present on trunk.....*Sparidicola*  
Posterior processes absent.....*Nudiclavella*
37. Antennary exopod reduced or vestigial, endopod aligned with long axis of protopod.....*Clavella*  
Antennary exopod not reduced, aligned with long axis of protopod..38
38. Maxillule with 2 terminal papillate setae and 1 seta on palp.....39  
Maxillule with 2 or 3 terminal elements and 2 setae on palp.....*Mixtio*
39. Long processes present at posterolateral angles of trunk.....*Advena*  
Trunk without posterolateral processes.....40
40. Flattened expansions present at base of maxillae.....41  
Base of maxillae without expansions.....42
41. Mandible without secondary teeth.....*Allella*  
Mandible with 1 or 2 secondary teeth.....*Proclavellodes*
42. Mandible with 2 secondary teeth.....*Pseudomixtio*  
Mandible with 1 secondary tooth or lacking secondary teeth.....43



43. Trunk less than one and a half times longer than wide; mandible lacking secondary teeth.....*Anaclavella*  
Trunk more than three times longer than wide; mandible with 1 secondary tooth.....*Clavellomimus*

### **Brazilian species and records**

#### *Genus Brachiella*

*Brachiella thynni* Cuvier, 1830

Description (Fig. 3.57): Female body length varying from 9 to 23mm (excluding posterior processes). Dorsal cephalothoracic shield well developed; cephalothorax either shorter or longer than trunk. Trunk slightly wider than long. Caudal rami wider distally than proximally, with semispherical swellings basally. Posterolateral processes as long as trunk. Mandibular formula P1, S1, P1, S1, P1, S1, B5.

Host: On fins of *Acanthocybium solandri* (Cressey & Cressey, 1980).

#### *Genus Charopinopsis*

*Charopinopsis quaternia* (Wilson, 1935)

Description (Fig. 3.58): Female body comprising short cylindrical cephalothorax and elongate trunk, somewhat dorsoventrally flattened posteriorly; total body length about 5.4mm. Trunk with pair of short posterolateral processes and pair of large medial processes, half as long as trunk. Maxillary arms about as long as cephalothorax. Mandibular formula P1, S1, P1, S1, P1, S1, B5. Maxillule with 2 large and 1 small apical papillae on inner lobe, outer lobe with 2 apical spines.

Host: Unpublished record.

#### *Genus Clavellopsis*

*Clavellopsis sargi* (Kurz, 1877)

Description (Fig. 3.59): Female body comprising elongate cephalothorax (3.5mm) longer than suboval trunk (2.3mm); trunk about as wide as long. Trunk lacking paired posterior processes but with well developed median genital process. Maxillary arms extremely short; with paired hemispherical swellings on cephalothorax near base. Mandibular formula P2, S1, P1, S1, B5 in male. Maxillule with 2 apical papillate setae on inner lobe, outer lobe with 2 spines. Male about 1.3mm long, globular in form with cephalothorax not delimited from trunk.

Host: *Pagrus pagrus* (Luque, 1996).

#### *Genus Clavellotis*

*Clavellotis dilatata* (Krøyer, 1863)

Description (Fig. 3.60): Female body comprising elongate cephalothorax about 2.4mm long and suboval trunk 1.9mm long. Trunk with 1 pair of subconical posterior lobes and median genital process. Maxillary arms short;

with paired hemispherical swellings on cephalothorax near base. Mandibular formula P1, S1, P1, S1, P1, S1, B3. Maxillule with 2 apical papillate setae and small spine on inner lobe, outer lobe small with 2 spines. Male about 0.6 to 0.7mm long, globular in form with cephalothorax not delimited from trunk.

Host: *Haemulon steindachneri* (Luque & Takemoto, 1996).

Genus *Lernaeopoda*

*Lernaeopoda galei* Krøyer, 1863

Description (Fig. 3.61): Female body length 13 to 16mm. Trunk about 3 times longer than cephalothorax, distinctly longer than wide, flattened and wider posteriorly; genital process absent. Mandibular formula P1, S1, P1, S1, P1, S1, B4. Maxillule with 3 apical papillate setae, outer lobe laterally located with 2 apical setae. Maxillary arms longer than trunk, with slight apical inflation but lacking apical collars.

