

COPEPODS PARASITIC ON BRAZILIAN COASTAL FISHES: A HANDBOOK

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Chapter 1. Introduction to copepod parasites

Parasitic crustaceans are common on fish hosts in coastal marine and brackish waters. Three major groups of Crustacea contain fish parasites: the Isopoda, the Branchiura and the Copepoda. They can be readily distinguished with the aid of a few key characters. Isopods are typically dorsoventrally flattened crustaceans (Fig. 1.1A) without a carapace. Their body is usually divided into a small cephalon which incorporates the first thoracic, maxilliped-bearing, somite, a thorax or pereaeon of 7 somites and an abdomen or pleon of 6 somites. The compound eyes are visible both dorsally and ventrally (Fig. 1.1C) on the margins of the cephalon. The only exception to this basic body plan that is relevant here is the family Gnathiidae which will be considered below. Typical isopod fish parasites are found in some families belonging to the suborder Flabellifera, such as the Aegidae and the Cymothoidae. Members of the largest family, the Cymothoidae, possess large prehensile dactyls on the tips of all the pereaeopods (Fig. 1.1B). Isopods typically brood their young in a marsupium or ventral brood chamber formed by oostegites, which are processes arising from the inner limb bases of up to 5 pairs of the anterior pereaeopods.

The gnathiids (suborder Gnathiidea, family Gnathiidae) differ quite markedly from the typical isopod outlined above. The cephalon is fused with 2 thoracic (pereaeonal) somites rather than one; the limbs of the second incorporated somite are modified as flattened pylopods (gnathopods) which cover the mouthparts ventrally, and the last pereaeon somite lacks a pair of limbs. The male is somewhat dorsoventrally flattened but the female and the praniza larva are both more cylindrical and have the third to fifth pereaeon somites inflated and fused (Fig. 1.2A,B). Females incubate the eggs internally, rather than in a marsupium, and the female pereaeon inflates to accommodate the developing eggs. The adults are free living but the praniza larval stage of these gnathiids is typically parasitic on fishes. The pranizae attach temporarily to their hosts and feed on blood. They readily leave the host when disturbed, i.e. when the fish is caught, so the true abundance of pranizae in both temperate and tropical waters is usually underestimated. Pranizae can be extremely common on fishes in estuarine and coastal waters.

The Branchiura or fish lice are most abundant in fresh water but also occur in marine and brackish water habitats. They were long confused with the copepods and were classified as a subgroup within the Copepoda until the early part of the Twentieth Century. They are now recognised as a separate class of crustaceans of equal taxonomic status to the Copepoda. Branchiurans are dorsoventrally flattened ectoparasites which attach to their hosts primarily by means of the maxillules which are modified as suckers in the genus *Argulus* (Fig. 1.1D,E) and as strong claws in the genus *Dolops*. The body is largely concealed in dorsal aspect by the large lateral lobes of the carapace. The cephalon comprises just 5 somites and bears conspicuous compound eyes dorsally. There are no maxillipeds but the maxillae are clawed. The thorax consists of 4 somites, each bearing a pair of biramous, laterally-directed

swimming legs and there is a short unsegmented abdomen which typically forms large paired lobes.

Branchiurans have an oral proboscis which carries at its tip the paired mandibles. They feed by rasping at the epidermis of the fish but they also have a preoral stylet which functions like a hypodermic needle, injecting material into the skin of the host. Branchiurans lay eggs in rows attached to submerged objects, and the females leave the hosts to deposit their eggs. The eggs usually hatch as a swimming larva.

Copepods are much more varied in body form than the two previous groups. The fish parasites can have a typical cyclopiform appearance with a clearly segmented body, divided into anterior prosome and posterior urosome, but they can also be highly transformed, lacking any vestige of external segmentation and ornamented with elaborate arrays of processes. Such modified forms often lack swimming legs and may even lack obvious cephalic appendages of any sort. The most characteristic features that can be used to identify a parasite as a copepod are the presence of paired egg sacs in the females, and the presence of an intercoxal sclerite joining the coxae of the swimming legs at least in the early copepodid (postnaupliar) stages, if not in the adults. The mouthparts of copepod fish parasites may be varied but the antennules are uniramous, the antennae are typically clawed, the mandible of the adult lacks any trace of a palp and the maxillae are usually clawed. The maxillipeds are sometimes absent, especially in females. The characteristics of parasitic copepods will be discussed in more detail later in this handbook but as an instant diagnostic character, at least for the fish parasites, the presence of paired egg sacs is the easiest character to use. There are no examples of fish parasitic copepods that lack egg sacs known to us.

Virtually all of the copepods parasitic on fishes are ectoparasites, inhabiting the outer body surface of their host as well as more sheltered microhabitats such as the oral-branchial cavity, the nasal sinuses, and the orbit of the eye. A few, such as the members of the family Philichthyidae, have become endoparasitic inhabiting the canals of the lateral line system. There is a third category - mesoparasitic, as introduced by Kabata (1979a). Mesoparasitic is used here as a general term for those parasitic copepods that live embedded in their hosts. Families such as the Pennellidae and Sphyrriidae contain forms that attach to their hosts by means of a cephalic holdfast. The head (cephalothorax) forms an anchor-like structure, often with processes, which is embedded in the musculature of their hosts. This is a particularly secure method of attachment and is often found in the largest parasites. Ectoparasitic copepods typically attach by means of clawed appendages, usually the antennae, but also the maxillae or maxillipeds in some cases. Exceptions to this include the Lernaeopodidae, a large and diverse family characterised by its attachment via paired maxillary arms which are typically secured to a small chitinous anchor, called the bulla, embedded in the skin of the host.

The larval stages of parasitic copepods are often encountered on their fish hosts, especially the post-infection stages of members of the Caligidae and related families. Here the life cycle consists of 2 free swimming, non-feeding

nauplius stages (Fig. 1.2C) followed by the infective copepodid stage. The sole copepodid stage (Fig. 1.2D) moults into the first of several chalimus stages which are attached to the host by means of a frontal filament. The frontal filament is secreted by the larva and is embedded in the epithelium of the host providing secure attachment even during moulting. Chalimus stages (Fig. 1.2E) are common on fish but are extremely difficult to identify. With the current state of knowledge of the group it is impossible to identify the genus correctly in the earliest chalimus stages.

Chapter 2. Copepod Classification and key to families

The monographic study of Kabata (1979a) on the parasitic copepods of British fishes is a landmark in the scientific investigation of parasitic copepods. It summarised available data on the morphology and systematics of the group and revised the classification of the parasitic forms. Kabata showed that the Sarsian classification of the parasites was not a natural system and he re-introduced the set of ordinal concepts and names first established by Thorell more than a century earlier (Thorell, 1859). All the fish parasites can be placed in three of the orders of copepods: the Poecilostomatoida, Siphonostomatoida or Cyclopoida (=Gnathostoma). The most recent comprehensive classification of the copepods (Huys & Boxshall, 1991) recognised a total of ten orders and introduced the following higher classification system for the group as a whole:

- Subclass Copepoda Milne Edwards, 1840
 - Infraclass Progymnoplea Lang, 1948
 - Order Platycopeioida Fosshagen, in Fosshagen & Iliffe, 1985
 - Infraclass Necopepoda Huys & Boxshall, 1991
 - Superorder Gymnoplea Giesbrecht, 1882
 - Order Calanoida Sars, 1903
 - Superorder Podoplea Giesbrecht, 1882
 - Order Misophrioida Gurney, 1933
 - Order Cyclopoida Burmeister, 1835
 - Order Gelyelloida Huys, 1988
 - Order Mormonilloida Boxshall, 1979
 - Order Harpacticoida Sars, 1903
 - Order Poecilostomatoida Thorell, 1859
 - Order Siphonostomatoida Thorell, 1859
 - Order Monstrilloida Sars, 1903

Members from several of these orders have adopted a parasitic mode of life and utilise an enormous variety of host taxa. Parasitic copepods may be found in association with hosts from virtually every phylum of metazoan animals from the Porifera (sponges) to the chordates, including mammals. Fish are commonly exploited as hosts by parasitic copepods, both in marine and freshwater systems and there are well in excess of 1500 species known from fish hosts worldwide. The parasitic copepods of fishes can be identified to order

and then to family using the key given below. All families of parasitic copepods occurring on fishes are covered in this handbook including those not yet reported from Brazil, since it is likely that representatives of many or all of these families will eventually be discovered on the rich and diverse Brazilian fish fauna. Parasites of freshwater fishes are not dealt with in this work although the Lernaeidae is included to complete the coverage of families.

Key to Families

1. Mouth tubular, formed from upper (labrum) and lower lips (labium) and containing stylet-like mandible; mandible rod-shaped and typically with teeth on one margin near apex (Fig. 2.1A,B).....3 - Siphonostomatoida
Mouth more or less gaping, typically with broad labrum anteriorly but lacking labium; mandible falcate (Fig. 2.1E,F) or small with terminal blade(s) (Fig. 2.1C-D)..... 2
2. Mandible small with tapering terminal blade (Fig. 2.1G); adult female with copulatory pore located midventrally on genital double-somite, genital apertures paired and typically located dorsolaterally; parasites of freshwater fishes.....Cyclopoida - Family Lernaeidae
Mandible falcate (Fig. 2.1E,F) or tapering with 1 to 3 distinct distal blades (Fig. 2.1C,D); adult female with copulatory pores not separate, situated within dorsolaterally located paired genital apertures.....21 - Poecilostomatoida

Siphonostomatoida

3. Body dorsoventrally flattened; cephalothorax typically covered by subcircular dorsal cephalothoracic shield; lateral margins of shield typically ornamented with strips of membrane; antennules typically 2-segmented.....4
Body not markedly dorsoventrally flattened, often highly transformed; cephalothorax not as above; antennules typically with at least 3 segments, or segmentation poorly expressed.....9
4. Dorsal or dorsolateral plates present on one or more of free somites behind cephalothorax.....5
Dorsal or dorsolateral plates lacking.....7
5. Only first pedigerous somite incorporated into cephalothorax; second and third pedigerous somites free.....6
First to third pedigerous somites incorporated into cephalothorax (Fig. 3.51 A,D)Euryphoridae

6. Female maxilliped with squat robust basis; egg sacs visible in dorsal view (Fig. 3.74 A; 3.75 A)..... Pandaridae
 Female maxilliped with long slender basis; egg sacs typically concealed in dorsal view (Fig. 3.46).....Cecropidae

7. Only first pedigerous somite incorporated into cephalothorax; second and third pedigerous somites free (Fig. 3.48 A, E).....Dissonidae
 Second or second and third pedigerous somites incorporated into cephalothorax.....8

8. Second pedigerous somites incorporated into cephalothorax; third free (Fig. 3.85 A, F).....Trebiidae
 Second and third pedigerous somites incorporated into cephalothorax; only one free somite present between cephalothorax and genital complex (Figs. 3.30 - 3.45)Caligidae

9. Adult females transformed, mesoparasitic, with anterior end forming cephalothoracic holdfast typically embedded in host tissues.....10
 Adult female body cylindrical and segmented, or lacking external segmentation, or highly transformed; typically attached to surface of host by means of appendages.....11

10. Egg sacs uniseriate; males cyclopiform; adult females retaining vestiges of 3 or 4 pairs of swimming legs in neck region (Figs. 3.77 - 3.80)Pennellidae (metamorphosed)
 Egg sacs multiseriate; males dwarf, lacking developed swimming legs; adult females without vestiges of swimming legs (Fig. 3.83 A, F).....Sphyrriidae

11. Attachment to host by means of modified maxillae, typically maxillae forming fleshy "arms" often fused at tip and with, or without small chitinous anchor (the bulla), sometimes ribbon-like and encircling gill filaments of host.....12
 Attachment usually by means of powerful, claw-like antennae.....13

12. Maxillae fused at tips only, partly or completely fused along length, sometimes ribbon-like and encircling gills of host; bulla present or absent; cephalothorax typically well developed, often reflexed back across trunk (Figs. 3.57 - 3.65).....Lernaeopodidae
 Maxillae completely fused; cephalothorax reduced, vestigial; trunk with aliform lateral expansions curving ventrally (Fig. 3.84 A, B).....Tanypleuridae

