A GENERIC KEY TO THE PROTOZOEAN, MYSIS, AND POSTLARVAL STAGES
OF THE LITTORAL PENAIDEAE OF THE NORTHWESTERN GULF OF
MEXICO

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ABSTRACT

An illustrated key presenting criteria for differentiating the stages and substages of Gulf of Mexico penaeid larvae (and post larvae) from comparable stages of the more common nonpenaeids is presented. A second key permits generic identification of penaeid protozoan, mysis, and postlarval stages. All genera are illustrated, and a table of important diagnostic characters is included.

Shrimp of the Family Penaeidae which support valuable commercial fisheries in the northwestern Gulf of Mexico are being studied comprehensively by fishery scientists at the Bureau of Commercial Fisheries Biological Laboratory in Galveston, Tex. To properly manage such fisheries, it is necessary to fully understand the dynamics of the shrimp populations upon which they depend. This capability requires, in turn, as complete a knowledge as possible of the life history of the species involved.

Studies of the early (planktonic) life history of the Gulf's commercially important shrimps have been hampered by difficulties encountered in distinguishing larvae of these species from those of lesser importance. Fortunately, there has been considerable research on the description and general systematics of larval and postlarval Penaeidae both in this country and abroad. As a result, all the littoral genera known to occur in the northwestern Gulf of Mexico have had representatives—although not necessarily of indigenous species—at least partially described. The principal problem, therefore, was one of consolidating all the available information and ascertaining what portions of it might help describe the local penaeid larvae. The intent of this paper is to present criteria that will aid in distinguishing larvae and postlarvae of the genus Penaeus Fabricius from those of Parapenaeus Smith, Sicyonida Milne Edwards, Solenocera Lucas, Trachypeneus Alcock, and Xiphopenaeus Smith, the five other littoral genera found locally.

The material made available for examination during this study was collected systematically between March 1959 and March 1960 and during January to December 1961. From January to September 1961, plankton was sampled with a Gulf-V net to depths of 45 fathoms between Cameron, La., and Freeport, Tex. In September, the sampling program was enlarged to include the area between Morgan City, La., and the mouth of the Colorado River, Tex.

Although various larval stages of several species represented in this area had been recorded, there were no established criteria for differentiating the penaeid larvae. Consequently, as new or therefore unrecognized penaeid larvae and postlarvae were found in the plankton samples, they were assigned a code number and a reference sketch of them was made. Through the use of descriptions

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1 Contribution No. 198, Bureau of Commercial Fisheries Biological Laboratory, Galveston, Tex.
taken from the literature, and by comparison with larvae reared in the laboratory from eggs of known parentage, planktonic larvae were assigned to genera. Subsequent examination of accumulated material revealed the presence of protozoal, mysis, and postlarval characters which remained constant within each genus. These characters were, in turn, used as criteria to construct a key to local genera. A key based for the most part on planktonic rather than laboratory-reared material has its limitations, but the scarcity of information concerning penaeid larvae from this area nevertheless justifies its presentation at this time.

Despite the fact that *Penaeus aztecus* Ives (brown shrimp); *P. duorarum* Burkenroad (pink shrimp); *Sicyonia brevirostris* (Stimpson) and *S. dorsalis* (Kingsley) (rock shrimps); *Trachypeneus similis* (Smith); and *Xiphopeneus kroyeri* (Heller) (seabob) have been reared successfully through the nauplial stage under laboratory conditions, the nauplii were found to be so similar as to defy attempts to fit them into a key. Although differences in setation are minor or absent, the lack of a dorsal protuberance (fig. 1f), as well as larger relative size, serves to distinguish nauplii of the genus *Penaeus*. In genera other than *Penaeus*, this protuberance is present on the dorsal surface of the body above the insertion of the second antennae.

Within a given developmental stage (e.g., Nauplius II, Protozoa I, etc.), the size ranges of penaeid larvae as a whole are extremely variable, although in the northern Gulf, larvae of the genus *Penaeus* are generally larger than those belonging to comparable stages of other genera. Hudinaga (1942) found that the protozoal stages of *P. japonicus* Bate exhibited intermolt growth, the occurrence of which may also be true for other stages as suggested for nauplii of *Xiphopeneus kroyeri* by Renfro and Cook (1963). The possibility also exists that larvae (and postlarvae) of the same species grow dissimilarly at different times of the year. Since the relative size at each stage overlaps considerably between, as well as within, the various genera, it should be used with discretion for purposes of identification.

