PHYLUM ARTHROPODA

Class Crustacea

The Lower Malacostraca (Peracarida)

The successful, abundant, and varied peracaridan crustaceans are most commonly represented in shore collecting by isopods and amphipods, the general features of which are well known to the average zoologist. In their rather specialized morphology these orders depart somewhat from the more generalized and shrimp-like body form which is basic to the Subclass Malacostraca. However, certain other peracaridan orders, the swimming Mysidacea and the small, bottom-dwelling Cumacea, retain an essentially shrimp-like form, with carapace and elongated abdomen. The Key to Orders given below will aid in the separation of these groups. The diverse peracaridan orders share one feature, namely, the brood pouch or "marsupium" formed of plates (oöstegites) borne by the thoracic legs of the female, and used to house the eggs and developing young.

KEY TO THE ORDERS OF PERACARIDA

1. Body having the "caridoid" (shrimplike) form, with a distinct carapace over the thorax and an elongated abdomen 2
1. Body having thorax and abdomen not sharply distinguishable; carapace lacking or very small 3

2. Eyes stalked when present; carapace covering all or most of thorax; swimming forms . . . . . MYSIDACEA (p.93)
2. Eyes sessile when present; carapace covering only 3 or 4 thoracic segments and inflated into a branchial chamber on each side; in bottom sediments . . . . . CUMACEA (p.98)

3. A small carapace present, covering only 2 thoracic segments; resemble small isopods but have first pair of legs chelate . . . . . TANAIDACEA (CHELIFERA) (p.102)
3. Carapace lacking 4

4. Body usually dorsoventrally flattened; thoracic legs (except for maxilliped) essentially alike; abdomen with 5 pairs of pleopods with unsegmented rami, and 1 pair of uropods . . . . . ISOPODA (p.102)
4. Body usually laterally compressed; thoracic limbs of more than one form, with the 2nd and 3rd pairs usually prehensile; abdominal appendages consist of 3 pairs of pleopods and 3 pairs of uropods . . . . . AMPHIPODA (p.107)

PART I. ORDER MYSIDACEA

By Roland L. Wigley

The mysids are the most typically shrimp-like ("caridoid") of the various peracaridan orders. They are adapted for swimming, with elongated bodies and a well developed carapace covering almost the entire thorax. The lightly calcified integument is thin and flexible. The antennules are biramous, having multi-segmented flagella; antennae have an exopod, usually in the form of a flattened scale (antennal scale); the endopod is flagelliform, composed of numerous segments. Eyestalks are cylindrical, well developed, terminating in a prominent brown or black (rarely red) cornea. The eight thoracic segments each bear biramous appendages; branchiae are absent in the species listed here. Females bear a large marsupium (hence the common name Opossum Shrimp) composed of 2-7 pairs of oöstegites attached to the thoracic limbs. The pleopod structure varies, depending on sex and species.

Mysids inhabit a wide variety of benthic and planktonic habitats. They are common in brackish and marine waters, but no freshwater forms are known in this region. Mysids are an important link in littoral and continental shelf food webs, and are particularly valuable as food for small species of fish as well as the young of larger fishes. Seasonal inshore-offshore migrations and other horizontal movements have been observed for a few species. Pronounced vertical migrations in which they swim upward during hours of darkness are characteristic of this group.

KEY TO MYSIDACEA OF THE CAPE COD REGION
(Figure references are to Plate 12)

1. Telson with posterior end cleft (figs. 4, 8, 9, 11) 2
1. Telson with posterior end entire (figs. 5-7, 10) 5

2. Antennal scale with setae present on both inner and outer margins (fig. 2) 3
2. Antennal scale with outer margin devoid of setae and terminating in an articulated spine (fig. 4) . . . . . *Praunus flexuosus*

3. Telson with the entire lateral margins armed with spines. Antennal scale elongate, width 9 to 12 times length, produced into an acute apex (figs. 8, 9) 4
3. Telson with basal one-half of the lateral margins devoid of spines; antennal scale elliptical, apex blunt, 3.5 times as long as broad (figs. 3, 11) . . . . . *Heteromysis formosa*

4. Antennal scale approximately 9 times as long as broad, outer margin nearly straight, telson lateral margin spines more than 30, extending posteriorly to apex (fig. 8) . . . . . *Mysis mixta*
4. Antennal scale approximately 12 times as long as broad, outer margin concave in outline; telson lateral margin spines 25, extending posteriorly as far as the cleft (fig. 9) . . . . . *Mysis stenolepis*

5. Antennal scale with setae present on both inner and outer margins; telson lateral margins armed with numerous spines (figs. 7, 10) 6
5. Antennal scale with setae absent on outer margin, terminating in a strong spine; telson without spines on lateral margins (figs. 5, 6) 7

6. Antennal scale about 10 times as long as broad (fig. 10); telson subequal in length to endopod of the uropod . . . . . *Neomysis americana*
6. Antennal scale about 5 times as long as broad (fig. 7); endopod of the uropod 1.5 times as long as the telson . . . . . *Mysidopsis bigelowi*

7. Eyes dorso-ventrally flattened, cornea kidney-shaped, red color; telson length subequal to its greatest width (fig. 5) . . . . . *Erythrops erythrophthalma*
7. Eyes globular not dorso-ventrally flattened, cornea black; telson elongate, length 2 times its greatest width (fig. 6) . . . . . *Meterythrops robusta*

ANNOTATED LIST OF MYSIDS

Erythrops erythrophthalma (Göes, 1863). Occasionally referred to as *Erythrops goesii*. Inhabits deeper waters, 40-275 meters, from Cape Cod to the Arctic. One of the most beautifully colored New England mysids. Eyes brilliant carmine red; opaque white pigment spots scattered over the body; an orange-red dorsal patch

on the carapace and clear bright yellow pigment spots on the ventral body surface. Adult length 9-11 mm.

Heteromysis formosa S. I. Smith, 1873. A common species from New Jersey to Canada. Frequently in small swarms inside dead bivalve shells such as Spisula. Intertidal to 248 meters. Males semi-translucent, but parts of the females are a rose color. Adult length 6-9 mm.

Meterythrops robusta S. I. Smith, 1879. Uncommon; in the western Atlantic, occurs from Cape Cod to Greenland. 66-300 meters. Adult length 14-16 mm.

Mysidopsis bigelowi Tattersall, 1926. A warm water species, from Louisiana to Cape Cod. Most common at shallow shelf depths, 16-50 meters, but has been found to 196 meters. Adult length 7.5 mm or somewhat more.

Mysis mixta Lilljeborg, 1852. Occasionally referred to as Michtheimysis mixta. A common species of the east coast from Woods Hole to Canada. Closely related to Mysis stenolepis; however, in contrast, M. mixta inhabits areas where algae and Zostera are absent. Intertidal to 200 meters. Adult length 20-25 mm.

Mysis stenolepis S. I. Smith, 1873. Sometimes referred to as Michtheimysis stenolepis and Mysis spinulosus. Inhabits intertidal and shallow shelf waters from New Jersey to Gulf of St. Lawrence. Closely related to M. mixta (see above), but is a more strictly littoral weed inhabiting species. Adult length 25-30 mm.