13. Maxillipeds absent in female14
 Maxillipeds present in female.....15

14. Cephalothorax usually elongate; free pedigerous somites distinct;
 tip of maxilla simple; swimming legs well developed, biramous (Figs.
 3.77 D, 3.80).....Pennellidae (pre-metamorphosis)
 Cephalothorax short; pedigerous somites not distinct, incorporated
 into unsegmented trunk; tip of maxilla bifid; swimming legs 3 and 4
 often reduced, sometimes absent (Fig. 3.54 A, E, H)Hatschekiidae

15. Leg 3 absent; body swollen, fleshy, comprising broad head, short
 neck region bearing pair of lateral processes, and large unsegmented
 trunk (Fig. 3.55 A, B, E)Hyponeoidae
 Leg 3 present, typically biramous, sometimes flattened and plate-like
 or reduced to lobe; body typically cylindrical, usually with some well
 defined somites; rarely comprising head and trunk, lacking external
 segmentation.....16

16. Leg 3 flattened, plate-like.....17
 Leg 3 biramous or lobate, not plate-like.....18

17. Body of adult female either cylindrical with somites weakly defined,
 or with pedigerous somites clearly defined and second pedigerous
 somite bearing pair of dorsal elytra; fourth legs absent (Fig. 3.47 A,B)..
 Dichelesthidae
 Body of female comprising head and trunk, lacking traces of external
 segmentation; fourth legs biramous and lobate or flattened (Figs. 3.66
 A; 3.67 A; 3.68 A,B; 3.69 A,B; 3.70 A, B, C)Lernanthropidae

18. Body comprising dorsoventrally-flattened, caligiform cephalothorax,
 3 free pedigerous somites, genital complex and 1 to 3-segmented
 abdomen (Fig. 3.56 A)Kroyeriidae
 Cephalothorax not caligiform; body not as above.....19

19. Female antennule 7-segmented; male antennule non-geniculate, 6
 or 7-segmented; leg 3 lobate (Figs. 3.81 - 3.82)..... Pseudocynidae
 Female antennule 8 to 18-segmented; male antennule geniculate,
 15-segmented, or secondarily reduced non-geniculate; leg 3
 biramous.....20

20. Female with separate genital and first abdominal somites; legs 1 to 4 of female each with 2 inner setae on second endopodal segment; leg 5 with 4 exopodal setae (Fig. 3.28 A)..... Archidactylinae
 Female usually with genital and first abdominal somites fused to form genital double-somite, these somites sometimes free; legs 1 to 4 of female usually with only 1 inner seta on second endopodal segment (2 in *Protodactylina*); leg 5 with at most 3 exopodal setae (Fig. 3.49 A, B)Eudactylinae

Poecilostomatoida

21. Mandible forming a tapering lobe typically bearing 2 distinct blades at its tip, rarely with 1 or 3 distal blades (Figs. 3.3D, 3.24E, 3.25B and 3.26C); distal part of antenna reflexed against proximal part, claws derived from second and third endopodal segments (Figs 3.24D, 3.26B and 3.27D); body typically with well defined external segmentation, rarely modified and lacking external segmentation.....22
 Mandible a curved, falcate blade, armed with teeth along both margins (Fig. 3.10D), sometimes with accessory toothed seta (Fig. 3.22D), or bearing 2 or 3 strongly spinulate blades (Figs. 3.12D and 3.14C), or forming a tapering lanceolate process or absent; antennae often subchelate with strong distal claw (Figs. 3.11E and 3.20F) or otherwise modified (Figs 3.10B and 3.22A,G); body usually modified and lacking clear segmentation, sometimes cyclopiform.....26
22. Female body comprising head, bearing expanded lateral lobes and subrectangular trunk (Fig. 3.27A).....Tuccidae
 Female body with at least second to fourth pedigerous somites free and well defined.....23
23. Body robust, with pair of posterior process carried on tergite of second pedigerous somite (Fig. 3.25A,C).....Tegobomolochidae
 Body without processes on tergite of second pedigerous somite.....24
24. Urosome elongate; leg 4 of female with rami modified as elongate unsegmented lobes (Fig. 3.26A).....Telsidae
 These characters not combined.....25
25. Maxillipeds located posterior to mouth.....Taeniacanthidae
 Maxillipeds located lateral to mouth.....Bomolochidae

26. Mandible bearing 2 or 3 strongly spinulate blades (Fig. 3.12D and 3.14C); female body typically cyclopiform with defined external segmentation; legs 1 to 3 biramous with segmented rami.....Ergasilidae
Mandible not as above; female body typically modified, lacking clearly defined segmentation; legs 1 to 3 often modified, lobate, sometimes lacking.....27
27. Body of adult female without external segmentation; adult males dwarf, with vestigial lobate swimming legs (Figs. 3.10C, 3.11D and 3.20D,E).....28
Body of adult female often modified by fusion of anterior somites but typically retaining well defined urosomal somites; adult males with well defined segmentation (Figs 3.21B and 3.22A); and with at least legs 1 and 2 biramous with segmented rami.....29
28. Mandible lanceolate with fine spinules; males with subchelate maxilla.....Pharodidae
Mandible forming a tapering bilaterally toothed lash (Fig. 3.10D); male maxilla not subchelate.....Chondracanthidae
Mouthparts and mandible not distinct in female; male unknown.....Lernaeosoleidae
29. Endoparasites, inhabiting mucous ducts of host or forming pouches in body wall or viscera; body of adult female elongate, flattened or often highly irregular with numerous processes; antennae of female modified, not subchelate; with at least 2 claws in malePhilichthyidae
Ectoparasites found on gills and nasal lamellae of hosts; body of adult female cylindrical, without processes; antennae forming strong subchela orientated either transversely or antero-posteriorlyShiinoidea

Chapter 3. Systematics

Order POECILOSTOMATOIDA

Family **Bomolochidae** Sumpf, 1871

(Figs. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9)

Podoplea, Poecilostomatoida. Body cyclopiform, typically with prosome dorsoventrally flattened to form a cephalothoracic sucker. Adult females sometimes elongate or with indistinct body segmentation. Prosome comprising

cephalothorax incorporating first pedigerous somite and 3 free pedigerous somites. Urosome typically 5-segmented; with genital and first abdominal somites fused to form genital double-somite in female; with 3 free abdominal somites; rarely 4-segmented in female, with only 2 free abdominal somites. Urosome typically 4-segmented in male; comprising fifth pedigerous, genital and 2 free abdominal somites. Genital apertures paired, located laterally or dorsolaterally on genital double-somite in female, ventrally on genital somite in male. Caudal rami with 6 setae, of which 1 or 2 well developed.

Rostrum well developed, often armed with paired rostral hooks. Nauplius eye present. Antennule 5-segmented to 8-segmented as in *Boylea*; typically divided into proximal part of 2 to 4 segments bearing oblique antero-ventral row of 15 large plumose setae plus up to 13 additional dorsal or ventral setae, and distal part of 3 or 4 segments bearing unmodified setae. Typical armature of 6-segmented antennule, as in *Bomolochus*; 5, 18, 5, 4, 2 + aesthetasc, 7 + aesthetasc. Male antennule non-geniculate, as in female. Antenna uniramous, without trace of exopod; coxa and basis fused to form coxobasis bearing single, basal seta. Endopod reflexed across coxobasis, 2 or 3-segmented; first endopodal segment with 1 seta; second and third segments typically fused, separate in *Pseudoeucanthus*. Second segment with finger-like process distally, ornamented on surface of segment and process with rows of fine spinules; armed with a pectinate blade and a claw-like element; third segment armature comprising up to 6 elements, 3 or 4 typically hook-like: endopodal armature sometimes reduced. Labrum well developed, typically highly ornamented. Mandible drawn out into medial process bearing 2 distal elements, a blade and a flagellum, both typically spinulate. Paragnath well developed, digitiform, typically with medial process hirsute. Maxillule a rounded lobe bearing 3 to 5 setae. Maxilla comprising robust syncoxa, bearing 1 seta or unarmed, and small basis forming a spinulated terminal process armed with a spinulated spine and 1 or 2 other elements. Maxilliped sexually dimorphic; female maxilliped typically comprising syncoxa, basis, 1 free endopod segment and terminal claw. Syncoxa and basis sometimes fused. Free endopodal segment often incorporated into claw. Syncoxa armed with 1 seta, basis with 2 plumose setae. Claw recurved, often bifid due to presence of accessory process; armed with 1 plumose seta proximally. Male maxilliped comprising syncoxa, robust basis, a free endopodal segment and curved terminal claw. Syncoxa with 1 seta, basis typically ornamented with spinule rows on medial surface, armed with 2 setae. Free endopodal segment unarmed. Claw armed with 1 or 2 setae proximally and typically carrying spinule rows along concave margin.

Swimming legs 1 to 4 biramous, often sexually dimorphic. First leg with 2 or 3-segmented rami, typically flattened and forming posterior border of cephalothoracic suction cup. Legs 2 to 4 with 2 or 3-segmented rami. Intercoxal sclerites present in legs 1 to 4. Spine and seta formula typically:

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

Inner spine on basis of leg 1 often absent. Inner coxal seta typically enlarged in leg 1, typically present in legs 2 to 3; absent in leg 4. Setae on rami of leg 1 typically enlarged. Exopodal segment 3 armature often reduced. Endopod of leg 4 armature sometimes reduced to 0-1; 0-1; 2, or 0-1; 2 or 3. Fifth leg 2-segmented; protopod with outer seta; 1-segmented exopod typically with 4 setae. Leg 6 represented by 3 setae on genital operculum in female; unarmed in male; egg sacs paired, multiseriate.

Type-genus: *Bomolochus* von Nordmann, 1832.

Included genera:

Acanthocolax Vervoort, 1969, *Acantholochus* Cressey, 1984, *Bomolochus* von Nordmann, 1832, *Boylea* Cressey, 1977, *Ceratocolax* Vervoort, 1965, *Dicrobomolochus* Vervoort, 1969, *Holobomolochus* Vervoort, 1969, *Holocolax* Cressey, 1982, *Naricolax* Ho, Do & Kasahara, 1983, *Neobomolochus* Cressey, 1981, *Nothobomolochus* Vervoort, 1962, *Orbitacolax* Shen, 1957a, *Pseudoeucanthus* Brian, 1906, *Pseudorbitacolax* Pillai, 1971, *Pumiliopes* Shen, 1957a, *Pumiliopsis* Pillai, 1967, *Unicolax* Cressey & Cressey, 1980.

Taxonomic notes

Ho et al. (1983) recognized that *Cephalocolax* Avdeev, 1980 was a junior synonym of *Unicolax* since it was proposed in July 1980, three months after the publication by Cressey & Cressey (1980). *Tricolax* Balaraman, 1983 was incompletely described when established Balaraman (1983). Its validity cannot be confirmed and so it is treated here as a *genus inquirendum* until a full, detailed description is published. The genera *Metoponaphrissontes* Hesse, 1871, *Metopocatacoteinus* Hesse, 1871 and *Charlesia* Oliveira, 1945 are all bomolochids but are too poorly described to be identified. They are treated as *genera inquirenda* here. *Parabomolochus* Vervoort, 1962 is a synonym of *Bomolochus*.