While the number of sublages in each penaeid larval stage described in the literature has been found to vary, the normal situation in the northwestern Gulf of Mexico—as ascertained from material in plankton collections—seems to be five nauplial, three protozoal, and three mysis sublages. Examples of departure from this sequence are provided by the larvae of *Sicyonia brevirostris* which, when reared in the laboratory, appeared to pass through four mysis sublages, and by those of *Parapeneus* sp. which, as determined from sample material, also have at least four. Such apparent anomalies suggest that descriptions of penaeid larvae obtained either from rearing experiments or plankton samples must be viewed with caution until more is known of the effects of environmental factors on early growth and morphology.

Table 1, in addition to presenting the principal diagnostic characters included in the following key, also furnishes other valuable characters for distinguishing larvae and postlarvae.

All illustrations are intended to clarify generic characteristics and do not represent particular species.

### KEY TO STAGES AND SUBSTAGES OF PENAEID LARVAE AND EARLY POST-LARVAE

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Body simple, unsegmented; three pairs of appendages arising from anterior portion of body, first unbranched, second and third branched; paired caudal spines arise from posterior end of body (Nauplius)</td>
</tr>
<tr>
<td>2</td>
<td>Not as above</td>
</tr>
<tr>
<td>2(1)</td>
<td>Body pear shaped; pairs of caudal spines of equal length, extending straight posteriorly; lateral setae on appendages arise singly or in pairs; appendages lack spines or processes such as would be utilized for feeding purposes; carapace present only as a close-fitting rudiment in later stages (Penaeid nauplius fig. 1)</td>
</tr>
<tr>
<td>3</td>
<td>One or more of the following characters present: body elliptical; pairs of caudal spines of unequal length or extending medially, crossing one another; lateral setae on appendages arising in clusters; spines or processes such as would be utilized for feeding purposes present; a well-developed or prominent carapace present</td>
</tr>
<tr>
<td>3(2)</td>
<td>Five setae on exopod of second antenna; one pair of caudal spines; surface of body between insertion of caudal spines convex. Nauplius I (fig. 1a)</td>
</tr>
<tr>
<td>4</td>
<td>More than five setae on exopod of second antenna; one or more pairs of caudal spines; surface of body between insertion of caudal spines not convex.</td>
</tr>
<tr>
<td>4(3)</td>
<td>Six setae on exopod of second antenna; usually one, sometimes two, pairs of caudal spines; surface of body between insertion of caudal spines flat. Nauplius II (fig. 1b)</td>
</tr>
</tbody>
</table>
Figure 1.—Penaeid nauplii: a, Nauplius I; b, Nauplius II; c, Nauplius III; d, Nauplius IV; e, and f, Nauplius V.

Peneidae of the Northwestern Gulf of Mexico
More than six setae on exopod of second antenna; usually three or more pairs of caudal spines; surface of body between insertion of caudal spines concave...

7(1) Large, prominent, carapace followed by a slender segmented thorax and an abdomen which may or may not be segmented; two pairs of prominent appendages arising from anterior portion of body, the first unbranched, the second branched; prominent labrum present (Protozoa)...

8(7) Carapace does not completely cover thorax; abdomen bifurcate posteriorly, with each force bearing at least seven spines; biramous first and second maxillipeds well developed, the third absent or present only as a rudiment; usually, no spines arise from posterior half of carapace; if spines present, a dorsal organ (fig. 2d) is present (Penaeid protozoa fig. 2).

9(8) Eyes sessile, beneath carapace; pereiopods absent; abdomen unsegmented

Protozoa I (fig. 2a)

Eyes stalked; pereiopods present at least as small buds; abdomen segmented...

10(9) Uropods not present externally, may be seen beneath cuticle; pereiopods present only as small buds; first five abdominal segments without dorsal spines...