Neomysis americana (S. I. Smith, 1873). Mysis americana is a synonym. Very common, from Virginia to the Gulf of St. Lawrence. Intertidal to 214 meters. Adult length 10-12 mm.

Praunus flexuosus (Müller, 1776). A European species of relatively large size, first found in American waters in 1960. Has been reported only in the harbor at Barnstable, Mass. In Europe is one of the commonest species in brackish waters and tidal zones along the coast. Adult length 24-25 mm.

REFERENCES ON MYSIDS

Lochhead, J. H., 1950. Heteromysis formosa. In: Selected Invertebrate Types. Frank A. Brown, Jr., ed. John Wiley and Sons, Inc., N. Y.

Smith, S. I., 1879. The stalk-eyed crustaceans of the Atlantic coast of North America north of Cape Cod. Trans. Conn. Acad. Arts and Sci., 5: 27-138, pls. 7-12.

Tattersall, W. M., 1951. A review of the Mysidacea of the United States National Museum. U. S. Nat. Mus. Bull. 201,: I-X, 1-292.

Tattersall, W. M., and Olive S. Tattersall, 1951. The British Mysidacea. Ray Society, London.

Verrill, A. E., S. I. Smith, and O. Harger, 1873. Catalogue of the marine invertebrate animals of the southern coast of New England, and adjacent waters. Section D. In: Report upon the invertebrate animals of Vineyard Sound and adjacent waters, with an account of the physical characters of the region. By A. E. Verrill. Rept. U. S. Comm. Fish and Fisheries, 1871-72: 537-749, pls. 1-38.

Plate 12

MYSIDACEA

Figures mainly from Tattersall (1951) and Tattersall and Tattersall (1951), redrawn by Ruth L. von Arx.

Fig. 1. Side view of a typical mysid, ovigerous female, thoracic legs 1-7 omitted.

2. Antennal scale and basal portion of antenna of a typical mysid.

3. Heteromysis formosa, dorsal view.

4-11. Upper row shows telsons, lower row shows antennal scales, both in dorsal view, of the following species:

4. Praunus flexuosus.

5. Erythrops erythrophathalma.

6. Meterythrops robusta.

7. Mysidopsis bigelowi.

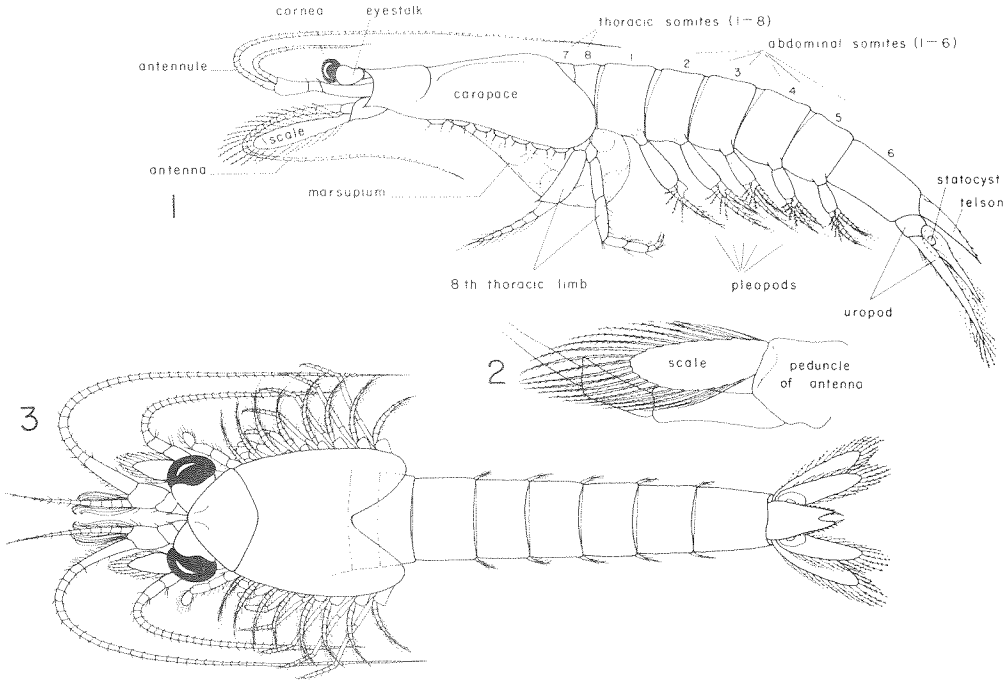
8. Mysis mixta.

9. Mysis stenolepis.

10. Neomysis americana.

11. Heteromysis formosa.

Plate 12



4	5	6	7	8	9	10	11
Praunus flexuosus	Erythrops erythrophthalma	Meterythrops robusta	Mysidopsis bigelowi	Mysis mixta	Mysis stenolepis	Neomysis americana	Heteromysis formosa
base, cleft							

PART 2. ORDER CUMACEA

By Roland L. Wigley

Cumaceans, although widespread in marine situations and with some species in brackish waters, are not well known to the average zoologist because of their small size and habit of living buried in sand or mud. The general body form is distinctive, characterized by an inflated cephalothorax and a slender, cylindrical abdomen. The carapace is moderately large, covering the anterior half of the cephalothorax. The integument in many species is rather heavily calcified and brittle. The first thoracic limb (maxilliped) bears a membranous epipodite, usually furnished with respiratory lamellae. A pseudorostrum is present in many species, formed by carapace lateral plates coming together above and in front of the head. Eyes are present in some species, sessile and usually coalesced to form a single organ on a lobe located mid-dorsally on anterior portion of carapace. First antenna with inner flagellum usually reduced or absent; second antenna vestigial in females, well developed in males. First 3 thoracic appendages modified as maxillipeds; remaining 5 as peraeopods. One pair of large styliform uropods present. Telson is distinct, or coalesced with last abdominal somite. Adults in this region generally range from 3 to 15 mm in length.

There is pronounced sexual dimorphism; pleopods are absent in all females and in males of some species, but males generally have from 1 to 5 pairs. Eggs are incubated in a marsupium, and hatch as postlarvae in which the past pair of peraeopods is undeveloped.

Cumaceans are primarily marine, but a few species occur in brackish waters. They are widely distributed in all oceans from intertidal zone to great depths in mid-ocean, most common subtidally. Basically benthic in habit, they commonly burrow in mud or sand. They occasionally undertake pelagic excursions, chiefly at night, at which time males greatly outnumber females.