Key to genera

1. One or more of 5 setae on proximal segment of antennule modified...2
All 5 setae on this segment plumose, unmodified.....8

2. One seta on proximal segment of antennule modified; caudal rami with 2 major setae.....3
Two or more setae on this segment modified; caudal rami with 1 major seta.....6
3. Fifth seta on proximal segment of antennule modified; antennule 8-segmented.....*Boylea*
Fourth seta on proximal segment of antennule modified; antennule at most 7-segmented.....4
4. Fourth seta on proximal segment of antennule modified to form hook, other setae on this segment plumose but reinforced by strips of thickened cuticle.....*Bomolochus*
Fourth seta modified to form heavy spine, other setae on segment not reinforced.....5
5. Second endopodal segment of leg 3 with 2 inner setae.....*Naricolax*
Second endopodal segment of leg 3 with 1 inner seta.....*Unicolax*
6. Second and third setae on proximal segment of antennule modified.....*Dicrobomolochus*
Third, fourth and fifth setae on proximal segment of antennule modified.....7
7. Second endopodal segment of leg 3 with 1 inner seta; this segment of leg 4 unarmed*Neobomolochus*
Second endopodal segment of legs 3 and 4 with 2 and 1 inner setae respectively.....*Nothobomolochus*
8. Legs 2 to 4 with 3-segmented rami.....9
Legs 2 to 4 with 2-segmented exopods.....16
9. Caudal rami with 2 major setae.....10
Caudal rami with 1 major seta.....12
10. Pair of hook-like chitinous processes present on anterior margin of dorsal cephalic shield either side of rostrum.....*Ceratocolax*
Such processes absent.....11

- | | | |
|-----|--|-------------------------|
| 11. | Second endopodal segment of leg 3 with 2 inner setae..... | <i>Holobomolochus</i> |
| | Second endopodal segment of leg 3 with 1 inner seta..... | <i>Acanthocolax</i> |
| 12. | Exopodal segment 2 of legs 2 to 4 without inner seta..... | 13 |
| | Exopodal segment 2 of legs 2 to 4 with 1 inner seta..... | 15 |
| 13. | Apical segment of leg 2 endopod with 5 elements..... | |
| | | <i>Pseudoeucanthus</i> |
| | Apical segment of leg 2 endopod with 3 or 4 elements..... | 14 |
| 14. | Accessory process present on maxilliped claw..... | <i>Orbitacolax</i> |
| | Maxilliped claw without accessory process..... | <i>Pseudorbitacolax</i> |
| 15. | Rostral hooks present; second endopodal segment of leg 3 with 2 setae..... | <i>Acantholochus</i> |
| | Rostral hooks absent; second endopodal segment of leg 3 with 1 seta..... | <i>Holocolax</i> |
| 16. | Apical segment of exopod of legs 2 to 4 with barbed or serrate spine..... | <i>Pumiliopsis</i> |
| | This segment with smooth, claw-like spine..... | <i>Pumiliopes</i> |

Brazilian species and records

Genus *Acantholochus*

Acantholochus asperatus (Cressey & Cressey, 1980)

Description (Fig. 3.1): Body length of female 1.8mm. Body form typically unmodified cyclopiform with cephalothorax widest and each of second to fourth pedigerous somites narrower than preceding somite. Caudal rami longer than wide, ornamented with patch of slender spinules ventrally. Leg 3 with enlarged external spines on second and third exopodal segments, each with a subapical, blade-like flagellum. Leg 4 endopod with formula 0-1; 0-1; I+1+I.

Host: In nasal sinuses of *Scomberomorus cavalla* (Cressey & Cressey, 1980).

Acantholochus divaricatus (Cressey & Cressey, 1980)

Description (Fig. 3.2): Body length of female about 2.6mm, 1.2mm for male. Second free pedigerous somite ovoid, largely concealing fourth pedigerous somite in dorsal view. Maxilliped with prominent curved claw with slight projection on outer curve and 3 plumose setae; syncoxa with 1 plumose seta.

Leg 3 with enlarged external spines on second and third exopodal segments, each with a subapical blade-like flagellum. Leg 4 endopod with formula 0-1; 0-1; 1+1+1.

Host: In nasal sinuses of *Scomberomorus brasiliensis* (Cressey & Cressey, 1980).

Genus *Bomolochus*

Bomolochus bellones Burmeister, 1835

Description (Fig. 3.3): Female body length 1.7 to 1.9mm. Cephalothorax reniform, with acutely pointed rostral tines. Second pedigerous somite reniform, almost as wide as cephalothorax, much wider than long. Fourth pedigerous somite wider posteriorly. Free abdomen 3-segmented, slightly longer than subspherical genital double-somite. Antennule with 4th seta modified in form of hook, inner margin sclerotized in proximal part. Terminal processes of maxilla of almost equal thickness. Maxilliped with strong sigmoid claw, with large auxiliary process; long seta on syncoxa. Leg 4 endopod with formula 0-1; 0-1; 1+1+1. Fifth leg with 3 patches of denticles near apex; with 3 robust spines and 1 seta.

Host: In gill chambers of *Ablennes hians* (Cressey & Collette, 1970).

Bomolochus nitidus (Wilson, 1911)

Description (Fig. 3.4): Body length of adult female 1.7 to 2.2mm, about 0.84mm for adult male. Cephalothorax reniform, with acutely pointed rostral tines. First to third free pedigerous somites each narrower than preceding somite. Antennule with 4th seta modified in form of hook, inner margin sclerotized in proximal part. Maxilliped with strong sigmoid claw, with small auxiliary process; long seta on syncoxa. Leg 3 with 4 setae on third exopodal segment. Leg 4 endopod with formula 0-1; 0-1; 1+1+1; third exopodal segment with transverse line of spinules. Fifth leg with 4 patches of denticles; with 3 small spines and 1 seta.

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

Bomolochus xenomelanirisi Carvalho, 1955

Description (Fig. 3.5): Body length of female 1.3 to 1.7mm, of male 0.7 to 0.8mm. Cephalothorax reniform, with acutely pointed, divergent, rostral tines. First to third free pedigerous somites each narrower than preceding somite. Antennule with 4th seta modified in form of hook, inner margin sclerotized in proximal part. Maxilliped apparently with 2 plumose setae and small auxiliary process.

Host: On inner side of operculum of *Xenomelaniris brasiliensis* (Carvalho, 1955).

Genus *Ceratocolax*

Ceratocolax euthynni Vervoort, 1965

Description (Fig. 3.6): Body length of female 3.1 to 4.2mm; male about 1.5mm. Prosome modified by lateral swelling of second and third pedigerous

somites. Cephalothorax with posterior swelling mid-dorsally and with small processes either side of bases of antennules. Third pedigerous somite constricted anteriorly, swollen dorsolaterally. Fourth pedigerous somite narrow. Antennule with large sclerotized hook originating dorsally at junction of first and second segments. Leg 1 with 2-segmented exopod. Leg 4 endopod elongate, all elements spine-like.

Host: In nasal sinuses of *Sarda sarda* (Cressey & Cressey, 1980).

Genus *Orbitacolax*

Orbitacolax dactylopterusi (Carvalho, 1958)

Description (Fig. 3.7): Body length of female 1.1mm. Second and third pedigerous somites almost as wide as cephalothorax, fourth narrower. Urosome relatively short, with free abdominal somites much wider than long. Antennule with second seta on second segment unusually long, naked and anteriorly directed. Maxilliped stout, terminal claw bearing small accessory process at outer angle; plumose setae not described by Carvalho (1958). Legs 2 to 4 without inner seta on second exopodal segment, third segment with formula II,I,3. Leg 4 endopod with formula 0-1; 0-1; I,2.

Host: In orbit of *Dactylopterus volitans* (Carvalho, 1958).

Orbitacolax haplogenyos (Yamaguti & Yamasu, 1959)

Description (Fig. 3.8): Body length of female 1.1mm. Second and third pedigerous somites almost as wide as cephalothorax, fourth narrower. Urosome relatively short, with free abdominal somite much wider than long. Antennule with second seta on second segment unusually long, naked and anteriorly directed. Maxilliped stout, terminal claw bearing small accessory process at outer angle; with 3 plumose setae on terminal segment, claw bearing small accessory process at outer angle. Legs 2 to 4 without inner seta on second exopodal segment, third segment with formula II,I,4. Leg 4 endopod with formula 0-1; 0-1; I,2.

Hosts: In the orbit of *Prionotus nudigula* (Cressey & Cressey, 1989).

Genus *Unicolax*

Unicolax collateralis Cressey & Cressey, 1980

Description (Fig. 3.9): Body length of female about 1.5 to 1.6mm, 1.1mm in male. Cephalothorax incorporating first and second pedigerous somites; free pedigerous somites narrower than preceding somites. Antennule with 4th seta on basal segment modified as heavily sclerotized, straight hook. Terminal claw of maxilliped without accessory process. Second endopodal segment with 2 inner setae in leg 2 but only 1 seta in leg 3.

Host: In nasal sinuses of *Euthynnus alletteratus* (Cressey & Cressey, 1980).

Family **Chondracanthidae** Milne Edwards, 1840
(Figs. 3.10, 3.11)

Podoplea, Poecilostomatoida. Body highly sexually dimorphic, with large transformed female carrying a dwarf male. Transformed female body divisible into head (cephalosome), neck (first, or first and second pedigerous somites), trunk (second or third to fifth pedigerous somites) and genitoabdomen (genital and abdominal somites). First pedigerous somite fused to cephalosome in some genera to form cephalothorax. Neck in subfamily Lernentominae formed by postantennary constriction of cephalosome. Head, neck and trunk often with processes. Dwarf male cyclopiform in some genera, retaining well defined segmentation and comprising cephalothorax (incorporating first pedigerous somite), free second to fifth pedigerous somites, genital somite and indistinctly 4-segmented abdomen. Segmental boundaries indistinct or lost in most genera. Genital apertures paired, located laterally or ventrolaterally on genitoabdomen in female, ventrally on genital somite in male. Caudal rami with up to 6 setae, often modified, with a terminal spiniform process and 3 setae.

Nauplius eye present. Antennule up to 6-segmented; typically cylindrical and fleshy, with indistinct segmentation in female; segmentation usually better defined in male. Antenna modified, forming main attachment organ: primitively 3-segmented; with coxa and basis fused to form coxobasis bearing 1 basal seta, and endopod of 2 segments. Proximal segment massive, typically produced into powerful, curved claw (uncinate type of antenna). Atrophied tip of antenna (formerly called the accessory antennule) slender, with up to 6 apical elements; tip lost in some genera. Proximal endopod segment sometimes forming bifurcate, trifurcate or clavate structure embedded in host (non-uncinate type of antenna). Labrum rectangular, sometimes with median knob in male. Mandible with a squat segment drawn out into a distal, lanceolate process with teeth on both concave and convex margins; sexually dimorphic, with fewer and larger teeth in male. Paragnath lobate, ornamented with spinules. Maxillule a simple lobe bearing 2 or 3 setae. Maxilla well developed, usually the largest oral appendage; 2-segmented; syncoxa unarmed, basis forming a claw-like process, often toothed along convex margin, armed with up to 2 proximal elements; sexually dimorphic with fewer or no teeth on distal margin in male. Maxilliped 3-segmented in female, comprising syncoxa, basis and short distal subchela formed from endopod and terminal claw: syncoxa unarmed, basis usually ornamented with spinules, claw with teeth in some genera. Male maxilliped typically as in female. In male *Auchenochondria* maxilliped 4-segmented with terminal claw separate from proximal endopodal segment.

Swimming legs 1 to 3 of female *Prochondracanthus* and male *Juanettia* biramous, with 2-segmented rami; leg 4 in male *Juanettia* with 2-segmented exopod, endopod lacking; leg 4 reduced to seta in female *Prochondracanthus*. Intercoxal sclerites present in legs 1 to 4. Inner seta on basis of leg 1 absent, inner coxal seta present in legs 1 to 4. Legs 1 to 4 typically specialized by fusion of segments, loss of armature elements and transformation of entire leg into

lobate structure. Intercoxal sclerites usually lacking. Modified legs may be unilobate, bilobate or trilobate. Legs sometimes extremely reduced, or absent (in some males). Legs 1 to 4 absent in female *Apodochondria*. Fifth leg highly reduced; represented by up to 2 setae on surface of somite, or absent. Leg 6 represented by genital opercula, armed with up to 2 setae in both sexes. Egg sacs paired, multiseriate.

First copepodid stage: antennular setation formula 3, 3/4, 2 + aesthetasc, 7 + aesthetasc: antenna with 1 geniculate claw on second endopodal segment and 2 geniculate claws on distal tip of third: mandible with single tapering blade distally.

Type-genus: *Chondracanthus* Delaroche, 1811.