Host: Unpublished record.

Genus *Naobranchia*

*Naobranchia lizae* (Krøyer, 1863)

Description (Fig. 3.62): Body comprising tapering cylindrical cephalothorax, about as long as subrectangular trunk; abdomen with relatively long caudal rami: female body length about 4.8mm. Eggs contained in sacs supported by 3 tissue strands. Mandible with 10 teeth. Maxillule with 2 apical papillate setae on inner lobe, each bearing distal seta; outer lobe reduced to spinous process. Maxillae forming broad band-like arms encircling gill filament of host. Maxilliped with robust syncoxa, terminal claw with 2 small spinous processes. Male body length about 0.3mm.

Hosts: On gills of *Mugil platanus* (Knoff et al., 1994) and *Chilomycterus spinosus* (Leigh-Sharpe, 1926b) [as *Naobranchia stibara* Leigh-Sharpe, 1926].

Genus *Neobrachiella*

*Neobrachiella exilis* (Shiino, 1956)

Description (Fig. 3.63): Female body comprising elongate cephalothorax about 1.9 to 3.4mm long and suboval trunk 1.5 to 1.8mm long. Trunk with 2 pairs of subconical posterior margin processes and small median genital process. Maxillary arms about half as long as trunk; with paired hemispherical swellings on cephalothorax near base. Mandibular formula P3, S1, P1, S1, B3. Maxillule with 2 apical papillate setae on inner lobe, outer lobe represented by spinous process. Male about 0.6mm long. Cephalothorax not delimited from trunk, trunk with stylet-like caudal rami at posterior extremity.

Host: On pectoral and pelvic fins of *Mugil platanus* (Knoff et al., 1994).

*Neobrachiella gulosa* (Wilson, 1915)

Description (Fig. 3.64): Female body comprising elongate cephalothorax with well defined dorsal cephalic shield, and trunk. Cephalothorax about 4.7mm long and trunk about 3.3mm long. Trunk with 2 pairs of posterior processes, each about as long as trunk. Maxillary arms short, with paired hemispherical

swellings on cephalothorax near base. Mandibular formula apparently P4, B3. Maxillule with 2 apical papillate setae on inner lobe, outer lobe small with 2 apical spines. Male about 1.5mm long. Cephalothorax defined from trunk.

Host: Unpublished record.

Genus *Thysanote*

*Thysanote lobiventris* (Heller, 1865)

Description (Fig. 3.65): Female body cylindrical; cephalothorax about half as long as, and slightly narrower than trunk. Trunk with parallel sides and with paired branching processes extending around posterior margin both ventrally, laterally and dorsally, and surrounding egg sacs. Maxillary arms similarly provided with paired branching processes.

Host: On wall of oral-branchial cavity of *Rhypticus saponaceus* (Heller, 1865).

Family **Lernanthropidae** Kabata, 1979

(Figs. 3.66 - 3.71)

Podoplea, Siphonostomatoida. Body comprising cephalothorax, incorporating first pedigerous somite, trunk, consisting of second to fifth pedigerous somites partly or completely fused to each other and to genital complex, and small 1 or 2-segmented abdomen. Cephalothorax with well developed dorsal shield curved ventrally on each side in female, flat in male. Second and third pedigerous somites sometimes with wing-like lateral expansions. Fourth pedigerous somite of female typically bearing a dorsal or ventral plate, sometimes lost; plate absent in male. Genital apertures ventral in both sexes. Caudal rami with up to 6 setae; often elongate with reduced armature.