KEY TO CUMACEANS OF THE CAPE COD REGION
(Figure references are to Plate 13)

1. Independent telson present (figs. 23-26) 2
1. Without independent telson (figs. 15-22) 7

2. Uropod inner ramus 1-jointed; telson without spines (figs. 13, 23) . . . . . *Petalosarsia declivis*
2. Uropod inner ramus 2- or 3-jointed; telson with lateral and apical spines (figs. 24-26) 3

3. Telson with 5 apical spines; male without pleopods . . . *Lamprops quadriplicata*
3. Telson with 0 or 2 apical spines; male with 2 pairs of pleopods . . . . . Family Diastylidae 4

4. Telson apex upturned, without apical spines (figs. 11, 26) . . . . . *Oxyurostylis smithi*
4. Telson apex not upturned, 2 apical spines (figs. 24, 25) . . . . . *Diastylis* 5

5. Carapace with 4 large spines on dorsal surface (figs. 1, 24) . . . . . *Diastylis quadrispinosa*
5. Carapace without dorsal spines (figs. 6, 7) 6

6. Carapace with 3 oblique lateral ridges; horizontal ridge on postero-lateral section of carapace in male (fig. 6) . . . . . *Diastylis polita*
6. Carapace with 4 oblique lateral ridges; without horizontal ridge on postero-lateral section of carapace in male (figs. 7, 25) . . . . . *Diastylis sculpta*

7. Mandibles broadly truncate at base (fig. 14); male with 2 pairs of pleopods . . . . . Family Leuconidae 8
7. Mandibles narrow or acuminate at base (fig. 13); male with 0, 3, or 5 pairs of pleopods 12

8. Pseudorostrum well developed . . . . . Leucon americanus
8. Carapace truncate anteriorly without pseudorostrum 9

9. Uropods with outer ramus longer than inner ramus (fig. 18) . . . . . Eudorellopsis deformis
9. Uropods with outer ramus shorter than inner ramus (figs. 15, 16) . . . . . Eudorella 10

10. Body setose; approximately 14-18 teeth on carapace ventral margin (figs. 8, 15) . . . . . Eudorella hispida
10. Body not setose; less than 14 teeth on carapace ventral margin 11

11. Anterior margin of carapace deeply emarginate in female, slightly emarginate in male (figs. 2, 3, 20) . . . . . Eudorella emarginata
11. Anterior margin of carapace slightly emarginate in female, serrate or entire in male (figs. 9, 16) . . . . . Eudorella truncatula

12. Endopod of uropod 2-jointed; 3 pairs of pleopods in male (figs. 10, 17) . . . . . Leptocuma minor
12. Endopod of uropod 1-jointed; 0 or 5 pairs of pleopods in male (figs. 19, 22) 13

13. Male has no pleopods and a rudimentary second antenna; in female, uropod peduncle length about equal to maximum width of last abdominal somite (figs. 4, 22) . . . . . Almyracuma proximoculi
13. Male has 5 pleopods and well developed second antenna; in female, uropod peduncle length greater than 2 times maximum width of last abdominal somite (figs. 5, 19) . . . . . Cyclaspis varians

ANNOTATED LIST OF CUMACEANS

Almyracuma proximoculi Jones, 1959. Brackish water species, known only from Pocasset River. Adult size 3-4 mm.

*Campylaspis affinis G. O. Sars, 1869. Not yet reported from Cape Cod waters, but expected to occur in deeper portions of this area.

*Campylaspis rubicunda (Lilljeborg, 1855). Not yet reported from Cape Cod waters, but expected to occur in the deeper portions of this area.

Cyclaspis varians Calman, 1912. Brackish water species found in surface waters of Woods Hole Harbor and Vineyard Sound. Adult size 3-4 mm.

*Diastylis abbreviata G. O. Sars, 1871. Not yet reported from Cape Cod waters, but expected to occur in deeper portions of this area.

Diastylis polita S. I. Smith, 1879. Found at depths less than ca. 35 meters from Nova Scotia to Block Island Sound. Adult size 12-14 mm.

Diastylis quadrispinosa G. O. Sars, 1871. Occurs from the Gulf of St. Lawrence to New Jersey in depths of 4-400 meters. Adult size 11 mm.

Diastylis sculpta G. O. Sars, 1871. In American waters occurs from Gulf of St. Lawrence to Long Island; low water to ca. 400 meters. Adult size 9-10 mm.

Eudorella emarginata (Krŏyer, 1846). In American waters occurs from the Arctic to Martha's Vineyard in depths from 2-130 meters. Adult size 10-12 mm.

Eudorella hispida G. O. Sars, 1871. Occurs from the Arctic to Martha's Vineyard, in depths from 30-130 meters. Adult size 5-6 mm.

Eudorella truncatula (Bate, 1856). On U. S. coast reported from Massachusetts Bay to Block Island Sound, in depths of 30-100 meters. Adult size 4-5 mm.

Plate 13

CUMACEA

Figures mainly from Sars (1900) and Calman (1912), redrawn by Ruth L. von Arx.

Fig. 1. Diastylis quadrispinosa, female, dorsal view.

2. Eudorella emarginata, female, lateral view.

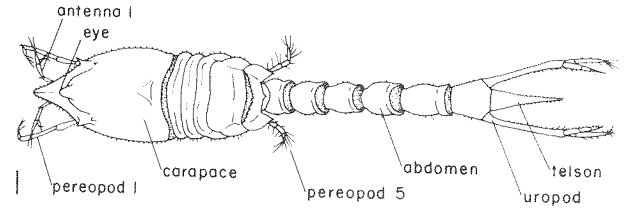
3. Eudorella emarginata, male, lateral view.

4-12. Carapace in lateral view of the following species:

4. Almyracuma proximoculi, male.
5. Cyclaspis varians, female.
6. Diastylis polita, male.
7. Diastylis sculpta, male.
8. Eudorella hispida, female.
9. Eudorella truncatula, female.
10. Leptocuma minor, male.
11. Oxyurostylis smithi, male.
12. Petalosarsia declivis, male.
13. Petalosarsia declivis, mandible.
14. Eudorellopsis deformis, mandible.

15-26. Dorsal view of last abdominal somite, uropod, and telson of the following species:

15. Eudorella hispida, female.
16. Eudorella truncatula, female.
17. Leptocuma minor, female.
18. Eudorellopsis deformis, female.
19. Cyclaspis varians, male.
20. Eudorella emarginata, female.
21. Leucon americanus, male.
22. Almyracuma proximoculi, male.
23. Petalosarsia declivis, female
24. Diastylis quadrispinosa, female.
25. Diastylis sculpta, female.
26. Oxyurostylis smithi, female; (inset: telson tip in side view).


antenna I
eye
carapace
abdomen
telson
pereopod I
pereopod 5
uropod

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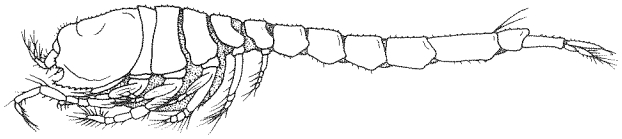

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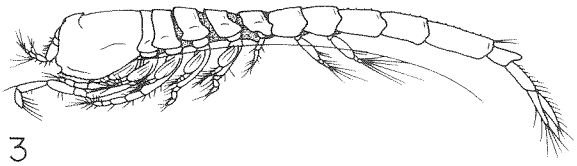