Protozoa II (fig. 2b)

Uropods present externally; pereiopods rudimentary, but biramous and prominent; first five abdominal segments with dorsal spines

Protozoa III (fig. 2c)

Carapace closely fitting with a rostrum that extends anteriorly between the eyes; five pairs of biramous pereiopods present, with the exopods elongate and bearing numerous setae which make them appear brushlike; six-segmented abdomen followed by telson and biramous uropods; pleopods, if present, rudimentary and non-functional (Mysis)...

Carapace closely fitting with a rostrum extending anteriorly between the eyes; five pairs of pereiopods absent; abdomen unsegmented

Nonpenaeid protozoa

Figure 2.—Penaeid protozoae: a, Protozoa I; b, Protozoa II; c, Protozoa III; d, Protozoa III, carapace.
pods present, with exopods absent or present only as rudiments; six-segmented abdomen followed by telson and biramous uropods; five pairs of setose, functional pleopods present (Postlarvae). 15

12(11) First three pairs of peraeopods cleft to form rudimentary chelae; pleura of first abdominal segment overlap second; antennal blades present; pleopods develop on first five abdominal segments simultaneously although they are not necessarily of equal length; telson narrow and notched medially; uropods without staeocytes; usually, no spines originate from posterior half of carapace and margins of carapace not serrate; if spines or serrations present, a dorsal organ also present (Penaeid mysis fig. 3) 13

One or more of following characters present: first three peraeopods not cleft to form rudimentary chelae; pleura of second abdominal segment overlap first; antennal blades absent; pleopods may not be present on all abdominal segments; telson broad and fan shaped or not notched medially; uropods with staeocytes; spines originate from posterior half of carapace or margins of carapace serrate, with no dorsal organ present. Nonpenaeid mysis

13(12) Pleopods absent. Mysis I (fig. 3a) 14

Pleon absent. 12

14(13) Pleopods small and unjointed. Mysis II (fig. 3b) 15

Pleon absent or not jointed. Mysis III (fig. 3c) 15

15(11) First three pairs of peraeopods chelate; pleura of first abdominal segment overlapping second; five pairs of functional pleopods present; gills covered by carapace; antennal blades present. Penaeid postlarva

Penaeid postlarva (fig. 4)

One or more of the following characters present: first three pairs of peraeopods not chelate; pleura of second abdominal segment overlapping first; less than five pairs of functional pleopods present; gills extending from beneath carapace; antennal blades absent. Nonpenaeid postlarva

**Figure 3.**—Penaeid mysis: a, Mysis I; b, Mysis II; c, Mysis III.

**Figure 4.**—Penaeid postlarva.
KEY TO GENERA OF PENAeid LARVAE AND POSTLARVAE

PROTOZOEAE

(Fig. 5)

1 Number of lateral setae on endopod of second appendage $1+1+2$ $^1$. $\textit{Penaeus}$

Number of lateral setae on endopod of second appendage not $1+1+2$. $\textit{Sticyonia}$

2(1) First appendage about twice as long as second; no spine on anterior margin of labrum; number of lateral setae on endopod of second appendage $1+2+3$.

$^1$ Starting with proximal seta, the number of lateral setae at each point of insertion is recorded.

3(2) Number of lateral setae on endopod of second appendage $1+2+2, 1+2+3$, or $2+2+2$. $\textit{Parapenaeus}$

Number of lateral setae on endopod of second appendage not $1+2+2$ or $2+2+2$. $\textit{Solenocera}$

4(3) Number of lateral setae on endopod of second appendage $2+2+3$.

Number of lateral setae on endopod of second appendage $2+2$.

5(4) Four long, terminal setae on endopod of second appendage.

Four long and one short terminal setae on endopod of second appendage.

$\textit{Trachypeneus}$ $\textit{Xiphopeneus}$

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Figure 5.—Penaeid protozoae: a, $\textit{Parapenaeus}$, Protozoa I; b, $\textit{Penaeus}$, Protozoa I; c, $\textit{Sticyonia}$, Protozoa I; d, $\textit{Solenocera}$, Protozoa I; e, $\textit{Solenocera}$, Protozoa II; f, $\textit{Trachypeneus}$, Protozoa I; g, $\textit{Xiphopeneus}$, Protozoa I.