Antennule indistinctly segmented or 7 to 8-segmented, sometimes secondarily unsegmented in female, typically with aesthetasc on penultimate segment; segmental homologies indeterminate. Male antennule similar to that of female; retaining traces of geniculation in pattern of fusion of distal segments. Parabasal flagellum present or absent. Antenna subchelate; coxa and basis separate or incompletely fused to form corpus; subchela formed by fused endopodal segments and distal claw; exopod absent. Oral cone well developed, tapering, with distal opening formed by labrum and labium. Mandible reduced to a stylet bearing 7 teeth on one side near apex; palp absent. Maxillule bilobed: inner lobe (endite) small, bearing 1 or 2 setae; outer lobe (palp) large, laterally-directed, with 3 apical setae. Maxilla comprising syncoxa (lacertus) and basis (brachium) drawn out into claw with 2 distal blades, one bearing marginal denticles bilaterally, and a subapical spine. Maxilliped 2-segmented, comprising massive protopod (corpus) and distal subchela representing fused endopodal segments plus terminal claw. Corpus with or without myxal process.



Swimming legs 1 to 4 modified. Leg 1 biramous with 1-segmented endopod and 1 or indistinctly 2-segmented exopod. Leg 2 similar to leg 1, or with both rami reduced and fused to protopod (in *Aethon*), or absent (in *Norion*). Inner seta on basis of leg 1 present. Inner coxal seta absent in legs 1 to 4. Leg 3 modified, flattened, plate-like; typically bilobed with outer lobe sometimes fused to dorsal plate of fourth pedigerous somite. Leg 4 flattened, bilobed, sometimes with lobes drawn out into filiform tips. Fifth leg reduced to a simple lobe, sometimes absent; armed with a single seta, or unarmed. Leg 6 represented by unarmed genital opercula in both sexes. Egg sacs uniseriate, linear or irregularly coiled under plate of fourth pedigerous somite.

**Type-genus:** *Lernanthropus* de Blainville, 1822.

**Included genera:**

*Aethon* Krøyer, 1837, *Lernanthropinus* Do in Ho & Do, 1985, *Lernanthropodes* Bere, 1936, *Lernanthropsis* Do in Ho & Do, 1985, *Lernanthropus* de Blainville, 1822, *Mitrapus* Song in Song & Chen, 1976, *Norion* von Nordmann, 1864, *Sagum* C.B. Wilson, 1913.

**Taxonomic notes**

Kabata (1979b) re-examined the generic discriminants in this family and recognized five valid genera. He did not discuss the 2 genera, *Mitrapus* and *Sanya*, established by Song in Song & Chen (1976). Do in Ho & Do (1985) established 2 further new genera, *Lernanthropinus* and *Lernanthropsis*, and redescribed a species of *Mitrapus*. Ho & Do considered *Mitrapus* to be valid primarily on male characters but rejected *Sanya* as inadequately known, placing the type species in *Lernanthropus*.

All *lernanthropids* are gill parasites of marine teleost fishes. About 140 species are known, mostly from warmer waters, with the number of species decreasing in higher latitudes (Kabata, 1979a). Attachment to the gill filaments of the host is achieved by the antennae and maxillipeds, sometimes with the assistance of the modified third legs.

**Key to genera**

- |    |  |                        |
|----|--|------------------------|
| 1. | Egg sacs linear.....   | 2                      |
|    | Egg sacs coiled.....   | 5                      |
| 2. | Members of leg 3 pair fused to form a ventral plate in female.....                                     |                        |
|    | ..... <i>Lernanthropodes</i>   |                        |
|    | Members of leg 3 pair fused with dorsal plates of fourth pedigerous somite to form lateral plates..... | <i>Lernanthropinus</i> |
|    | Members of leg 3 pair not fused.....   | 3                      |

3. Somite bearing leg 4 with single dorsal plate.....4  
 Somite bearing leg 4 with pair of dorsal knob-like processes.....  
 .....*Lernanthropsis*
4. Endopod of leg 4 distinctly shorter than exopod.....*Mitrapus*  
 Endopod of leg 4 as long as, or longer than, exopod.....*Lernanthropus*
5. Second leg absent.....*Norion*  
 Second leg present.....6
6. Second leg unsegmented, bifid.....*Aethon*  
 Second leg biramous with discrete 1-segmented rami.....*Sagum*