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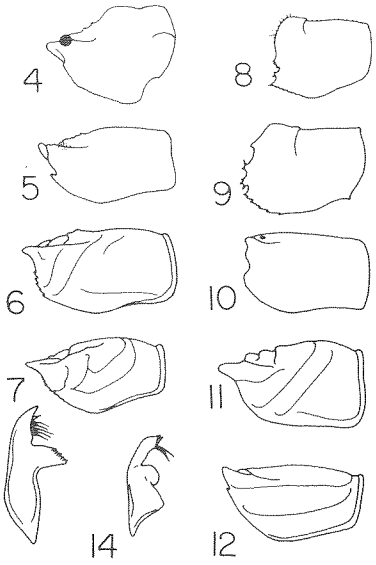
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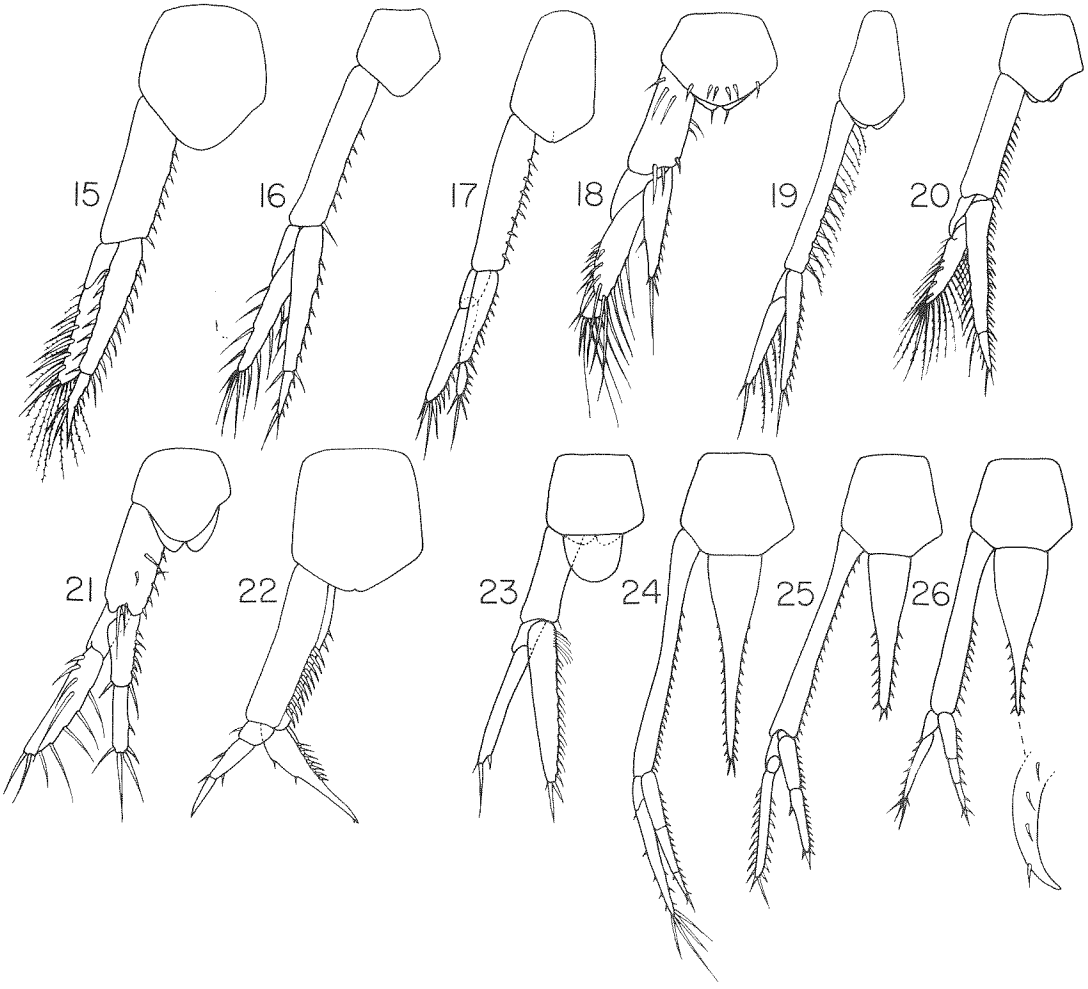
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Eudorellopsis deformis (Kroyer, 1846). In American waters reported from the Arctic to Long Island in depths of ca. 2-100 meters. Adult size 4-5 mm.
Lamprops quadriplicata S. I. Smith, 1879. Occurs from Newfoundland to southern New England, in depths from ca. 2-150 meters. Adult size 8-9 mm.
Leptocuma minor Calman, 1912. Occurs from Gloucester, Mass. to Woods Hole, in depths of ca. 2-100 meters. Adult size 6-7 mm.
Leucon americanus Zimmer, 1943. A brackish water species reported from Woods Hole and Chesapeake Bay. Adult size 4-5 mm.
Oxyurostylis smithi Calman, 1912. A euryhaline species, Maine to Louisiana, from surface to 20 meters. Adult size 6-7 mm.
Petalosarsia declivis (G. O. Sars, 1864). In American waters occurs from the Arctic to Buzzards Bay, in 20-200 meters.

*Not in key.

REFERENCES ON CUMACEANS

Calman, W. T., 1912. The Crustacea of the order Cumacea in the collection of the United States National Museum. Proc. U. S. Nat. Mus. 41: 603-676, text figs. 1-112.
Jones, N. S. and W. D. Burbanck, 1959. Almyracuma proximoculi gen. et sp. nov. (Crustacea, Cumacea) from brackish water of Cape Cod, Massachusetts. Biol. Bull. 116: 115-124.
Sars, G. O., 1900. An account of the Crustacea of Norway. vol. 3, Cumacea, pp. I-X, 1-115, pls. 1-72.
Smith, S. I., 1879. The stalk-eyed crustaceans of the Atlantic coast of North America north of Cape Cod. Trans. Conn. Acad. Arts and Sci. 5: 28-138, pls. 8-12.

PART 3. ORDERS ISOPODA AND TANAIDACEA (CHELIFERA)

Isopods are readily recognizable in most instances, except for the grossly modified parasitic forms. Since isopods are so common they are of great ecological significance, and certain species have been widely used in experimental work, hence their identification is a practical matter of much importance. Fortunately, the group is reasonably well known in the Woods Hole region, and specific identification does not offer such difficulties to the average zoologist as does the identification of amphipods. Tanaidaceans, because of their small size, are less frequently noticed. Since they have often been classified as a group within the Isopoda, and since they are so similar in general form, the two orders are combined in the following key. The advice of Thomas E. Bowman and of Roland L. Wigley in the preparation of the following key and check-list is gratefully acknowledged. Figure references on isopods and tanaidaceans are to Plates 14 and 15.

KEY TO THE MORE COMMON TANAIDACEA AND MARINE ISOPODA

1. First pair of legs chelate (figs. 1-3); 6 free thoracic segments; tiny creatures . . . . . Order TANAIDACEA (CHELIFERA)
Not well known locally; possibly species include:

a) 3 pairs of pleopods . . . . . Tanais cavolinii
b) 5 pairs of pleopods . . . . . Leptochelia savignyi

1. First pair of legs simple or subchelate; 7 free thoracic segments . . . . . Order ISOPODA 2

2. Parasitic on crustacea; body may be grossly modified; males tiny . . . . . Suborder Epicaridea (Bopyroidea) 26
2. Not parasitic on crustacea (a few are ectocommensal); body easily recognizable as that of an isopod 3

3. Uropods terminal, set at rear (figs. 17-19, 29, 30). 22
3. Uropods set laterally or ventrally (figs. 4-16, 26-28) 4

4. Uropods lateral, visible from above, flattened, forming with telson a caudal fan in most instances 5
4. Uropods ventral, not visible dorsally, turned inwards to form the cover of a chamber encasing the pleopods (fig. 11) . . .Suborder Valvifera 14