Included genera:

Acanthochondria Oakley in Leigh-Sharpe & Oakley, 1927, *Acanthochondrites* Oakley, 1930, *Andreina* Brian, 1939, *Apodochondria* Ho & Dojiri, 1988, *Auchenochondria* Dojiri & Perkins, 1979, *Berea* Yamaguti, 1963, *Blas* Krøyer, 1864, *Brachiochondria* Shiino, 1957, *Brachiochondrites* Markevich, 1940, *Ceratochondria* Yü, 1935, *Chelonichondria* Ho, 1994, *Chondracanthodes* C.B. Wilson in Oakley, 1930, *Chondracanthus* Delaroche, 1811, *Cryptochondria* Izawa, 1971, *Diocus* Krøyer, 1864, *Heterochondria* Yü, 1935, *Hoia* Avdeev & Kazachenko, 1986, *Humphreysia* Leigh-Sharpe, 1934, *Immanthe* Leigh-Sharpe, 1934, *Juanettia* C.B. Wilson, 1921, *Jusheyhoea* Villalba & Fernandez, 1985, *Lagochondria* Ho & Dojiri, 1988, *Lateracanthus* Kabata & Gusev, 1966, *Lernentoma* de Blainville, 1822, *Markevitchielinus* Titir, 1975, *Mecaderochondria* Ho & Dojiri, 1987, *Medesicaste* Krøyer, 1864, *Neobrachiochondria* Kabata, 1969a, *Praecidochondria* Kabata, 1968b, *Prochondracanthopsis* Shiino, 1960, *Prochondracanthus* Yamaguti, 1939, *Protochondracanthus* Kirtisinghe, 1950, *Protochondria* Ho, 1970, *Pseudacanthocanthopsis* Yamaguti & Yamasu, 1959, *Pseudoblas* Heegaard, 1962, *Pseudochondracanthus* C.B. Wilson, 1908, *Pseudodiocus* Ho, 1972, *Pterochondria* Ho, 1973, *Rhynchochondria* Ho, 1967, *Rohdea* Kabata, 1992, *Scheherazade* Leigh-Sharpe, 1934, *Strabax* von Nordmann, 1864.

Taxonomic notes

Ho (1970) comprehensively reviewed the Chondracanthidae, recognizing two subfamilies and a total of 30 genera as valid. Ho rejected 12 other genera as invalid. Since then another 12 genera have been added. Ho (1984) examined the homology of the so-called accessory antennule of chondracanthids and identified this structure as the atrophied apical segment of the antennary endopod. It is referred to in the key as the atrophied tip of the antenna. Fowler (1912), in his synonymy of the genus *Chondracanthus* designated *Lernaea cornuta* Müller as the type species of *Entomoda* Lamarck, 1818. Leigh-Sharpe & Oakley (1927) made the same species the type of a new genus, *Acanthochondria*. *Entomoda* is thus a senior objective synonym of

Acanthochondria but, in view of the erroneous use of *Entomoda* in preference to *Salmincola* by Yamaguti (1963) and in view of the widespread usage of *Acanthochondria*, a case should be made to suppress *Entomoda* Lamarck in the interest of stability.

Ho (1991, 1994) carried out a preliminary review of the type genus *Chondracanthus* and provided a key to the valid species plus a summary of recorded hosts. Ho & Kim (1995) published a similar review of the large genus *Acanthochondria* and also provided a key to species and summary of hosts.

Key to genera (adapted from Ho, 1994)

1. Cephalosome subdivided by long constricted "neck" between anterior antennary and posterior oral regions.....6
 Head region consisting of entire cephalosome or cephalothorax, neck derived from pedigerous somites.....2
2. Trunk region with lateral outgrowths in form of processes, protrusions or knobs; posterolateral processes typically present, rarely absent.....3
 Trunk region without lateral outgrowths; with or without posterolateral processes.....14
 Trunk region with aliform lateral expansions (appearing wider than long); posterolateral processes absent.....*Praecidochondria*
3. Neck region greatly prolonged.....4
 Neck region short, moderately long, or indistinct.....5
4. Head with 3 pairs of knob-like processes; lateral processes on trunk large and digitiform; antennule absent.....*Strabax*
 Head with a pair of long, blunt lateral processes; lateral processes on trunk small and knob-like; antennule present.....*Markevitchielinus*
5. One pair of unmodified or vestigial legs present.....6
 More than one pair of legs present, either modified or unmodified.....9
 Body devoid of legs.....*Apodochondria*
6. Head comprising cephalosome and first pedigerous somite; male with atrophied tip of antenna.....7
 Head comprising cephalosome only; male lacking atrophied tip of antenna.....*Protochondracanthus*

7. Body without neck; atrophied tip of antenna present in both sexes.....8
 Second pedigerous somite forming a neck; atrophied tip of antenna
 absent in female.....*Pseudodiocus*

8. Trunk bearing pair of anteriorly-directed, dorsal processes; male with
 6 pairs of legs.....*Juanettia*
 Trunk without such dorsal processes; male with only 2 pairs of
 legs.....*Neobrachiochondria*

9. Three pairs of unmodified legs present; head with large anteromedial
 process between antennular bases.....*Rhynchochondria*
 Two pairs of legs present, either modified or unmodified; head without
 anteromedial process.....10

10. Head comprising cephalosome only; atrophied tip of antenna
 absent.....11
 Head comprising cephalosome and first pedigerous somite; atrophied
 tip of antenna present or absent.....12

11. Two pairs of legs modified into sac-like structures, either bilobate or
 trilobate.....*Chondracanthus*
 Two pairs of legs partly modified, with sac-like protopods and rod-like
 rami.....*Chondracanthodes*

12. Antennule modified, sac-like; both sexes with atrophied tip of
 antenna.....*Hoia*
 Antennule unmodified, filiform and segmented; atrophied tip of
 antenna present only in male.....13

13. Claw of antenna hook-like; posterior surface of trunk with large
 median process.....*Cryptochondria*
 Claw of antenna T-shaped; posterior surface of trunk without median
 process.....*Diocus*

14. Trunk with pair of posterolateral processes.....15
 Trunk without posterolateral processes.....26

15. No legs present in female; male with 2 pairs of reduced or modified
 legs.....16
 At least one pair of legs present in female; male with or without
 legs.....17

16. First pedigerous somite bearing elongate, tranverse ventral plate; terminal segment of male maxilliped a lash-like process.....*Immanthe*
First pedigerous somite without such a plate; terminal segment of male maxilliped a short claw.....*Rohdea*
17. Head comprising cephalosome and first pedigerous somite; antenna with atrophied tip in both sexes.....18
Head consisting of cephalosome only; antenna with or without atrophied tip.....19
18. Intersegmental area of first and second pedigerous somites elongated into long neck; male with 6 pairs of legs, first 3 pairs biramous, unmodified.....*Auchenochondria*
No such neck present; male with 2 pairs of biramous legs.....*Pseudacanthocanthopsis*
19. Two pairs of unmodified biramous legs present; antenna with atrophied tip in both sexes.....*Lagochondria*
One or two pairs of modified legs or partially modified legs, with rod-like rami, present; atrophied tip of antenna absent in female, present or absent in male.....20
20. One pair of modified or vestigial legs present.....25
Two pairs of modified or partially modified legs present.....21
21. Two pairs of modified legs present, bilobate or unilobate.....22
Two pairs of partially modified legs present, bearing rod-like rami....24
22. Legs bilobate (parasites of teleosts).....23
Legs unilobate (parasites of elasmobranchs).....*Acanthochondrites*
23. Head with 2 pairs of processes posteriorly; first and second pedigerous somites greatly elongated.....*Pterochondria*
Head without such processes; first and second pedigerous somites may or may not be elongated.....*Acanthochondria*
24. Head without processes; antennule small, cylindrical.....*Mecaderochondria*
Head with pair of large processes; antennule large, fleshy.....*Lateracanthus*

25. Head with pair of processes; neck region not elongated*Pseudochondracanthus*
Head without processes; neck region greatly elongated.. *Medesicaste*
26. Legs absent.....*Brachiochondria*
One to 3 pairs of legs present, vestigial, modified or unmodified.....27
27. Only one pair of legs present.....28
Two or more pairs of legs present.....29
28. Head with 2 pairs of lateral processes; neck region not elongated*Humphreysia*
Head without processes; neck region greatly elongated.....
.....*Scheherazade*
29. Three pairs of unmodified, biramous legs present.....
.....*Prochondracanthus*
Two pairs of legs present, modified or unmodified.....30
30. Two pairs of unmodified, biramous legs present.....*Andreina*
Two pairs of modified legs present, either lobate or vestigial.....31
31. Terminal segment of antenna bifurcate; male with only 1 pair of legs....
.....*Ceratochondria*
Terminal segment of antenna uncinat, clavate or trifurcate; male with
2 pairs of legs or without legs.....32
32. Terminal segment of antenna not uncinat; male with 2 pairs of
legs.....33
Terminal segment of antenna uncinat; male with 2 pairs of legs or
without legs.....34
33. Both pairs of legs partially modified, with lobate protopod and rod-like
rami; male antenna with atrophied tip.....*Blas*
Both pairs of legs modified, bilobate; male antenna without atrophied
tip.....*Berea*
34. Female legs modified, unilobate; male without legs....*Heterochondria*
Female legs vestigial, bilobate, or partially modified; male with 2 pairs
of legs.....35

35. Legs partially modified, with rod-like rami; antenna of both sexes with atrophied tip.....*Protochondria*
 Legs vestigial; antenna of both sexes without atrophied tip.....*Prochondracanthopsis*
 Legs modified, with tiny, knob-like endopod; atrophied tip of antenna absent in both sexes.....*Pseudoblias*
36. Head inflated, almost spherical; neck longer than trunk.....37
 Head cylindrical, not inflated; neck distinctly shorter than trunk.....*Chelonichondria*
37. Sac-like modified leg protopods with lateral expansion or process; male antenna with atrophied tip.....38
 Sac-like modified leg protopods without expansion or process; male antenna without atrophied tip.....*Lernentoma*
38. Trunk with small lateral knobs and lacking posteromedial process; rami of legs in male rod-like and bearing setae.....*Brachiochondrites*
 Trunk with large lateral processes and posteromedial process; rami of legs in male modified, reduced to tiny conical sacs with or without setation.....*Jusheyhoea*

Brazilian species and records

Genus *Blias*

Blias prionoti Krøyer, 1863

Description (Fig. 3.10): Body length of female about 2.3mm, dwarf male about 0.5mm. Body short and swollen, lacking processes. Head separated from trunk by short neck formed by first pedigerous somite. Caudal rami with fused spinous element plus 5 setae. Antenna lanceolate, with trifurcate tip. Legs 1 and 2 modified, biramous, with large swollen protopods and rather unmodified rami.

Hosts: On the gills of *Prionotus punctatus* and other species of *Prionotus* (Carvalho, 1951; Ho, 1970).

Genus *Chondracanthus*

Chondracanthus merlucii (Holten, 1802)

Description (Fig. 3.11): Female body length about 12mm. Cephalosome trapezoidal with short acuminate processes at posterolateral angles. Anterolateral processes of trunk small, tubercular; lateral pair of processes subcylindrical, extending beyond end of abdomen; posterior pair of processes about as long as lateral pair. First legs smaller than second; both pairs bilobed.

Host: In oral-branchial cavities of *Merluccius hubbsi* (Carvalho, 1951).

Family **Ergasilidae** von Nordmann, 1832
(Figs. 3.12, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18)

Podoplea, Poecilostomatoida. Body cyclopiform but often slightly transformed in female by swelling of prosome somites; cyclopiform in male. Prosome comprising cephalosome and 4 free pedigerous somites; sometimes with first or first and second pedigerous somites incorporated into cephalothorax, or with boundaries between some or all prosome somites indistinct and forming inflated trunk. Some genera provided with large, movable posteriorly-directed stylets (retrostylets) at posterolateral angles of dorsal cephalic shield. Postantennary "neck" region present in *Therodamas*. Urosome typically 5-segmented in female, comprising fifth pedigerous somite, genital double-somite formed by fusion of genital and first abdominal somites and 3 free abdominal somites. Anal somite deeply incised. Number of abdominal somites often reduced. Urosome typically 6-segmented in male. Genital apertures paired, located dorsolaterally on double-somite in female, ventrally in male. Caudal rami with 3 to 5 setae.