### Brazilian species and records

#### Genus *Lernanthropus*

##### *Lernanthropus atrox* Heller, 1865

Description (Fig. 3.66): Body length of female about 1.6 to 3mm. Cephalothorax subrectangular, wider than long. Third legs posteroventrally directed, visible in dorsal view forming widest part of body. Dorsal plate of fourth pedigerous somite small, with convex posterior margin. Caudal rami concealed beneath plate but rami of leg 4 extending well beyond posterior margin of body. Egg sac straight, often longer than body.

Host: *Pagrus pagrus* (Luque, 1996).

##### *Lernanthropus belones* Krøyer, 1863

Description (Fig. 3.67): Body length of female ranging from 2.2 to 4.0mm. Cephalothorax about one third of total length; without posterolateral processes. Fourth pedigerous somite forming very broad, apron-like dorsal plate completely concealing abdomen and fourth legs beneath.

Hosts: On gill filaments of *Strongylura* sp. (either *S. marina* or *S. timucu* according to Cressey & Collette, 1970) (Krøyer, 1863); on *Strongylura timucu* (Cressey & Collette, 1970).

##### *Lernanthropus cornutus* Kirtisinghe, 1937

Description (Fig. 3.68): Body length of female ranging from 7 to 8mm. Cephalothorax between one quarter and one third of total length; with conspicuous posterolateral processes. Fourth pedigerous somite forming broad dorsal plate completely concealing abdomen and most of fourth legs beneath. Body length of male about 2.5mm, excluding fourth legs.

Hosts: On gill filaments of *Strongylura timucu* (Cressey & Collette, 1970, as *Lernanthropus tylosuri* Richiardi, 1885 which was shown to be a *nomen nudum* by Ho & Do, 1985).

*Lernanthropus giganteus* Krøyer, 1863

Description (Fig. 3.69): Body length of female about 7.5mm. Cephalothorax about one quarter of total length; with parallel lateral margins. Trunk very broad, expanding in width at level of third legs. Dorsal plate of fourth pedigerous somite subcircular, completely concealing abdomen in dorsal view. Rami of fourth legs extending well beyond posterior margin of dorsal plate, endopod longer than exopod. Body length of male about 4.2mm.

Host: On *Caranx carangus* (Krøyer, 1863).

*Lernanthropus nobilis* Heller, 1865

Description (Fig. 3.70A): Body length of female about 5mm. Cephalothorax about one third of total length; with straight lateral margins narrowing anteriorly. Trunk relatively slender, widest at level of third legs. Dorsal plate of fourth pedigerous somite ovoid, well developed, with posterior margin slightly medially incised, completely concealing abdomen in dorsal view but with rami of fourth legs extending well beyond posterior margin of dorsal plate, endopod just shorter than exopod.

Host: On gill filaments of *Temnodon saltator* (Heller, 1865).

*Lernanthropus pagodus* Krøyer, 1863

Description (Fig. 3.70B): Cephalothorax about one quarter of total length; with straight lateral margins tapering slightly anteriorly and curved ventrally. Trunk broad, expanding in width at level of third legs but with dorsal plate of fourth pedigerous somite the widest part of body. Dorsal plate narrowing posteriorly, with posterior margin slightly medially incised. Plate concealing abdomen in dorsal view but with rami of fourth legs extending well beyond posterior margin of dorsal plate, endopod longer than exopod.

Hosts: On gill filaments of *Eques balteatus* (Krøyer, 1863).

*Lernanthropus pupa* Burmeister, 1835

Description (Fig. 3.70C,D): Cephalothorax about one quarter of total length. Trunk very broad, expanding in width at level of third legs. Dorsal plate of fourth pedigerous somite subcircular, completely concealing abdomen and rami of fourth legs in dorsal view. Male with cephalothorax and trunk about equal in length; trunk longer than wide. Leg 3 well developed, exopod of leg 3 almost as long as leg 4.