5. Thorax with only 5 pairs of normal walking legs; not reported locally . . . . . Suborder Gnathiidea
5. Thorax with 7 pairs of more or less normal walking legs 6

6. Exopodal part of uropod arched over telson; body very long (7 times the width): Suborder Anthuridea; one species common locally in brackish situations (fig. 4) . . . . . Cyathura polita
6. Uropodal exopods lateral; body length seldom if ever more than 5 times width . . . . . Suborder Flabellifera

7. Pleotelson (abdomen and telson) shows 6 segments (figs. 6-9) 10
7. Pleotelson with segments fused so as to have only two complete segments, the terminal one of which is large and conspicuous 8

8. Uropods each with two flattened branches; all legs simple; animals able to roll themselves into a complete ball 9
8. Uropods each a single slender pointed process, lacking outer branches (exopods); terminal segment of abdomen triangular, with truncated apex (fig. 26); first and second pairs of legs subchelate . . . . . Ancinus depressus

9. Terminal segment of abdomen rounded at rear; exopods of uropods with outer serrated margin (fig. 27) . . . . . Sphaeroma quadridentatum
9. Terminal segment bluntly triangular; exopods of uropods with smooth outer margin (fig. 28) . . . . . Exosphaeroma papillae

10. Exopod of uropod flattened (not clawlike) and comparable to endopod in size, forming a normal caudal fan 12
10. Exopod of uropod clawlike and much smaller than endopod (fig. 7); uropods very small relative to telson; animals burrow in wood ("gribbles") . . . . . Limnoria 11

11. Telson lacking tubercles and with a Y-shaped ridge (fig. 7) . . . . . Limnoria lignorum
11. Telson with tubercles on posterior margin and with three tubercles on dorsal surface (fig. 8) . . . . . Limnoria tripunctata

12. Bases of antennae seem to meet in front of the head as seen from above (fig. 5); head terminating in a small point; front 3 legs with slightly hooked tips; endopod of uropod notched laterally . . . . . Cirolana concharum
12. Bases of antenna not meeting in midline (figs. 6, 9); all thoracic legs end in hooked dactyls; animals usually found clinging to fish or around fish-landing docks 13

13. Form regular and oval; 2 longitudinal light stripes run length of body; head subquadrate with trilobed rear margin and distinct eyes; abdomen and uropods well developed; body to 13 mm long (fig. 9) . . . . . Nerocila munda
13. Form oval but with a slight asymmetry; head relatively small with eyes indistinct; abdomen with relatively small uropods; body stout, to 25 mm long (fig. 6) . . . . . Lironeca ovalis

14. Sides of head entire (figs. 10, 12); eyes lateral 18
14. Sides of head notched or incised (figs. 23-25); eyes dorsal; body broad, with pointed telson . . . . . Chiridotea 15

(Note: see Bowman (1955) and Wigley (1961) for additional details on identification of Chiridotea species).

15. Second (more ventrally placed) antennae decidedly longer than the first pair (figs. 23, 24) 16
15. Second antennae nearly equaling in length the first pair (fig. 25) 17

16. Sides of telson curved; finger of first large gnathopod with a single spine back of the terminal claw (fig. 23 A-C); animal occurs in brackish water . . . . . Chiridotea almyra
16. Sides of telson straight, telson wedge shaped; finger of first gnathopod with several spines along the inner margin (fig. 24 A-C); animal marine . . . . . Chiridotea tuftsi

17. Clefts in sides of head deep (fig. 25A); antero-lateral margins of head with numerous bristles; body color light . . . . . Chiridotea coeca
17. Clefts in sides of head shallow; antero-lateral margins of head only sparsely provided with bristles; body color dark; occurs in brackish waters . . . . . Chiridotea nigrescens

18. Pleotelson seems to consist of 3 parts (plus grooves showing a 4th partly coalesced segment); common . . . . . Idotea 19
18. Pleotelson seems to consist of one part (plus grooves suggesting one partly coalesced segment) 20

19. Rear of telson bracket-shaped, with a central point (fig. 10) . . . . . Idotea baltica
19. Rear of telson truncated (cut square across) (fig. 12) . . Idotea metallica
19. Rear of telson pointed (fig. 13) . . . . . Idotea phosphorea

20. Pleotelson sides tapering to a point; in side view shows 2 rounded elevations separated by a depression (fig. 14); second antennae short, reaching back only to second thoracic segment . . . . . Edotea triloba
20. Pleotelson with more or less parallel sides cut off to a triangular point at rear; second antennae long, reaching to 5th thoracic segment . . . . . Erichsonella 21

21. Pleotelson with a pronounced tubercle on either side (fig. 15) . . . . . Erichsonella filiformis
21. Pleotelson with only a suggestion of a tubercle on either side (fig. 16) . . . . . Erichsonella attenuata

22. Aquatic forms; pleotelson consisting of 2 sections . . . . Suborder Asellota 25
22. Terrestrial or high-beach forms; pleotelson showing 6 sections . . . . . Suborder Oniscoidea 23

(Most terrestrial forms are not in this key; members of the fully terrestrial genera Porcellio, Armadillidium, etc., may often be washed into bays and estuaries, to confuse the collector).

23. Less than 1 cm long; uropods decidedly shorter than pleotelson 24
23. Length may exceed 2 cm; uropods as long as pleotelson, each with 2 slender terminal articles (fig. 29); animals may be very active, running about like young cockroaches near high tide marks . . . . . Ligia oceanica

24. Under boards, rubbish, etc. above high tide marks; small (up to 6.5 mm long); body surface smooth (fig. 19) . . . . Philoscia vittata
24. In beach sand; very small (up to 4.5 mm long); body surface thickly covered with small, spine-tipped tubercles (fig. 30) . . . . . Scyphacella arenicola

25. Uropods very small (fig. 18), in a posterior notch of telson; all thoracic legs simple; very small (to 5 mm long); in marine situations . . . . . Jaera marina
25. Uropods at least as long as telson (fig. 17); first legs subchelate; up to 15 mm long; in fresh water or water of quite low salinity . . . . . Asellus sp.

26. On Callianassa; female with six pairs of jointed branching abdominal processes; small male with elongated appendages at sides of abdomen (fig. 20) . . . . . Ione thompsoni
26. On Palaemonetes, forming a bulge in wall of gill chamber; female and male with short abdominal processes (fig. 21) . . . . . Probopyrus pandalicola
26. On Pagurus longicarpus; female with pleopods and with 6th thoracic segment longer than others; male with unsegmented abdomen (fig. 22) . . . . . Stegophryxus hyptius

LIST OF MORE COMMON SHALLOW WATER ISOPODA AND TANAIDACEA

Order Tanaidacea (Chelifera)

Leptochelia savignyi (Krŏyer, 1842).
Tanais cavolinii Milne-Edwards, 1829.

Order Isopoda

Suborder Anthuridea

Calathura branchiata (Stimpson, 1853). Rare south of Cape. Not in key.
Cyathura polita (Stimpson, 1855). Common in areas of low or very low salinity, as in the tidal drainages from ponds. Until recently has been called C. carinata Krŏyer (see Miller and Burbanck, 1961).
Ptilanthura tenuis Harger, 1879. Rare. Not in key.