Rostrum broad, occasionally forming large, posteriorly-directed spine. Nauplius eye present. Antennule 5 or 6-segmented in both sexes: homologies of 3 distal segments XXI-XXIV, XXV, XXVI-XXVIII; distal 3 segments typically armed with 4 + ae (aesthetasc), 2 + ae, 7 + ae. Antenna 3 or 4-segmented; with coxa and basis fused to form coxobasis unarmed or bearing 1 basal seta, and an endopod of 2 or 3 segments. First segment well developed, often elongate; second and third segments often fused, together with apical claw forming subchela; 2 claws present in some genera, 3 in *Paraergasilus*. Labrum broad, with slightly concave posterior margin. Mandible a single segment produced medially; armed with a large spinulate blade distally, a smaller, spinulate blade subapically on posterior margin and a smaller spine subapically on anterior margin; armature rarely reduced. Maxillule typically a broad lobe armed with 2 setae on apex and 1 seta medially, sometimes reduced to unarmed lobe. Maxilla comprising unarmed syncoxa and distal basis; syncoxa with opening of maxillary gland, basis densely covered with spinules. Maxilliped absent in female. Male maxilliped 3 to 5-segmented, comprising syncoxa, robust basis and distal subchela consisting of 1 or 2 free endopodal segments plus terminal claw, incorporating at least 1 endopodal segment: maximum armature formula 0, 0, 0, 2, 1+claw.

Swimming legs 1 to 4 biramous typically with 3-segmented rami except for 2-segmented exopod on leg 4. Segmentation often reduced so that rami may be 1 or 2-segmented. Intercoxal sclerites present in legs 1 to 4. Leg 4 reduced to a seta in *Abergasilus*, rarely absent, as in *Brasergasilus* and *Mugilicola*. Spine and seta formula typically:

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

Inner seta on basis of leg 1 absent. Inner coxal seta absent. Setation of rami often further reduced or modified. Fifth leg 2-segmented with free protopodal segment or with protopod incorporated into somite, represented by outer basal seta; exopod 1-segmented with 1, 2 or 3 setae; leg 5 sometimes lacking free segment, and reduced to a single seta. Leg 6 represented by unarmed genital opercula in female; armed with 1 seta in male. Egg sacs paired, usually multiseriate.

Nauplii with characteristic mandible: mandibular palp with 2-segmented endopod, first segment typically produced medially and bearing 2 spines, second segment bearing large spatulate apical element plus up to 3 setae.

First copepodid stage: antennular setation formula 3, 3 + aesthetasc, 2 + aesthetasc, 7 + aesthetasc: antenna with single claw (or claws) located apically on third endopodal segment: mandible with 2 laterally spinulate blades distally and 1 located proximally on outer margin.

Type-genus: *Ergasilus* von Nordmann, 1832.

Included genera:

Abergasilus Hewitt, 1978, *Acusicola* Cressey in Cressey & Collette, 1970, *Amplexibranchius* Thatcher & Paredes, 1985b, *Brasergasilus* Thatcher & Boeger, 1983, *Dermoergasilus* Ho & Do, 1982, *Diorgasilus* Do, 1981, *Ergasilus* von Nordmann, 1832, *Gamidactylus* Thatcher & Boeger, 1984a, *Gamispatulus* Thatcher & Boeger, 1984c, *Gamispinus* Thatcher & Boeger, 1984b, *Miracetyma* Malta, 1993, *Mugilicola* Tripathi, 1960, *Neoergasilus* Yin, 1956, *Nipergasilus* Yin, 1949, *Paeonodes* C.B. Wilson, 1944, *Paraergasilus* Markevich, 1937, *Pindapixara* Malta, 1994, *Prehendorastrus* Boeger & Thatcher, 1990, *Pseudovaigamus* Amado, Ho & Rocha, 1995, *Rhinergasilus* Boeger & Thatcher, 1988, *Sinergasilus* Yin, 1949, *Teredophilus* Rancurel, 1954, *Thersitina* Norman, 1905, *Therodamas* Krøyer, 1864, *Vaigamus* Thatcher & Robertson, 1984.

Taxonomic notes

The Ergasilidae is a well defined family characterized by the form of the antennae, mandibles, maxillules and maxillae. The presence of a 2-segmented exopod on the fourth leg is also characteristic of the group although a few genera have secondarily reduced fourth legs. The family comprises four subfamilies of which only three are recognized here as valid: Ergasilinae, Therodamasinae and Acusicolinae. The Abergasilinae proposed by Thatcher

& Boeger (1983) is not accepted. It is based on the erroneous observation that the fourth leg is absent in *Abergasilus*, but as Jones (1981) has shown this appendage is present although much reduced. In addition, *Paeonodes* lacks a fourth leg but its close similarity to *Mugilicola* (a four-legged form) in gross morphology suggests that the loss of this limb is convergent in *Paeonodes* and *Brasergasilus*. Boxshall (1986a) reviewed the Therodamasidae and adopted the suggestion of Cressey (1972a) that this family, excluding *Mugilicola* and *Paeonodes*, should be accorded subfamilial status within the Ergasilidae.

Amazonicopeus is a junior synonym of *Therodamas* within the family Ergasilidae, following Alston et al. (1993) and Amado et al. (1995). The subfamily Therodamasinae, distinguished by its postantennary cephalic "neck", occupies an analogous position to the subfamily Lernentominae within the Chondracanthidae.

Thatcher & Boeger (1985) included *Macrobrachinus* Hesse, 1871 and *Megabrachinus* Hesse, 1871 in the Ergasilinae but these two genera are here treated as genera inquirenda as suggested by Kabata (1979a). The genus *Limnoncaea* Kokubo, 1914, originally placed in the Oncaeidae, comprises species of *Ergasilus* and *Diargasilus*. Assuming *L. genuina* to be the type species of *Limnoncaea*, this genus becomes a junior synonym of *Ergasilus*. The four genera previously placed in the Vaigamidae are here included in the Ergasilidae following the analysis of Amado et al. (1995). Kabata (1992) expressed some doubts as to the validity of *Dermoergasilus* but did not follow Gusev (1987) in rejecting it as not distinct from *Ergasilus*.

There are over 150 described species of ergasilids. Most of these are found in freshwater with only 23 species occurring in estuarine or coastal marine habitats. The life cycle typically comprises six naupliar stages, five copepodids and the adults, as described for *Neoergasilus japonicus* Harada by Urawa et al. (1980a, b), for *Ergasilus sieboldi* von Nordmann by Abdelhalim, Lewis & Boxshall (1991) and for *E. briani* Markewitsch by Alston et al. (1996). Of these, only the adult females are parasitic, all the developmental stages and the adult males are free-living. The free-living, planktonic stages are rarely caught in freshwater plankton samples but in some habitats can be exceedingly abundant. Nearly all adult female ergasilids are parasites of teleost fishes, typically attaching to the gill filaments with their large subchelate antennae. Some species utilise other microhabitats on the fish host, attaching to the fins or inside the nasal fossae.

Key to genera

1. Antennary region of cephalosome separated from oral region by slender "neck".....*Therodamas*
Cephalosome separated from pedigerous somites by long neck region; body lacking external segmentation.....2
- Cephalosome not separated from pedigerous somite by long neck; body typically with clear external segmentation.....3

2. Leg 4 absent.....*Mugilicola*
 Leg 4 present, biramous with 1-segmented rami.....*Paeonodes*
3. Large, posteriorly-directed stylets (retrostylets) present at posterolateral angles of dorsal cephalic shield.....19
 Rear margin of cephalosome without such stylets.....4
4. Antenna with extremely elongate second segment (first endopodal segment) and short claw that locks into groove in third segment of other member of pair.....5
 Antennae not interlocking in this manner.....6
5. Endopod of first leg 2-segmented, lacking setae.....*Amplexibranchius*
 Endopod of first leg armed with at least 6 elements.....*Acusicola*
 Endopod of first leg 1-segmented, armed with long terminal claw.....
*Miracetyma*
6. Fourth leg absent.....*Brasergasilus*
 Fourth leg present.....7
7. Fourth leg reduced to lobe bearing single seta.....18
 Fourth leg biramous.....8
8. Antenna with 3 distal claws.....*Paraergasilus*
 Antenna with 1 or 2 claws.....9
9. Antenna with 2 claws.....10
 Antenna with single claw.....11
10. Antennary claws similar in size; second pedigerous somite not fused with cephalothorax.....*Diergasilus*
 Antennary claws unequal; second pedigerous somite fused to inflated cephalothorax.....*Thersitina*
11. Antenna covered with loose, hyaline cuticular membrane.....
*Dermoergasilus*
 Antenna not covered with loose, hyaline cuticular membrane.....12

12. Fourth and fifth pedigerous somites fully fused but separate from third pedigerous and genital somites.....*Nipergasilus*
Fourth and fifth pedigerous somites not fused into isolated double-somite..... 13
13. Second segment (first endopodal segment) of antenna robust with 1 or 2 prominent teeth on medial margin.....*Prehendorastrus*
Second antennary segment without such teeth..... 14
14. Leg 1 with large spatulate spine on outer margin of exopodal segment 2; spinous process present on basis between rami.....*Neoergasilus*
Leg 1 without modified spine on exopod and without process on basis..... 15
15. Free pedigerous somites distinct and about equal in width, prosome not tapering posteriorly.....*Sinergasilus*
Prosome tapering posteriorly, or pedigerous somites swollen and fused..... 16
16. First to fourth pedigerous somites grossly inflated and fused to cephalosome; antenna with spinous processes on first and second segments.....*Teredophilus*
Pedigerous somites typically well defined, rarely all fused; antenna without spinous process on first and second segments..... 17
17. Leg 4 with both rami 2-segmented.....*Pindapixara*
Leg 4 with exopod 2-segmented and endopod 3-segmented
.....*Ergasilus*
18. Antenna 4-segmented; egg sac uniseriate.....*Rhinergasilus*
Antenna 3-segmented; egg sac multiseriate.....*Abergasilus*
19. Antenna with single terminal claw..... 22
Antenna with 2 terminal claws..... 20
20. Antennule 6-segmented in female; second segment of antenna with 1 inner spine.....*Gamidactylus*
Antennule 5-segmented in female; second segment of antenna with inner spine plus a large patch of spinules..... 21

21. Large spatulate process present medial to retrostylets on rear margin of dorsal cephalic shield.....*Gamispatulus*
 Retrostylets simple, without adjacent processes.....*Gamispinus*
22. Leg 4 with 2-segmented endopod and 1-segmented exopod.....*Vaigamus*
*Vaigamus*
 Leg 4 with 3-segmented endopod and 2-segmented exopod.....*Pseudovaigamus*
*Pseudovaigamus*

Brazilian species and records

Genus *Acusicola*

Acusicola cunula Cressey & Collette, 1970

Description (Fig. 3.12): Body length of female 0.65mm. Body form cyclopiform, with relatively short urosome including 3 free abdominal somites. Antennule 5-segmented. Antenna with extremely elongate first endopodal segment comprising over half total length of limb; second endopodal segment with shield-like expansion partly enclosing fourth segment. Leg 1 with 2-segmented endopod due to fusion of second and third segments. Leg 5 reduced to papilla with apical seta.

Host: On gill filaments of *Pseudotyllosurus angusticeps* (Cressey & Collette, 1970).

Genus *Ergasilus*

Ergasilus euripedesi Montú, 1980

Description (Fig. 3.13): Body length of adult female about 0.8mm. Cephalothorax wider than, and apparently separated, from first pedigerous somite. Antenna with distinctive barb-like tooth on inner margin of claw. Leg 1 with 2-segmented endopod due to fusion of second and third segments. Legs 2 to 4 each with 2 inner setae on second endopodal segment. Fifth leg reduced to small papilla with 2 setae.

Hosts: Free in plankton and on body and gills of *Brevoortia pectinata*, *Micropogonias furnieri*, *Lycengraulis grossidens* (Montú, 1980).

Ergasilus lizae Krøyer, 1863

Description (Fig. 3.14): Body length of adult female about 1.1mm. Cephalothorax retaining trace of boundary between cephalosome and first pedigerous somite; cephalothorax violin-shaped, narrowing posteriorly. Antenna slender, lacking any inflation between coxobasis and first endopodal segment, with small outgrowth on inner margin of first endopodal segment; subchela with proximal and distal setules on inner margin.

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

Ergasilus longimanus Krøyer, 1863

Description (Fig. 3.15): Incompletely known. Antenna with long slender claw.

Host: On gill filaments of *Mugil* sp. (Krøyer, 1863).