Hosts: On gill filaments of *Chaetodipterus faber*, *Lobotes surinamensis* and *Platax* sp. (Burmeister, 1835; Bere, 1936).

*Lernanthropus rathbuni* Wilson, 1922

Description (Fig. 3.71): Body length of female about 3.2mm. Frontal margin of cephalothorax produced anteriorly, slightly concave; posterolateral corners



slightly produced. Third legs ventrally directed, visible in dorsal view. Dorsal plate of fourth pedigerous somite small, with medially incised posterior margin; caudal rami visible dorsally. Rami of leg 4 extending well beyond posterior margin of body.

Hosts: On gill filaments of *Orthopristis ruber* and *Haemulon steindachneri* (Luque & Takemoto, 1996).

Family **Pandaridae** Milne Edwards, 1840  
(Figs. 3.72 - 3.76)

Podoplea, Siphonostomatoida. Body dorsoventrally flattened comprising caligiform anterior cephalothorax, incorporating first pedigerous somite, 3 free pedigerous somites, a genital complex consisting of fused fifth pedigerous and genital somites (and possibly first abdominal somite in female), and a free abdomen of 1 or 2 somites. Free pedigerous somites typically with dorsal plates in female. Free abdominal somites sometimes with dorsal plates in female. Genital apertures ventral in both sexes. Caudal rami with 6 setae.

Rostrum absent; paired frontal plates present between antennules; lunules absent. Nauplius eye present. Antennule 2-segmented in both sexes; first segment with 27 setae, second with 13 setae; setation often reduced. Segmental homologies indeterminate. Male antennule non-geniculate; as in female. Antenna uniramous; comprising coxa, basis and laterally directed distal part consisting of a free endopodal segment and terminal claw; exopod absent. Oral cone well developed, with opening formed by both labrum and labium. Mandible reduced to a stylet bearing teeth on one side near apex; palp absent. Maxillule bilobed: anterior lobe (palp) papilla-like, with 3 setae; posterior lobe (endite) a spinous process. Maxilla comprising syncoxa (lacertus) and basis (brachium) bearing calamus and canna; clavus present in some genera. Maxilliped 2-segmented, comprising a massive protopod (corpus) and distal subchela derived from fused endopod segment plus terminal claw. Myxal area well developed, located on middle or distal part of medial surface; claw spatulate in some genera.

Swimming legs 1 to 4 biramous; leg 1 with 2-segmented exopod and 1 or 2-segmented endopod; legs 2 and 3 with 2 or 3-segmented exopod and endopod; leg 4 with 1 to 3-segmented rami, often plate-like in female. Intercoxal sclerite present in legs 1 to 4. Inner seta on basis of leg 1 present. Inner coxal seta present in legs 2 and 3, or absent. Endopodal segment 2 when present in 3-segmented ramus (*Pagina*) with 2 inner setae in legs 2 to 4. Exopodal segment 3 with 3 outer spines and 5 setae in legs 2 to 4, usually reduced. Endopod of leg 4 armature 0-1; 0-2; 3 (*Pagina*); usually reduced. Fifth leg reduced to a lobe bearing 2 to 4 setae. Leg 6 represented by unarmed genital operculum in female; bearing 2 setae in male. Egg sacs uniseriate, typically straight.

**Type-genus:** *Pandarus* Leach, 1816.

**Included genera:**

*Demoleus* Heller, 1865, *Dinemoleus* Cressey & Boyle, 1978, *Dinemoura* Latreille, 1829, *Echthrogaleus* Steenstrup & Lütken, 1861, *Gangliopus* Gerstaecker, 1854, *Nesippus* Heller, 1868, *Pagina* Cressey, 1964, *Pandarus* Leach, 1816, *Pannosus* Cressey, 1967, *Paranesippus* Shiino, 1955, *Perissopus* Steenstrup & Lütken, 1861, *Phyllothyreus* Norman, 1903, *Pseudopandarus* Kirtisinghe, 1950.