Suborder Flabellifera

Ancinus depressus (Say, 1818). Reported from Woods Hole (see Richardson, 1909).
Exosphaeroma papillae Bayliff, 1938. A brackish water species, reported from Long Island, and from Sandwich, on Cape Cod.
Cirolana concharum (Stimpson, 1853). A scavenger, often very common around fish landing docks.
Cirolana polita (Stimpson, 1853). Not in key. Reported north of Cape.
Limnoria lignorum (Rathke, 1799). Found burrowing into surface layers of submerged, untreated wood.
Limnoria tripunctata Menzies, 1951.
Lironeca ovalis (Say, 1818). An ectoparasite on fish; uncommon.
Livoneca, see Lironeca. The commonly used name Livoneca is the result of a typographical error; the group of names including Lironeca, Cirolana, and Nerocila was intended as a series of anagrams on Caroline and Carolina.
Nerocila munda Harger, 1873. Uncommon; an ectoparasite on various fish.
Sphaeroma quadridentatum Say, 1818. Along shores, under stones, among algae, on peat banks.

Suborder Valvifera

Chiridotea almyra Bowman, 1955. In water of low salinity, as in the Pocasset River, along with Cyathura polita.
Chiridotea coeca (Say, 1818). Burrows like a little mole beneath the surface of intertidal sand flats. Common.
Chiridotea nigrescens Wigley, 1961. Recently described from brackish waters of tidal marshes, North Falmouth to Chatham, on the southern side of the Cape. Resembles the more common C. coeca, which is more marine in its habitat.
Chiridotea tuftsi (Stimpson, 1883). On subtidal sand and mud bottoms in marine situations; sometimes concealed by mud adhering to rough back.
Edotea triloba (Say, 1818). On muddy shores, usually with adherent dirt. Edotea montosa (Stimpson, 1853) is probably a synonym (Wallace, N. A., 1919. Univ. Toronto Studies, Biol. Ser. no. 18: 42 pp.)
Erichsonella attenuata (Harger, 1873). Apparently uncommon.
Erichsonella filiformis (Say, 1818). Among eelgrass and algae. Common.
Idotea balthica (Pallas, 1772). Ubiquitous.
Idotea metallica Bosc, 1802. Common, swimming or clinging to vegetation.
Idotea phosphorea Harger, 1873. Among weeds and on gravelly bottoms.

Suborder Asellota

Asellus sp. or spp.. Asellus is characteristic of fresh waters or of very low salinities. Although the name Asellus communis Say, 1818, has been the most widely used in the past (see, for example, Van Name, 1939) it now seems that Asellus militaris is the most common eastern American species (Van Name, 1942). For specific determination, the assistance of a specialist is advised.
Jaera marina (Fabricius, 1780). Very common if looked for among weeds, mussels.

Suborder Oniscoidea

Ligia oceanica (Linnaeus, 1767). Has been reported in numbers near high tide mark on rocky shores and under boards north of Boston. Its reported occurrence at Woods Hole needs confirmation.
Philoscia vittata Say, 1818. Found along the shore near high water mark, under boards and rubbish.
Scyphacella arenicola Smith, 1873. Found in the sand of beaches

Note: See Van Name, 1936, for other terrestrial as well as fresh water isopods.

Suborder Epicaridea (Bopyroidea)

Ione thompsoni Richardson, 1904. On Callianassa; the type locality is North Falmouth.

Probopyrus pandalicola (Packard, 1879). On Palaemonetes, in the gill chamber.

Stegophryxus hyptius Thompson, 1902. Thompson reported 3-4% of hermit crabs Pagurus longicarpus at Hadley Harbor infested, and 1.5% at Woods Hole. Parasite occurs on the abdomen of its host.

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PART 4. ORDER AMPHIPODA

By Eric L. Mills

Amphipods are a widespread and important group of crustaceans. That they are poorly known is mostly due to their wide limits of morphological variation, making taxonomy difficult, and partly due to lack of patience in investigators, since long and careful scrutiny is sometimes necessary. Since members of the group are found in a wide variety of ecological niches, they are of interest to students of taxonomy, ecology, physiology, genetics, and behavior.

GENERAL MORPHOLOGY

Amphipods have the basic malacostracan body plan of 6 head, 8 thoracic, and 6 abdominal segments, but there appear to be only 7 free thoracic segments because of the fusion of the first thoracic segment with the head capsule. This first thoracic segment bears the maxillipeds, and each of the 7 free thoracic segments bears a pair of limbs. The abdomen is divided into a pleon of 3 segments, each bearing a pair of pleopods and a urosome of three segments, each with a pair of uropods. A terminal telson projects from the rear of the urosome. The appendages are as follows:

Plate 14

ISOPODA AND TANAIDACEA

Sources in Plates 14 and 15: Redrawn from Richardson (R), from Kunkel (K), from specimens (S), or as noted.

Fig. 1. Tanais cavolini, with chela at greater scale (R).

2. Leptochelia savignyi, male (R).

3. L. savignyi, female (R).

4. Cyathura polita (R).

5. Cirolana concharum (S).

6. Lironeca ovalis (K).

7. Limnoria lignorum, with details of pleotelson, after Menzies.

8. Limnoria tripunctata, details of pleotelson, after Menzies.

9. Nerocila munda (R).

10. Idotea baltica (S).

11. Same, ventral view of pleotelson with valve-like left uropod raised, exposing pleopods.

12. Idotea metallica (R).

13. Telson of Idotea phosphorea (R).

14. Edotea triloba (R).

15. Erichsonella filiformis (R).

16. Telson of E. attenuata (R).

17. Asellus militaris (R).

18. Jaera marina (R).

19. Philoscia vittata (R).

20. Ione thompsoni, female in dorsal view at left, male enlarged at right (S).

21. Probopyrus thompsoni, female at left with male beside it to same scale; male enlarged at right (R).

22. Stegophryxus hyptius, female in dorsal view at left, in ventral view at right with male indicated at same scale, male enlarged in center (R).