Ergasilus orientalis Yamaguti, 1939

Description (Fig. 3.15): Body length of female about 0.7 to 0.8mm. Prosome large due to swollen first pedigerous somite fused to cephalosome. Second to fourth pedigerous somites separate, relatively small, each narrower than preceding somite. Urosome short. Antennule 6-segmented. Antenna with area of inflated membrane between coxobasis and first endopodal segment. Legs 1 to 4 with 1, 2, 2, 2 inner setae on second endopodal segment. Leg 4 with outer spine on first exopodal segment, 5 setae on distal segment. Fifth leg with 1 basal and 2 terminal setae.

Host: On gill filaments of *Potamorrhaphis guianensis* (Cressey & Collette, 1970).

Ergasilus versicolor Wilson, 1911

Description (Fig. 3.16): Body length of adult female 1.0 to 1.3mm. Cephalothorax often with deep transverse furrow. Antenna lacking any inflation between coxobasis and first endopodal segment, with papilliform process on inner margin of first endopodal segment; subchela claw with papilla proximally and setule distally on inner margin. Leg 1 with 2-segmented endopod due to fusion of second and third endopodal segments.

Hosts: On gill filaments of *Mugil cephalus* (Paiva Carvalho, 1962 as *Ergasilus cyanopictus*) and *Mugil platanus* (Knoff et al., 1994).

Genus *Therodamas*

Therodamas serrani Krøyer, 1863

Description (Fig. 3.17): Body comprising cephalic region, neck of variable length and trunk. Antennule 5-segmented. Antenna robust with short distal claw. Leg 1 with 3-segmented endopod. Third exopodal segment of leg 4 with 4 setae. Caudal ramus apparently with 2 setae.

Hosts: On gills of *Trachyurus barbatus* and *Mugil* sp. (Carvalho, 1955b).

Therodamas tamarae Amado & Rocha, 1996.

Description (Fig. 3.18): Length of cephalosome 0.58mm, neck and head shield 0.44mm, genital double-somite and abdomen 0.30mm. Antennule 5-segmented. Antenna robust with short distal claw. Leg 1 with 2-segmented endopod. Second exopodal segment of leg 4 with 5 setae. Caudal ramus with 4 setae.

Host: On gill arches of *Plagioscion squamosissimus* (Amado & Rocha, 1996).

Family **Lernaeosoleidae** Yamaguti, 1963
(Fig 3.19)

Podoplea, Poecilostomatoida. Body of adult female highly transformed, divisible into head, neck, trunk and genitoabdomen, but with no external segmentation. Head with or without lobes; embedded in host. Neck slender. Trunk bilobed: posterolateral lobes very well developed. Genitoabdomen small, lobate, bearing paired gonopores ventrolaterally and reduced caudal rami posteriorly. Head with antennary region more or less produced. Antennules short, indistinctly segmented, with reduced armature. Antennae forming pair of large basal socket-like structures, apparently bearing terminal claw. Presence of mouth, mouthparts and swimming legs unconfirmed in adult. Egg sacs paired, multiseriate.

Type-genus: *Lernaeosolea* C.B. Wilson, 1944.

Included genera:

Bobkabata Hogans & Benz, 1990, *Lernaeosolea* C.B. Wilson, 1944.

Taxonomic notes

Hogans & Benz (1990) established this as a new family and placed it in the Poecilostomatoida. However as Yamaguti (1963) used the name Lernaeosoleinae, based on *Lernaeosolea* Wilson as type genus, for a subfamily of his Lernaeidae (= Pennellidae), he becomes the authority for the familial name. Hogans & Benz (1990) pointed to a close relationship between the Lernaeosoleidae and the Chondracanthidae but distinguished between these families on the basis of the lack of a distinct mouth and associated oral appendages in lernaeosoleids, on the lack of thoracic swimming legs, and on the morphology of the trunk.

Key to genera

1. Head branching, with 5 processes.....*Bobkabata*
Head subspherical, without paired processes.....*Lernaeosolea*

Brazilian species and records

None.

Family **Pharodidae** Illg, 1948
(Fig. 3.20)

Podoplea, Poecilostomatoida. Body highly transformed in both sexes. Female body divisible into head, trunk and caudal process. Head comprising cephalosome somites, with or without cephalic processes. Trunk comprising all post-cephalosomic somites fused into large horseshoe-shaped region lacking external segmentation. Caudal process representing a posterior

extension of pregenital region of trunk. Genital and abdominal somites fused to form minute genitoabdomen located posteroventrally on trunk. Genital apertures paired, located posteriorly on genitoabdomen. Dwarf male with body comprising swollen cephalothorax and short, tapering trunk. Genital apertures paired, posteroventral on trunk. Caudal rami with 4 setae in female, 5 in male; terminal seta large.

Antennule indistinctly 4-segmented in both sexes. Antenna with coxa and basis fused to form unarmed coxobasis; first and second endopodal segments fused forming powerful, strongly curved claw; distal segment of endopod forming small offset process (accessory antennule) bearing 2 apical setae. Labrum a triangular plate, strongly convex posteroventrally. Mandible lanceolate with fine spinules on terminal blade. Paragnaths absent. Maxillule reduced to a simple lobe bearing a short apical spine. Maxilla in female comprising syncoxa and basis drawn out into a slender tapering process bearing a proximal spine. Male maxilla subchelate comprising robust syncoxa and distal subchela representing basis. Maxilliped indistinctly 3-segmented in female, comprising swollen, unarmed and partly fused syncoxa and basis plus an unsegmented endopod bearing a proximal spine and an apical spinous process, possibly incorporating another endopodal segment. Male maxilliped subchelate; robust proximal segment representing fused syncoxa and basis, subchela comprising free endopodal segment plus terminal claw.

First swimming leg lobate, armed with 1 seta; legs 2 to 5 absent in female. Male legs 1 and 2 lobate with 1 apical seta; leg 3 represented by seta on surface of somite. Legs 4 and 5 absent. Leg 6 represented by unarmed genital opercula in both sexes. Egg sacs paired, multiseriate.

Type and only included genus: *Pharodes* C.B. Wilson, 1935.

Taxonomic notes

Illg (1948) placed *Pharodes* in a separate subfamily, the Pharodinae, within the Chondracanthidae and Ho (1971), in his redescription of *Pharodes*, proposed the establishment of a new family for this genus and recognized only three valid species. Ho also recognized the so-called caudal process as a thoracic outgrowth and correctly identified the genitoabdomen. The Pharodidae differs from the Chondracanthidae in the possession of a subchelate maxilla in the male and in the form of the mandible. The species of *Pharodes* are all parasites on the gills of marine fishes. The hosts are from a wide range of families including the Gobiidae, Clinidae, Blenniidae, Bothidae, Caracanthidae and Labridae (Ho, 1971). The male is markedly smaller than the female but it attaches directly to the gills of its host using both maxillae and maxillipeds, unlike the dwarf males of chondracanthids which attach to the female.

Brazilian species and records

None.

Family **Philichthyidae** Vogt, 1877
(Fig. 3.21)

Podoplea, Poecilostomatoida. Body of female highly transformed; elongate, flattened or highly irregular with numerous processes. Male body slender, with segmentation distinct. Body in both sexes comprising cephalosome, 5 free pedigerous somites, genital somite and 4-segmented abdomen. Pedigerous somites of female often swollen, or fused together. Simple or bifurcate lobes often present on cephalosome, fused pedigerous somites, genital somite and abdomen of female. Male with pair of dorsal processes on second pedigerous somite. Genital apertures paired, dorsolateral on genital somite in female; ventral in male. Caudal rami with up to 6 setae.

Rostrum possibly represented by medium lobe on anterior margin of cephalosome. Nauplius eye present. Antennule indistinctly 2 to 8-segmented in female; 5 to 6-segmented in male; typically with aesthetasc on apical segment. Antenna 4-segmented in male, comprising fused coxobasis and 3-segmented endopod; endopodal segment 2 typically with 1 claw and 2 setae, segment 3 with 1 claw and 3 setae; sometimes absent. Labrum enclosed within buccal capsule formed by antennae and a posterior cuticular fold. Mandible unsegmented with 2 falcate blades in male, often reduced or missing in female. Maxillule small, unilobate; bearing a medial spine and up to 3 apical setae; often reduced. Maxilla large, lobate; with 2 large spines apically and 2 small spines proximally, or with a single claw-like apical spine; often reduced. Maxilliped reduced to simple, 1 to 2-segmented lobe bearing a long apical spine; often absent.

Swimming legs 1 and 2 biramous with 1 or 2-segmented rami; leg 3 biramous, uniramous or absent; leg 4 represented by setose lobe in *Procolobomatus*, more usually by single seta or absent. Leg segmentation more distinct in males. Inner coxal seta present or secondarily absent in legs 1 and 2 of male. Fifth leg absent. Leg 6 represented by lobe armed with up to 2 setae near genital apertures of female; typically with 1 seta in male. Egg sacs multiseriate; attached about at midlevel.

First copepodid stage: antennular setation formula 1 2, 3 + aesthetasc, 2 + aesthetasc, 7 + aesthetasc; antenna with 1 geniculate claw on second endopodal segment and 2 geniculate claws on third; mandible vestigial in *Sarcotaces*, drawn out into tapering medial process in *Colobomatus*.

Type-genus: *Philichthys* Steenstrup, 1862.

Included genera:

Colobomatoides Essafi & Raibaut, 1980, *Colobomatus* Hesse, 1873, *Ichthyotaces* Shiino, 1932, *Leposphilus* Hesse, 1866, *Lernaeascus* Claus, 1886, *Philichthys* Steenstrup, 1862, *Procolobomatus* Castro Romero, 1994, *Sarcotaces* Olsson, 1872, *Sphaerifer* Richiardi, 1876.

Taxonomic notes

The family comprises 53 species, 40 of which belong to *Colobomatus*. Five of the known genera are monotypic. West (1992) presented a revised diagnosis of the family and of the genus *Colobomatus*, and his scanning electron micrographs of the oral area greatly facilitate interpretation of the buccal capsule and associated appendages. Castro Romero (1994) erected *Procolobomatus* to include a new species *P. hemilutjani* Castro Romero and *P. kyphosus* (Sekerak).

Philichthyids are internal parasites; most are occupants of subcutaneous spaces associated with the sensory canals of the lateral line and skull bones of marine teleost fishes. Some genera produce pouch-like invaginations by burrowing either under scales along the side of its host, or into the walls of the alimentary canal, often in the rectal area. Philichthyids differ from true endoparasites in retaining contact with the external environment via their pore of entry.

Key to genera (based on adult females)

1. Body elongate, typically with slender, tapering abdomen; often with paired lobes.....2
Body squat, globular with paired lateral lobes and dorsal lobes.....*Ichthyotaces*
2. Body nearly ovate, surface ornamented with numerous lobules; caudal rami lost in adult.....*Sarcotaces*
Body elongate, typically with large, paired lateral lobes; abdomen ending in paired caudal rami.....3
3. Body with at least 1 pair of lateral processes.....5
Body without lateral processes.....4
4. Middle section of body comprising third to fifth pedigerous somites swollen, wider than anterior and posterior sections.....*Leposphilus*
Entire anterior part of body from cephalothorax to genital somite swollen, free abdomen narrow.....*Lernaeascus*
5. Third to fifth pedigerous somites swollen, bearing single pair of lateral processes; no other processes present.....*Sphaerifer*
More than one pair of lateral processes present on body.....6
6. At least five pairs of lateral processes present on free abdominal somites posterior to genital somite.....7
Free abdominal somites without lateral processes.....8

7. Buccal region surrounded by circlet of processes; paired clusters of dorsal processes present on swollen region of thorax.....*Colobomatoides*
Cephalothorax with 3 pairs of lateral processes; processes on swollen region of thorax laterally located.....*Philichthys*
8. Leg 3 biramous in both sexes; leg 4 2-segmented, with 3 setae in female; lobate with 3 setae in male.....*Procolobomatus*
Leg 3 uniramous in male; leg 4 absent in female, lobate with single seta or absent in male.....*Colobomatus*

Brazilian species and records

Genus *Colobomatus*

Colobomatus belizensis Cressey & Schotte, 1983

Description (Fig. 3.21): Female body length 4.1 to 9.4mm. Single cephalic lobe extending anteriorly from above buccal cone. Paired anterior and posterior processes present. Genital somite with small lateral lobes. Four more or less distinct abdominal somites present; penultimate somite with paired posterolaterally directed processes. Caudal rami forming elongate posterolateral processes. Male body length 1.9mm, with paired processes dorsally on second pedigerous somite.