**Taxonomic notes**

The revision published by Cressey (1967a) recognized 12 valid genera of Pandaridae and dramatically reduced the number of included species by relegating many to synonymy. There are approximately 40 valid species at present. The genus *Nogaus* Leach, 1816 (or *Nogagus*) is based on pandarid males, most of which were found free-swimming. Several *Nogaus* species have yet to be attributed to a valid genus. A single new genus, *Dinemoleus*, has been established since Cressey's revision in 1967.

Pandarids are parasites of elasmobranch fishes and are found on the body surface, gills and gill arches, around the cloacal aperture, and in the mouth and nasal passages. Those found on the body surface are often heavily pigmented; those in more protected microhabitats are devoid of pigment (Cressey, 1967a). Adhesion pads are typically present on some appendages and on the ventral cephalothoracic surface, but are reduced or absent in *Phyllothyreus* and *Gangliopus*, which are found only on the host gills.

**Key to genera** (Based on females)

1. Dorsal plates present on second to fourth pedigerous somites; apex of maxilla bearing spinous process (clavus) in addition to calamus and canna.....2  
     Dorsal plates, if present, on fourth pedigerous somite only; apex of maxilla bearing patch of spinules or setules (crista) in addition to calamus and canna.....7
2. Dorsal plates of third pedigerous somite extending beyond plates of second somite.....4  
     Dorsal plates of third pedigerous somite not extending beyond plates of second somite.....3
3. Abdomen and caudal rami hidden dorsally.....*Perissopus*  
     Abdomen and caudal rami visible dorsally.....*Pandarus*

4. Dorsal plates of second pedigerous somite large, overlapping those of third somite.....5  
Dorsal plates of second pedigerous somite reduced and lateral to those of third somite.....6
5. Maxilliped with spatulate tip.....*Pannosus*  
Maxilliped with pointed tip.....*Phyllothyreus*
6. Maxilliped with pointed tip; genital complex less than half total body length.....*Gangliopus*  
Maxilliped with spatulate tip; genital complex at least half total body length.....*Pseudopandarus*
7. Abdomen 2-segmented.....8  
Abdomen 1-segmented.....10
8. Fourth leg plate-like; rami 1-segmented.....9  
Fourth leg not plate-like; rami 3-segmented.....*Pagina*
9. Legs 2 and 3 with 3-segmented rami .....*Dinemoura*  
Legs 2 and 3 with 2-segmented rami.....*Dinemoleus*
10. Fourth leg plate-like.....*Echthrogaleus*  
Fourth leg not plate-like.....11
11. Abdomen with large dorsal plate.....*Demoleus*  
Abdomen without dorsal plate.....12
12. Legs 1 to 3 with 3-segmented exopod.....*Paranesippus*  
Legs 1 to 3 with 2-segmented exopod.....*Nesippus*

### Brazilian species and records

#### Genus *Dinemoura*

*Dinemoura latifolia* (Steenstrup & Lütken, 1861)

Description (Fig. 3.72): Body length of female about 15mm. Dorsal cephalothoracic shield suborbicular; lateral margins partly delimited by sutures. Second pedigerous somite with posterolateral plates reaching posterior margin of unarmed second somite. Fourth pedigerous somite with narrow anterior part and prominent, slightly-indented posterodorsal plates. First free abdominal somite with ventrolateral plates not reaching posterior margin of second



abdominal somite: paired dorsal plates also present on first abdominal somite, and single dorsal plate on second. Body length of male about 8mm.

Hosts: On skin of *Carcharinus* sp. (Montú, 1982) and *Isurus oxyrinchus* (Montú, 1996).

#### Genus *Echthrogaleus*

*Echthrogaleus coleoptratus* (Guerin-Meneville, 1837)

Description (Fig. 3.73): Body length of female about 10mm. Cephalothorax incorporating first pedigerous somite. Fourth pedigerous somite with large paired dorsal plates, slightly bilobed distally; distal margin of plates smooth. Genital complex with large rounded posterior lobes, largely concealing 1-segmented abdomen and caudal rami. Fifth leg concealed in dorsal view.