Plate 14

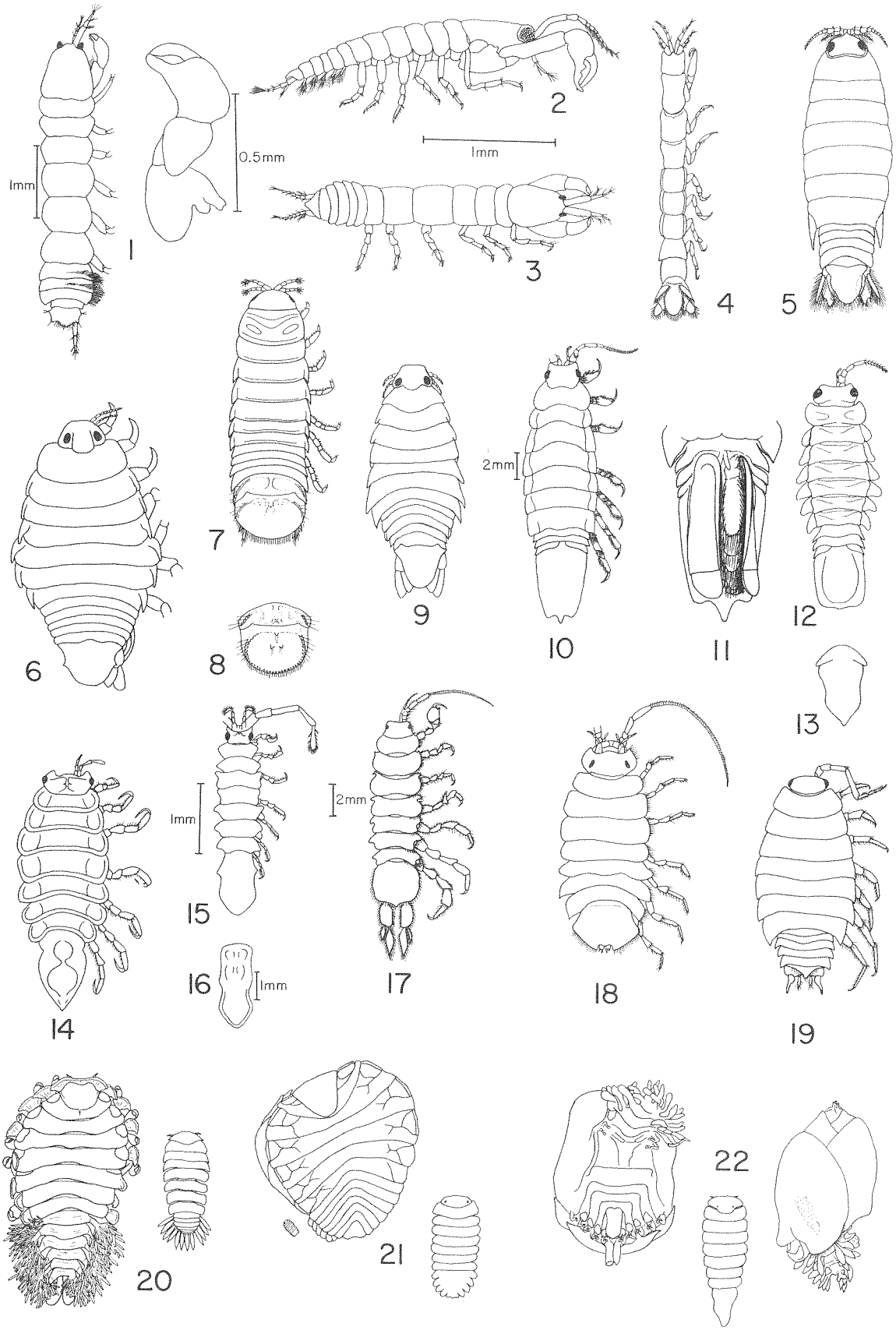
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Plate 15

ISOPODA (cont.), HYPERIIDEA, CAPRELLIDEA

Fig. 23, Chiridotea almyra; A. head, B. first pereipod of male, C. pleotelson; redrawn after Bowman.

24. Chiridotea tuftsi: A, B, C, as above.

25. Chiridotea coeca: A, B, C, as above.

26. Ancinus depressus (R).

27. Sphaeroma quadridentatum (R).

28. Exosphaeroma papillae, redrawn after Bayliff.

29. Ligia oceanica (R).

30. Scyphacella arenicola (R).

31. Hyperia galba, hyperiid amphipod (K).

32. Aeginella longicornis, caprellid amphipod (K).

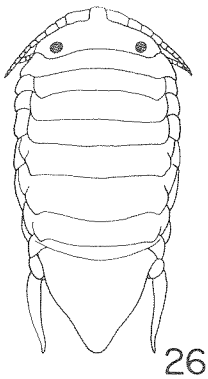
33. Caprella geometrica, caprellid amphipod (K).

Plate 15

23A

24A

25A



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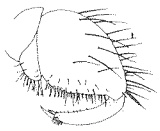
23B

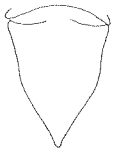
24B



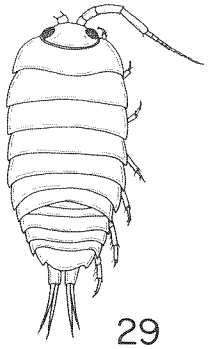
25B

23C

24C



25C



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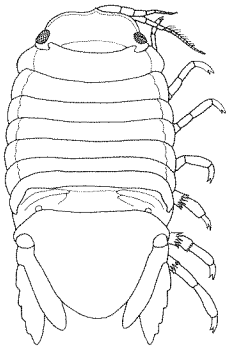

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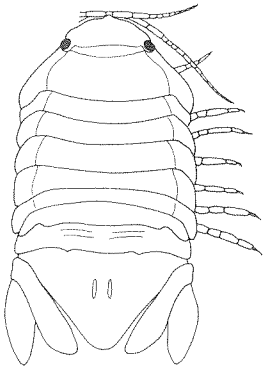

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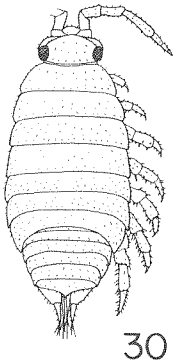

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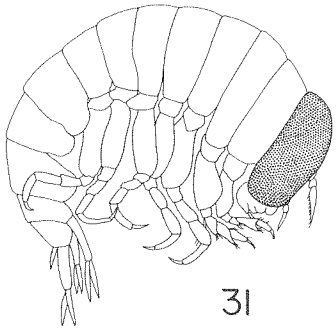

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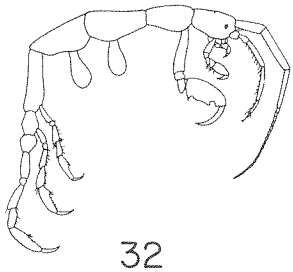

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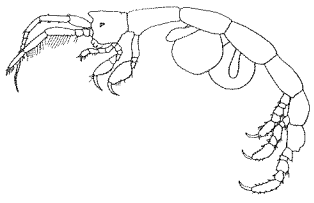

33

1-2: Antennae - (two pairs) - both with peduncles and flagella, first antenna often with accessory flagellum.
3: Mandibles - with molar and incisor surfaces and a palp.
4: First maxillae - with inner and outer lobes and a 2-segmented palp.
5: Second maxillae - simple, of inner and outer lobes.
6: Maxillipeds - with inner and outer plates and a 4-segmented palp.
7-13: Seven peraeopods, each 7-segmented, including flattened coxal plates which contribute to the sides of the body. The first 2 pairs of peraeopods are often called gnathopods and are subchelate, with the 6th segment expanded as a hand. When this "gnathopod 1 and 2" terminology is used, the remaining peraeopods are numbered from 1-5.
14-16: Pleopods (3 pairs) - with a basal peduncle and 2 many jointed setose rami.
17-19: Uropods (3 pairs) - with a basal peduncle and 2 more or less spinose single segmented rami.

For illustrations, see Chevreux and Fage (1925, figs. 1 and 2).