Hosts: In mucus canals in head region of *Haemulon aurolineatum*, *H. steindachneri* and *Orthopristis chrysopterus* (Cressey & Schotte, 1983; Luque & Takemoto, 1996)

Family **Shiinoidae** Cressey, 1975

(Fig. 3.22)

Podoplea, Poecilostomatoida. Body of female transformed by swelling of prosome and anterior part of urosome. Male body cyclopiform. Prosome comprising cephalosome, cylindrical trunk comprising first to fifth pedigerous somites and showing well defined external segmentation posteriorly but with segmentation obscure anteriorly, and posterior region comprising genital and abdominal somites. Posterior margin of trunk with posterolateral lobes in some species. Male with well defined segmentation; prosome-urosome boundary not well defined. Posterior region 4-segmented in female; comprising genital double somite and 3 free abdominal somites; or these somites fused. Urosome 6-segmented in male. Genital apertures paired, located dorsolaterally on genital complex in female, ventrally in male. Caudal rami well developed, with 6 setae.

Rostral area produced anteriorly in female, bearing antennules and antennae. Antennule indistinctly 6-segmented in both sexes. Antenna well developed, forming primary attachment mechanism: sexually dimorphic; in female comprising 2 large curved segments closing against produced rostral area to form chela. Antennae aligned anteroventrally (in *Shiinoa*) or

transversely (in *Parashiinoa*). Male antenna 2-segmented; distal segment representing fused second and third endopodal segments, armed with 2 or 3 large claws and 4 to 6 setae. Labrum well developed, medially incised. Mandible drawn out into a bilaterally toothed lash and bearing a bilaterally toothed seta. Maxillule a simple lobe bearing 1 to 3 apical setae. Maxilla comprising unarmed syncoxa and claw-like basis; basis bearing 2 setae proximally; claw with large teeth bilaterally. Maxillipeds absent in both sexes.

Swimming legs 1 and 2 biramous with 2 to 3-segmented rami; setation reduced. Leg 3 uniramous; reduced to protopodal segment partly incorporated into somite, armed with outer seta, and unsegmented exopod bearing 2 or 3 spines. Legs 4 and 5 absent. Inner seta on basis of leg 1 absent. Inner coxal seta absent in legs 1 and 2. First exopodal segment without inner seta in legs 1 and 2. Leg 6 represented by genital opercula, armed with up to 2 setae in both sexes. Egg sacs paired, multiseriate.

Type-genus: *Shiinoa* Kabata, 1968.

Included genera:

Parashiinoa West, 1986, *Shiinoa* Kabata, 1968a.

Taxonomic notes

Cressey (1975) erected the family to accommodate two species of *Shiinoa*, a genus established by Kabata (1968a) but not assigned to any family due to the lack of adult specimens. *Shiinoa bakeri* Cressey & Cressey, 1986, was transferred by West (1986) to his new genus, *Parashiinoa*.

Shiinoids are parasites of marine fishes. Species of *Shiinoa* are found on the nasal lamellae and gill filaments of their hosts, species of *Parashiinoa* on the nasal lamellae or fins. They have a wide distribution, occurring on scombrid, haemulid, lutjanid and carangid fishes in the Indo-Pacific and western Atlantic oceans.

Key to genera

1. Female antennae aligned antero-posteriorly; legs 1 and 2 with at least one or both rami 3-segmented in both sexes.....*Shiinoa*
 Female antennae aligned transversely; legs 1 and 2 with 2-segmented rami in both sexes.....*Parashiinoa*

Brazilian species and records

Genus *Shiinoa*

Shiinoa inauris Cressey, 1975

Description (Fig. 3.22): Body length of adult female about 3.7mm, male 1.9mm. Body cylindrical, prosome somewhat swollen but with external

segmentation obvious. Frontal margin of head produced into large rostrum opposing large subchelate antennae. Urosome tapering, somites poorly defined; representing about one third of body length. Fifth pedigerous somite with pair of dorsolateral processes. Legs 2 and 3 with 2-segmented exopods in both sexes.

Hosts: On the nasal lamellae of *Scomberomorus brasiliensis*, *S. maculatus* and *S. regalis* (Cressey & Cressey, 1980)

Family **Taeniacanthidae** C.B. Wilson, 1911

(Figs. 3.23, 3.24)

Podoplea, Poecilostomatoida. Body cyclopiform in both sexes; females of some genera slightly transformed by enlargement and partial fusion of some or all of the pedigerous somites, or by elongation and swelling of abdominal somites. Prosome comprising cephalothorax incorporating first pedigerous somite, and 3 free pedigerous somites. Pedigerous somites sometimes swollen and more or less fused. Urosome typically 6-segmented in both sexes comprising fifth pedigerous somite, genital somite and 4 free abdominal somites; abdomen reduced to 2 or 3 free somites in some genera. Genital apertures paired; lateral in female, ventral in male. Caudal rami with 6 or 7 setae.

Rostrum well developed; variable in form, with median posteroventral spine in *Taeniacanthodes*. Nauplius eye present. Antennule 5 to 7-segmented; typically with armature formula 5, 15, 5, 3, 4, 2 + aesthetasc, 7 + aesthetasc. Armature may be reduced in some genera. Segments 3 and 4 fused in 6-segmented antennule, and segments 1 and 2 also fused in 5-segmented antennule. Antenna typically 4-segmented; with coxa and basis fused to form coxobasis bearing 1 basal seta, endopod 3-segmented. Antenna sometimes 3-segmented due to fusion of second and third endopodal segments. Endopodal segment 1 with 1 seta; segment 2 with 1 claw-like spine and 2 pectinate processes; segment 3 typically with 2 claw-like spines and 4 setae. Armature sometimes reduced. Postantennal process located posterolaterally to bases of antennules; absent in some genera. Labrum typically with rounded, convex posterior margin. Mandible forming a medially-directed process bearing 2 spinulated blades distally; an accessory seta present in some species; rarely single blade retained. Paragnath a small, digitiform lobe. Maxillule a rounded lobe bearing 3 to 6 setae. Maxilla comprising robust syncoxa, bearing 1 seta or unarmed, and small basis forming a spinulated terminal process bearing 1 spinulated spine and 1 or 2 setae, rarely 3 in some *Pseudotaeniacanthus*. Maxilliped typically 3-segmented in female, comprising syncoxa, basis and terminal claw incorporating endopod; claw sometimes recurved, or reduced or sigmoid in form; setal formula 1, 2, 1 + claw. Maxilliped absent in *Echinirus*. Male maxilliped 4-segmented, comprising syncoxa, robust basis, 1 free endopodal segment and terminal claw incorporating at least 1 endopodal segment; setal formula 1, 2, 0, 2 + claw. Claw with toothed concave margin.

Swimming legs 1 to 4 biramous. Leg 1 with 2 or 3-segmented rami, typically flattened and forming posterior border of cephalothoracic suction cup. Legs 2 and 3 with 3-segmented rami. Leg 4 with 3-segmented exopod and 2 or 3-segmented endopod. Third exopodal segments long and claw-like in some *Taeniacanthus*. Intercoxal sclerites present in legs 1 to 4. Spine and seta formula:

	coxa	basis	exopodal segments	endopodal segments
leg 1	0-1	1-I	I-0; I-1; 5/8	0-1; 0-1; I,2,3
leg 2	0-0/1	1-0	I-0; I-1; III,I,5	0-1; 0-1/2; I,II,3
leg 3	0-0/1	1-0	I-0; I-1; II,I,5	0-1; 0-1/2; I,2,3
leg 4	0-0	1-0	I-0; I-1; II,I,5	0-1; 0-1; II,1

Inner seta on basis of leg 1 sometimes secondarily absent. Exopodal segment 3 with a total of 5 to 8 typically setiform elements in leg 1. Setation of rami often reduced. Endopod of leg 4 armature variable with between 2 and 4 elements on distal segment. Fifth leg uniramous, 2-segmented; protopod with outer seta, exopod typically with 4 elements, rarely 3. Leg 6 represented by genital opercula, armed with 3 setae in female, unarmed in male. Egg sacs paired, multiseriate.

First copepodid stage: antennular setation formula 2, 2, 2 + aesthetasc, 2 + aesthetasc, 7 + aesthetasc: antenna with distal process and well developed claw on spinulate inner margin of second endopodal segment, third endopodal segment slightly offset and bearing 2 distal claws: mandible with 2 distal blades.

Type-genus: *Taeniacanthus* Sumpf, 1871.

Included genera:

Cirracanthus Dojiri & Cressey, 1987, *Clavisodalis* Humes, 1970, *Echinirus* Humes & Cressey, 1959, *Echinosocius* Humes & Cressey, 1959, *Irodes* C.B. Wilson, 1911b, *Metataeniacanthus* Pillai, 1963, *Nudisodalis* Dojiri & Cressey, 1987, *Phagus* C.B. Wilson, 1911, *Pseudotaeniacanthus* Yamaguti & Yamasu, 1959, *Scolecicara* Ho, 1969, *Taeniacanthodes* C.B. Wilson, 1935, *Taeniacanthus* Sumpf, 1871, *Taeniastroto* Cressey, 1969.

Taxonomic notes

This family has been extensively studied and is the subject of two recent revisions. Dojiri & Humes (1982) reviewed the taeniacanthids parasitic on sea urchins in the southwestern Pacific. Dojiri & Cressey (1987) revised the entire family and provided a comprehensive diagnosis of the family, a key to genera and keys to the species parasitic on fishes. The key to genera presented here is modified from Dojiri & Cressey (1987) after adopting Kabata's (1992) treatment of *Anchistroto* Brian, 1906 as a synonym of *Taeniacanthus*.

Haemaphilus Hesse, 1871 is a taeniacanthid but is here treated as a *genus inquirendum*.

Key to genera (based on females)

1. Rami of leg 1 flattened, lamellate, 2 or 3-segmented; setae with long pinnules.....3
 Rami of leg 1 slender, 2-segmented; setae with short pinnules.....2
2. Maxilliped absent; second pedigerous somite free.....*Echinirus*
 Maxilliped present; second pedigerous somite partly or completely fused to cephalothorax.....*Clavisodalis*
3. Maxilliped without distinct basis and claw, reduced to pear-shaped swelling bearing a ridge armed with 3 setae; antennule 5-segmented..
*Echinosocius*
 Maxilliped with well developed, distinct basis and claw, or with distinct basis but claw reduced to rounded process (in which case antennule 6-segmented).....4
4. Second pedigerous somite forming elongate neck.....*Scolecicara*
 Second pedigerous somite not forming elongate neck.....5
5. Rostral area with corrugated shield-like plate on ventromedian surface.....*Taeniastrotos*
 Rostral area without corrugated shield-like plate on ventromedian surface.....6
6. Cephalothorax with pair of spatulate processes on posteroventral surface; antennule 5-segmented.....*Taeniacanthodes*
 Cephalothorax without such posteroventral process; antennule 6 or 7-segmented.....7
7. Rostral area with Y-shaped, sclerotized structure bearing transverse rows of hooklets or ridges.....*Pseudotaeniacanthus*
 Rostral area otherwise armed.....8
8. Postantennal process absent.....*Phagus*
 Postantennal process present.....9

9. Cephalothorax with ventrally directed lateral margins.....*Metataeniacanthus*
Cephalothorax without ventrally directed lateral margins.....10
10. Maxilla with 1 spinulated process and minute spine on basis.....*Nudisodalis*
Maxilla otherwise armed.....11
11. Maxilliped subchelate, with claw curved towards basis...*Cirracanthus*
Maxilliped otherwise.....12
12. Claw of maxilliped absent or fused to basis.....*Irodes*
Claw of maxilliped distinct.....*Taeniacanthus*

Brazilian species and records

Genus *Taeniacanthus*

Taeniacanthus lagocephali Pearse, 1952

Description (Fig. 3.23): Body length of female 2.0 to 2.4mm, of male 0.9mm. cephalothorax globular, incorporating first pedigerous somite, second to fourth pedigerous somites globose, about equal in width. Urosome short, 6-segmented, with separate genital somite. Postantennal process present. Mandible with 3 distal blades. Maxilliped claw curving away from basis. Rami of leg 1 both 2-segmented; rami of legs 2 to 4 all 3-segmented. Setation formula of leg 4 exopod I-0; I-1; II,I,4, endopod 0-1; 0-1; II, 1 or 2. Fifth leg with spatulate exopodal segment bearing 4 setae.