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MYSES
(Fig. 6)

1 Carapace and abdomen with many spines; dorsal organ present on dorsal surface of carapace
Solenocera
Carapace and abdomen without many spines; dorsal organ absent

2(1) Dorsomedian spines not present on first five abdominal segments
Sicyonia
Dorsomedian spine present on at least fourth and fifth abdominal segments

3(2) Dorsomedian spine not present on third abdominal segment
Dorsomedian spine present on third abdominal segment

4(3) Lateral spine present on fifth abdominal segment; rostrum shorter than eye
Trachypeneus
Lateral spine not present on fifth abdominal segment; rostrum as long as or shorter than eye
Xiphopeneus

5(3) Dorsomedian spine on third abdominal segment elongate
Parapeneus
Dorsomedian spine on third abdominal segment not elongate
Peneus

POSTLARVAE
(Fig. 7)

1 Total length 6.0 mm. or less
Total length greater than 6.0 mm

2(1) Total length 6.0 mm. to 12.0 mm
Total length 12.0 mm. to 25.0 mm

3(1) No terminal spines on telson
Sicyonia
Terminal spines present on telson

4(3) Medioterminal spines of telson longer than those adjacent to it
Trachypeneus
Medioterminal spine of telson equal in length to those adjacent to it
Peneus

5(2) First abdominal segment with dorsal anteromedian spine
Sicyonia
First abdominal segment without dorsal anteromedian spine

6(5) Pterygostomial spine present; pleopods of fifth abdominal segment with exopods and endopods of equal length
Pterygostomial spine absent; pleopods of fifth abdominal segment with endopods inferior to exopods

7(6) Antennules round; no cervical sulcus on carapace; rostrum curved
Parapeneus
Antennules flattened; well-defined cervical sulcus present on carapace; rostrum straight
Solenocera

8(5) Antennal spine absent or minute; if present, subrostral teeth also present
Peneus
Antennal spine very prominent; no subrostral teeth

9(8) Rostrum shorter than eye
Trachypeneus
Rostrum longer than eye
Xiphopeneus

10(2) Rostrum usually with ventral teeth and shallowly compressed
Peneus
Rostrum without ventral teeth and broadly compressed

11(10) Pterygostomial spine present
Pterygostomial spine absent

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Figure 6.—Penaeid myses: a, Parapeneus, Mysis I; b, Peneus, Mysis I; c, Sicyonia, Mysis I; d, Solenocera, Mysis I; e, Trachypeneus, Mysis I; f, Xiphopeneus, Mysis I.

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2 Early Xiphopeneus postlarvae probably fall in the <6.0-mm. category, but none in this size range was noted during the study.

PENEIDAE OF THE NORTHWESTERN GULF OF MEXICO

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12(11) Antennules flattened; cervical sulcus present; sixth abdominal segment short and slightly curved. **Solenocera**
Antennules round; cervical sulcus absent; sixth abdominal segment long and straight. **Parapenaeus**
13(11) Rostrum longer than eye. **Xiphopenaeus**
Rostrum shorter than eye. **Trachypeneus**

14(13) First abdominal segment with anteromedian spine on dorsal surface; sixth abdominal segment short. **Sicyonia**
First abdominal segment without anteromedian spine on dorsal surface; sixth abdominal segment elongate. **Trachypeneus**

*Figure 7.*—Penaeid postlarvae: *a,* *Parapenaeus* postlarva, 8.0 mm.; *b,* *Penaeus* postlarva, 6.0 mm.; *c,* *Penaeus* postlarva, 15.0 mm.; *d,* *Sicyonia* postlarva, 5.0 mm.; *e,* *Sicyonia* postlarva, 14.0 mm.; *f,* *Solenocera* postlarva, 7.0 mm.; *g,* *Trachypeneus* postlarva, 6.0 mm.; *h,* *Trachypeneus* postlarva, 10.0 mm.; *i,* *Trachypeneus* postlarva, 25.0 mm.; *j,* *Xiphopenaeus* postlarva, 6.0 mm.; *k,* *Xiphopenaeus* postlarva, 7.5 mm.; *m,* *Xiphopenaeus* postlarva, 12.0 mm.; *l,* Tip of telson.
Table 1.—Characters of diagnostic importance in distinguishing genera during the early life history stages of the littoral Penaeidae occurring along the northern Gulf coast.