KEY TO THE SUBORDERS OF AMPHIPODA
(After Kunkel, 1918)

1. Eyes absent, but articulated eye lobes present . . . . . INGOLFIELLIDEA
1. Eyes present, sessile 2

2. Eyes large, covering side of head; uropods with laminate rami, forming a tail fan with telson . . . . . HYPERIIDEA
2. Eyes not covering whole side of head 3

3. Abdomen well developed . . . . . GAMMARIDEA
3. Abdomen rudimentary; body very slender (typical caprellids) or very much flattened ("whale-lice") . . . . . CAPRELLIDEA

The Hyperiidea are mostly pelagic; some are commensals with scyphozoan jellyfish (Plate 15, fig. 31). Caprellidea (figs. 32, 33) are common inhabitants of weedy areas in littoral and sub-littoral zones. See Chevreux and Fage (1925) for common families and genera of these two suborders. Ingolfiellidea are rare, highly aberrant, mostly abyssal forms, unfamiliar to most taxonomists. Gammaridean amphipods are abundant and obvious members of all aquatic communities, but at present it seems advisable to present only a key to families. For figures, the references must be consulted.

KEY TO COMMON FAMILIES OF GAMMARIDEAN AMPHIPODA
(Based on Stebbing, 1906)

1. Antenna 1, first joint stout, with accessory flagellum; mandible cutting edge almost smooth; gnathopod 2 with 3rd joint elongated . . . . . LYSIANASSIDAE
1. These characters not combined 2

2. Head tapering, truncate; eyes simple, usually 4; antennae 1 without accessory flagellum; telson cleft . . . . . AMPELISCIDAE
2. These characters not combined 3

3. Peraeopods 3-5 with heavy armature of spines and setae, joints greatly expanded 4
3. Peraeopods 3-5 less setose, joints not greatly expanded 5

4. Peraeopod 4 not greatly longer than peraeopod 5 . . . . . HAUSTORIIDAE
4. Peraeopod 4 greatly longer than peraeopod 5. . . . . PHOXOCEPHALIDAE

5. Antenna 1 without accessory flagellum; maxillipeds abnormal; telson entire; fourth coxal plates greatly enlarged . . . . . STENOTHOIDAE
5. These characters not combined 6

6. Mandible with molar weak or wanting; telson divided; maxilliped inner plate small . . . . . LILJEBORGIIDAE
6. These characters not combined 7

7. Eyes dorsally continuous or confluent; pronounced rostrum; peraeopod 5 elongated . . . . . OEDICEROTIDAE
7. Eyes lateral, rostrum not well developed, peraeopod 5 not greatly elongated 8

8. Side plate 4 excavate behind; peraeopods 1 & 2 not glandular; animal not tube dwelling 9
8. Side plate 4 usually not excavate behind; peraeopods 1 & 2 glandular; animal often tube dwelling 13

9. Mandible with palp 10
9. Mandible without palp 12

10. Telson entire . . . . . CALLIOPIIDAE
10. Telson usually cleft, antenna 1 with accessory flagellum, urosome with patches of dorsal spines . . . . . GAMMARIDAE
10. Telson cleft; other features unlike previous combination 11

11. Gnathopod 1 without hand . . . . . BATEIDAE
11. Gnathopods 1 & 2 without hands, telson cleft, antennae of male with calceoli . . . . . PONTOGENEIIDAE

12. Uropod 3, both rami well developed . . . . . DEXAMINIDAE
12. Uropod 3, one ramus small or wanting . . . . . TALITRIDAE

13. Pleon compressed 14
13. Pleon usually depressed; tubicolous animals, often banded with color . . . . . COROPHIIDAE

14. Uropod 3 uncinate, i.e. with short hooks 15
14. Uropod 3 not uncinate . . . . . PHOTIDAE

15. Inter-antennal lobes small; gnathopod 2 palm usually simple, hand not expanded . . . . . AMPITHOIDAE
15. Inter-antennal lobes prominent; gnathopod 2 palm often complex, hand expanded . . . . . ISCHYROCERIDAE

Animals may be most readily placed at least to genus by using the keys in Stebbing (1906) and by reference to Sars (1895), Holmes (1905), Kunkel (1918) and Chevreux and Fage (1925). Kunkel is particularly useful for local species. The following list of local genera and species is by no means complete but may aid in narrowing the search, and is presented merely as an aid to those starting a study. The development of keys to the species of amphipods in the Woods Hole region must await further studies. We are indebted to Dr. E. L. Bousfield for assistance in the compilation of the following list.

A PRELIMINARY LIST OF THE COMMONER LOCAL AMPHIPODS

Lysianassidae

Lysianopsis alba Holmes, 1903. In sand, gravel or mud in shallow subtidal.
Orchomenella pinguis (Boeck, 1861).
Tmetonyx nobilis Stimpson, 1853.

Ampeliscidae

Ampelisca macrocephala Liljeborg, 1852.
Ampelisca vadorum Mills, 1963.
Byblis serrata Smith, 1873.

Haustoriidae

Found burrowing in sandy beaches. A complex family of several genera, currently being revised.

Phoxocephalidae

Paraphoxus epistoma (Shoemaker, 1938).
Paraphoxus spinosus Holmes, 1903.
Phoxocephalus holbolli (Kröyer, 1842).

Stenothoidae

Stenothoe spp.

Liljeborgiidae

Listriella clymenellae (Mills, 1961). Commensal in tubes of *Clymenella torquata*.

Oedicerotidae

Monoculodes edwardsi Holmes, 1903.

Calliopiidae

Calliopius laeviusculus (Kröyer, 1838). Commonly taken swimming at night lights.

Gammaridae

Carinogammarus mucronatus (Say, 1818). In both marine and brackish waters.
Crangonyx spp. In fresh water.
Elasmopus laevis (Smith, 1873).
Gammarus annulatus Smith, 1873. Marine.
Gammarus fasciatus Say, 1818. In fresh water.
Gammarus oceanicus Segerstråle, 1947. Marine and brackish water.
Gammarus tigrinus Sexton, 1939. Brackish waters.
Melita nitida Smith, 1873.

Bateidae

Batea catharinensis Fr. Müller, 1865.

Pontogeneiidae

Pontogeneia inermis (Kröyer, 1838).

Dexaminidae

Dexamine thea Boeck, 1861.

Talitridae

Allorchestes littoralis Stimpson, 1853. Intertidal.
Hyale spp. Intertidal.
Hyalella azteca (Sausseure, 1818). In fresh water.
Orchestia spp. Rather small, dark, beach hoppers.
Talorchestia longicornis (Say, 1818). The common, large whitish beach hopper.
Talorchestia megalophthalma (Bate, 1862). A beach hopper similar to the above but smaller and less common.

Corophiidae (a family of tube dwellers)

Cerapus tubularis Say, 1818. Among masses of Amaroucium, and among eelgrass. Said to carry tubes about.
Corophium spp. In soft tubes.
Ericthonius spp.
Unciola irrorata Say, 1818. Often found in tubes of polychaetes or other amphipods.

Photidae

Leptocheirus pinguis (Stimpson, 1853).
Leptocheirus plumulosus Shoemaker, 1932.
Photis spp.

Ampithoidae

Ampithoe longimana Smith, 1873.
Ampithoe rubricata (Montagu, 1808).
Cymadusa compta (Smith, 1873).

Ischyroceridae

Ischyrocerus spp.
Jassa falcata (Montagu, 1808).

Cheluridae

Chelura terebrans Philippi, 1839. A wood borer.

Pleustidae

Sympleustes glaber (Boeck, 1861).

Aoridae

Lembos smithi (Holmes, 1905).
Microdeutopus damnoniensis (Bate, 1856).
Microdeutopus gryllotalpa Costa, 1853.

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