Host: In branchial cavities of *Lagocephalus laevigatus* (Dojiri & Cressey, 1987).

Genus *Taeniastroto*

Taeniastroto braziliensis Montú & Boxshall, 1997

Description (Fig. 3.24): Body length of female 1.3mm. Body cyclopiform, second to fourth pedigerous somites free, each narrower than preceding somite. Urosome short, 6-segmented, with separate genital somite 1.7 times wider than long. Rostrum with large shield-like plate ventrally. Maxilliped subchelate, with short distal claw lacking accessory process. Setation formula of leg 4 endopod 0-1; 0-1; II,1,I.

Host: On gills of *Cathrops pixi* (Montú & Boxshall, 1997)

Family **Tegobomolochidae** Avdeev, 1978

(Fig. 3.25)

Podoplea, Poecilostomatoida. Body squat, cyclopiform, slightly transformed by expansion of tergites of second to fourth pedigerous somites. Prosoma

comprising cephalothorax incorporating first pedigerous somite and 3 free pedigerous somites. Second pedigerous somite with pair of posterior processes on tergite; tergite of third somite narrower than that of fourth in female, wider than fourth in male. Urosome 5-segmented in female, with genital and first abdominal somites fused to form genital double-somite; 3 free abdominal somites. Urosome 4-segmented in male; comprising fifth pedigerous, genital and 2 free abdominal somites. Genital apertures paired, located dorsolaterally on double-somite in female, ventrally in male. Caudal rami with 6 setae.

Rostrum with rounded posterior margin. Nauplius eye present. Antennule 6-segmented; with horn-like process on first segment: setation formula 5, 12, 7, 3, 2 + 1 aesthetasc, 8 + 1 aesthetasc. Antenna 4-segmented; with coxa and basis fused to form coxobasis; endopod 3-segmented and reflexed. First segment with 1 seta; second segment with 2 claws and a distal process, covered with rows of spinules, extending over third segment; third segment small with 6 distal setae, 3 of which claw-like. Postantennary process absent. Labrum slightly incised at posterior tip. Mandible drawn out medially, bearing 2 distal blades. Paragnath a well developed, spinulose process with a hirsute lobe proximally. Maxillule a simple lobe with 4 setae. Maxilla 2-segmented; large syncoxa with 1 tiny seta, basis forming spinous apical process, bearing a large spine and 2 setae. Maxilliped 3-segmented in female, comprising slender syncoxa, basis with 1 seta, and distal claw incorporating at least 1 endopodal segment, bearing 1 seta. Male maxilliped 4-segmented, comprising unarmed syncoxa, robust basis ornamented with spinules medially and 1 spine, and distal subchela comprising free endopodal segment plus terminal claw bearing 2 setae proximally.

Swimming legs 1 to 4 biramous, with 3-segmented rami, except for 2-segmented exopod in leg 1. Rami and setae of first leg normally developed, as in other legs, not especially flattened. Intercoxal sclerite present in legs 1 to 4. Spine and seta formula:

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

Fifth leg uniramous, without any vestige of endopod: comprising protopodal segment bearing outer seta and large exopodal segment bearing 4 setae in both sexes. Leg 6 represented by opercula closing genital apertures in both sexes. Egg sacs paired, kidney-shaped, concealed beneath expanded tergite of fourth pedigerous somite.

Type and only included genus: *Tegobomolochus* Izawa, 1976.

Taxonomic notes

Tegobomolochus was established in the Bomolochidae by Izawa (1976) but was later made the type of a new family, the Tegobomolochidae, by Avdeev (1978). *Tegobomolochus* differs from members of the Bomolochidae in the unmodified state of the first leg, in the slender maxilliped of the female, in the form of the maxillule, and in the presence of expanded tergites on the second to fourth pedigerous somites. The single species, *T. nasicola* Izawa, lives in male-female pairs in the nasal cavities of the goatfish, a marine teleost, found off the coast of Japan. It is a large copepod (body length up to 4 mm) and lacks the attachment mechanism provided by the ventral sucker-like concavity formed by the cephalothorax in bomolochids.

Brazilian species and records

None.

Family **Telsidae** Ho, 1967
(Fig. 3.26)

Podoplea, Poecilostomatoida. Body extremely elongate, with length of abdominal region exceeding length of head and thorax. Prosome-urosome boundary non-functional. Body comprising cephalothorax, incorporating first pedigerous somite, 4 free pedigerous somites, a genital double-somite, and a very long, indistinctly 3-segmented abdomen. Genital apertures paired; located laterally on genital double-somite in female; ventrally on genital somite in male. Caudal rami with 6 setae on each ramus.

Rostrum small. Nauplius eye present. Antennule 6-segmented; setation formula 5, 13, 8, 4, 2 + aesthetasc, 7 + aesthetasc. Antenna with coxa and basis fused to form coxobasis, bearing 1 basal seta; endopod 2-segmented, reflexed over coxobasis. First endopodal segment with 1 seta; distal segment formed by fusion of second and third endopodal segments, armed with lateral group of 2 pectinate processes and a seta, and apical group of 7 elements. Mandible tapering distally, bearing 2 toothed blades. Maxillule reduced to a simple lobe bearing 3 setae. Maxilla well developed, prehensile; comprising robust proximal segment (syncoxa) and strong distal claw (basis). Maxilliped 3-segmented in female, comprising syncoxa, basis, and recurved, bifid apical claw representing endopod: setal formula 1, 2, 1 + claw. Male maxilliped 4-segmented, comprising syncoxa, robust basis, and 2-segmented endopod with distal segment drawn out into powerful claw: setal formula 1, 2, 0, 2 + claw.

Swimming legs 1 to 4 biramous with 3-segmented rami, connected by intercoxal sclerites. Leg 4 of female with elongate, indistinctly segmented rami. Spine and seta formula (using male leg 4):

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

Fifth leg elongate, protopod distinct, with outer seta; exopod 1-segmented with 3 serrate spines and 1 seta. Segments may be fused in female. Leg 6 represented by opercular plate armed with 3 setae in female and with 2 setae in male. Egg sacs paired, elongate, multiseriate.

Type and only included genus: *Telson* Pearse, 1952.

Taxonomic notes

Ho (1967c) established the Telsidae to accommodate *Telson*, a genus previously attributed either to the Taeniacanthidae or to the Bomolochidae. The Telsidae is undoubtedly related to these two families but is distinguished by the prehensile structure of the maxillae and by the extreme development of the female fourth legs. Only two species of *Telson* are known and both are parasites of uranoscopid fishes of the genus *Astroscopus* in the Gulf of Mexico.

Brazilian species and records

None.

Family **Tuccidae** Vervoort, 1962
(Fig. 3.27)

Podoplea, Poecilostomatoida. Body highly transformed in female; comprising cephalothorax incorporating first pedigerous somite, neck formed by second pedigerous somite, trunk comprising third and fourth pedigerous somites, and urosome. Cephalothorax with lateral expansions. Trunk inflated. Urosome flattened, with all somites fused. Genital apertures paired, dorsolateral on unsegmented urosome. Caudal rami with 6 setae.

Rostrum with strong median process. Antennule 5-segmented in female, armature bomolochid-like, setae densely packed along anterior margin; segmental armature 15 + 1 hook, 8, 3, 3 + 1 aesthetasc and 7 + 1 aesthetasc. Antenna with coxa and basis fused to form coxobasis; endopod 2-segmented; first endopodal segment with 1 seta; terminal segment representing fused second and third endopodal segments; margin of double segment with several rows of tiny spinules; armature comprising a pectinate, lamelliform process, a rod-shaped process, and 8 setae. Labrum slightly indented medially. Mandible produced medially, bearing toothed blades, 1 apical and 1 subapical. Paragnath a spinulose lobe. Maxillule a simple lobe bearing 4 setae. Maxilla 2-segmented; comprising unarmed syncoxa and basis drawn out into spinulate

process and bearing 2 spinulate spines. Maxilliped indistinctly 3-segmented, comprising partly fused syncoxa and basis plus a distal subchela representing endopod and terminal claw.

Swimming legs 1 to 4 biramous. Leg 1 with flattened, 3-segmented rami armed with broad, hirsute setae. Leg 2 with 2-segmented rami. Legs 3 and 4 with 2-segmented exopod and small 1-segmented endopod. Spine and seta formula:

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

Inner seta on basis of leg 1 modified as flattened lobe. Inner coxal seta present in leg 2 only. Fifth leg reduced to a lobe fused to somite proximally, bearing 3 setae. Leg 6 represented by unarmed genital opercula in female. Egg sacs paired, multiseriate.

Type and only included genus: *Tucca* Krøyer, 1837.

Taxonomic notes

Vervoort (1962) erected the subfamily Tuccinae in his revision of the Bomolochidae. Ho (1967b) redescribed *Tucca* in detail, providing evidence justifying the recognition of the Tuccidae as a separate family, as proposed by Yamaguti (1963). The sole species of *Tucca* is an ectoparasite of marine fishes belonging to the families Tetraodontidae and Diodontidae. It is typically located on the fins of its host. It occurs in the western North Atlantic from Massachusetts to São Paulo in Brazil, and in the Caribbean and Gulf of Mexico.

Brazilian species and records

Genus *Tucca*

Tucca impressus Krøyer, 1837

Description (Fig. 3.27): As for family diagnosis.

Host: On body surface and fins of *Chilomycterus schoepfii* (Carvalho, 1951)

Order SIPHONOSTOMATOIDA

Family **Archidactylinidae** Izawa, 1996
(Fig. 3.28)

Podoplea, Siphonostomatoida. Body elongate, slightly transformed, somites typically well defined, prosome and urosome not markedly separated.

Prosoma with cephalothorax incorporating first pedigerous somite, with conspicuous tergites on free second to fourth pedigerous somites. Fifth pedigerous somite large, fifth legs located dorsolaterally. Genital somite small, free. Four free abdominal somites. Genital apertures dorsolateral in female, copulatory pores ventrolateral; ventral in male. Caudal rami with 6 setae on each ramus.

Nauplius eye present. Antennule indistinctly 14 or 15-segmented in female, with aesthetasc on penultimate and apical segments. Male antennule bilaterally geniculate; geniculation between segments 13 and 14 of indistinctly 15-segmented antennule. Segmental homologies: segment 1 (I), segment 2 (II-III) double, segments 3 (IV) to 7 (VIII) more or less defined, segment 8 (IX-XII) compound but with partial sutures defining original segmental boundaries, segments 9 (XIII) and 10 (XIV) free, segment 11 (XV-XVI) double, segments 12 (XVII) and 13 (XVIII) free, segment 14 (XIX-XX) double, segment 15 (XXI-XXIII) triple, apical segment (XXIV-XXVIII) compound. Antenna located on distinct pedestal, comprising coxa, basis and 2 free endopodal segments; coxa, basis and elongate first endopodal segment unarmed; second endopodal segment distinct, bearing terminal claw and 2 proximal setae; exopod 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 3 setae. Maxilla located on pedestal; comprising syncoxa (lacertus) and basis (brachium) with curved apical claw (calamus) partly subdivided near base. Maxilliped 3-segmented, proximal segment comprising fused syncoxa and basis; endopod 2-segmented and bearing terminal subchela; first and second endopodal segments each armed with single spine. Syncoxa bearing small spine proximally.

Swimming legs 1 to 4 biramous, with 3-segmented rami. Intercoxal sclerites present. Spine and seta formula as follows (based on female):

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

Fifth leg of female large, lobate, located dorsolaterally at posterior margin of somite, armed with 4 minute setae. Male fifth leg comprising protopodal segment bearing outer seta, and free exopodal segment bearing 4 setae. Leg 6 represented by unarmed genital opercula in female; armed with 3 setae in male. Egg sacs uniseriate.

Type and only included genus: *Archidactylina* Izawa, 1996.