Host: On body surface and fins of *Prionace glauca* (Montú, 1996).

#### Genus *Pandarus*

*Pandarus bicolor* Leach, 1816

Description (Fig. 3.74): Body length of female about 9mm. Dorsal plates of first free pedigerous somite extending only as far as posterior margin of plates on second free pedigerous somite. Cephalothorax only about one third length of body; caudal rami small, hardly visible in dorsal aspect. Abdomen covered by broad dorsal plate.

Host: On body surface of *Carcharinus signatus* (Montú, 1996).

*Pandarus sinuatus* Say, 1817

Description (Fig. 3.74): Body length of female 6 to 7mm. Dorsal plates of first free pedigerous somite extending well beyond posterior margin of plates on second free pedigerous somite. Cephalothorax equal to about 40% of total body length. Abdomen covered by narrow dorsal plate. Caudal rami slender, tapering, without basal swelling; projecting posterolaterally well beyond abdominal plate.

Host: On body surface of *Eulamia limbata* (Carvalho, 1940; 1951).

*Pandarus smithii* Rathbun, 1886

Description (Fig. 3.75): Body length of female 8mm. Dorsal plates of first free pedigerous somite extending well beyond posterior margin of plates on second free pedigerous somite. Cephalothorax equal to about 45% of total body length. Abdomen covered by narrow dorsal plate. Caudal rami with inner basal part expanded to form broad lobe.

Hosts: On body surface of *Eulamia limbata* and *Sphyrna zygaena* (Carvalho, 1940 as *Pandarus marcusii* n.sp., 1951; Cressey, 1967a).

#### Genus *Perissopus*

*Perissopus dentatus* Steenstrup & Lütken, 1861

Description (Fig. 3.76): Body length of female about 5mm, of male about 3mm. Cephalothorax broad, trapezoidal. Second to fourth pedigerous somites with dorsal plates. Dorsal plates of first free pedigerous somite extending to

posterior margin of plates on second free pedigerous somite. Plates on fourth somite covering anterior part of genital complex. Abdomen and caudal rami largely concealed beneath genital complex. posterior corners of genital complex sharply angular. Legs 1 to 4 small weakly developed, endopods of all legs unarmed in female.

Host: On body surface of *Eulamia limbata* (Carvalho, 1940).

Family **Pennellidae** Burmeister, 1835  
(Figs. 3.77 - 3.80)

Podoplea, Siphonostomatoida. Body of adult female highly transformed during postmating metamorphosis. Male and premetamorphic female comprising cephalothorax, incorporating first pedigerous somite, 2 or 3 free pedigerous somites and an unsegmented urosomal region incorporating fifth pedigerous somite, genital somite in male or double-somite in female, and abdomen. Integument of urosomal region of female highly folded giving transversely striated appearance. Postmetamorphic female swollen and basically cylindrical, often modified by torsion. Cephalothorax oval and retaining dorsal shield, or with simple or branching lateral or other processes or lobes. Pedigerous somites typically forming slender neck region, with or without lobes or processes. Urosomal region forming enlarged trunk comprising fifth pedigerous and genital double-somite; trunk sometimes sigmoid, sometimes with processes. Abdomen unsegmented, indistinctly separated from trunk; sometimes elongate, often extremely reduced. Lateral abdominal processes present in *Lernaeolophus*, *Pennella* and *Parinia*. Genital apertures ventral in both sexes. Caudal rami with up to 6 setae; rami often incorporated into abdomen or lost.

Rostrum absent. Nauplius eye present. Antennule up to 4-segmented in female, segmentation often indistinct; segmental homologies indeterminate. Male antennule as in female, non-geniculate. Antenna chelate; with separate coxa and basis; basis produced into spinous process. Endopodal segments fused into distal claw forming chelate apparatus by opposing process on basis; exopod absent. Lobate processes often formed at base of antenna. Oral cone well developed with large distal opening formed by labium; cone carried on protrusible base which is extremely elongate in *Ophiolernaea*. Mandible reduced to a stylet, unarmed or bearing teeth on one side near apex; palp absent. Maxillule bilobed: inner lobe (endite) represented by single seta on basal papilla; outer lobe (palp) with 2 apical setae. Maxilla comprising syncoxa and recurved distal claw representing basis; syncoxa with 1 or 2 triangular processes. Maxilliped absent in female; 2-segmented in male, comprising massive protopod representing fused syncoxa and basis, and distal subchela representing fused endopodal segments plus terminal claw.

Swimming legs 1 and 2 typically biramous with 2-segmented rami, sometimes uniramous; legs 3 and 4 typically uniramous, with 2-segmented exopod, endopod lacking. Leg 3 biramous in *Trifur*, leg 4 sometimes absent. Legs 1 to 4 with intercoxal sclerites. Inner seta on basis of leg 1 present or

absent. Inner coxal seta absent in legs 1 to 4. Fifth leg reduced to single seta on surface of trunk or absent. Leg 6 represented by unarmed genital opercula in both sexes. Egg sacs uniseriate; may be linear, spirally coiled or loosely coiled round an axial filament. Chalimus larva attached by frontal filament.

**Type-genus:** *Pennella* Oken, 1815.

**Included genera:**

*Allotrifur* Yamaguti, 1963, *Cardiodectes* C.B. Wilson, 1917, *Creopelates* Shiino, 1958, *Exopenna* Boxshall, 1986, *Haemobaphes* Steenstrup & Lütken, 1861, *Impexus* Kabata, 1972, *Lernaeenicus* Lesueur, 1824, *Lernaeocera* de Blainville, 1822, *Lernaeolophus* Heller, 1865, *Metapeniculus* Castro Romero & Baeza Kuroki, 1985, *Ophiolernaea* Shiino, 1958, *Parinia* Kazachenko & Avdeev, 1977, *Peniculisa* C.B. Wilson, 1917, *Peniculus* von Nordmann, 1832, *Pennella* Oken, 1815, *Peroderma* Heller, 1865, *Phrixocephalus* C.B. Wilson, 1908b, *Sarcotretes* Jungersen, 1911, *Serpentisaccus* Blasiola, 1979, *Trifur* C.B. Wilson, 1917.

**Taxonomic notes**

Since Boxshall (1986b) analysed evolution within the Pennellidae only one new genus, *Metapeniculus*, has been described, raising to 20 the number of valid genera. The primary distinguishing character of *Metapeniculus* is the presence of only three rather than four pairs of swimming legs. Since other genera, including *Cardiodectes* and *Phrixocephalus*, contain species with both three and four pairs further consideration of the value of this character will be necessary. As currently defined *Peniculus haemuloni* Alexander belongs to *Metapeniculus*, as *Metapeniculus haemuloni* (Alexander) n. comb., since it is characterised by the possession of three pairs of legs.

*Pennella* Oken, 1815 was placed on the Official List of Generic Names in Zoology (Bulletin of Zoological Nomenclature 1995: Opinion 1817) since Oken, 1815 is a rejected work. The species of *Pennella* parasitic on cetaceans were reviewed by Hogans (1987) who concluded that only a single valid species, *Pennella balaenoptera* Koren & Danielsen, 1877 occurs on whales. Earlier, Kabata (1979a) had addressed the problem of intraspecific variability in *Pennella* species parasitic on teleosts and considered seven other species to be synonyms of the type species *Pennella filosa* L. Hogans (1988b), in his provisional review of the genus, concluded that only seven of the 35 nominal species of *Pennella* are valid.

The largest of all copepods belong in the genus *Pennella*, which may attain body lengths of up to 250 mm and carry linear egg strings up to 350 mm in length (Wilson, 1917). Species of this genus commonly parasitize large hosts: *Pennella balaenoptera* occurs on a variety of cetaceans, *P. filosa* occurs on large scombrid and molid teleosts, and *P. instructa* Wilson occurs on the swordfish, *Xiphias gladius* L.