<table>
<thead>
<tr>
<th>Stage and structure</th>
<th>Parapeneus</th>
<th>Penaeus</th>
<th>Sicyonia</th>
<th>Solenocera</th>
<th>Trachypeneus</th>
<th>Xiphopeneus</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROTOZOOEAE—GENERAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative lengths of 1st and 2d appendages.</td>
<td>Approximately equal.</td>
<td>Approximately equal.</td>
<td>First about twice as long as second.</td>
<td>Approximately equal.</td>
<td>First about 1½ as long as second.</td>
<td>First about 1½ as long as second.</td>
</tr>
<tr>
<td>Spine on labrum</td>
<td>Small</td>
<td>Small</td>
<td>Medium width and notch</td>
<td>Absent</td>
<td>Very long</td>
<td>Small</td>
</tr>
<tr>
<td>Telson</td>
<td>Narrow and deeply notched.</td>
<td>Medium width and notch</td>
<td>Medium width and notch</td>
<td>Spines and dorsal organ.</td>
<td>Medium width and notch.</td>
<td>Medium width and notch.</td>
</tr>
<tr>
<td>Dorsal surface of carapace</td>
<td>Smooth</td>
<td>Smooth</td>
<td>Small hump</td>
<td>2+2 lateral</td>
<td>Small specimen</td>
<td>Small hump.</td>
</tr>
<tr>
<td>Setation of endopod of second appendage</td>
<td>Variable 1+1+2 lateral</td>
<td>1+2+3 lateral</td>
<td></td>
<td>2+2 lateral, 4 terminal</td>
<td>2+2 lateral, 5 terminal</td>
<td></td>
</tr>
<tr>
<td>PROTOZOOEAE I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projection on front of carapace</td>
<td>Pointed</td>
<td>Round</td>
<td>Round</td>
<td>Pointed</td>
<td>Round</td>
<td>Round</td>
</tr>
<tr>
<td>Third maxilliped</td>
<td>Small, biramous, no setae</td>
<td>Absent or present as small uniramous bud.</td>
<td>Small, biramous, no setae</td>
<td>Small, biramous, with setae.</td>
<td>Small, biramous, with setae.</td>
<td>Small, biramous, with setae.</td>
</tr>
<tr>
<td>Spines on carapace</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Four pairs</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>PROTOZOOEAE II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rostrum</td>
<td>Long</td>
<td>Two pairs</td>
<td>Long</td>
<td>Absent</td>
<td>Long</td>
<td>Long</td>
</tr>
<tr>
<td>Supraorbital spines</td>
<td>One pair</td>
<td>One pair</td>
<td>One pair</td>
<td>One pair with many branches</td>
<td>One pair</td>
<td>One pair</td>
</tr>
<tr>
<td>PROTOZOOEAE III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rostrum</td>
<td>Long</td>
<td>One pair</td>
<td>Long</td>
<td>Absent</td>
<td>Long</td>
<td>Absent</td>
</tr>
<tr>
<td>Supraorbital spines</td>
<td>Present on six segments.</td>
<td>Present on first five segments.</td>
<td>Present on first five segments.</td>
<td>Present on sixth segment.</td>
<td>Present on fifth and sixth segments.</td>
<td>Present on fifth and sixth segments.</td>
</tr>
<tr>
<td>Dorsomedian spines of abdomen</td>
<td>Present on fourth, fifth, and sixth segments.</td>
<td>Present on fifth and sixth segments.</td>
<td>Present on fifth segment.</td>
<td>One pair</td>
<td>Two pairs</td>
<td></td>
</tr>
<tr>
<td>Posterolateral spines of abdomen</td>
<td>One pair</td>
<td>One pair</td>
<td>One pair</td>
<td>One pair</td>
<td>Two pairs</td>
<td>Two pairs.</td>
</tr>
<tr>
<td>Ventrolateral spine on sixth segment.</td>
<td>Mysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supraorbital spine</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>Hepatic spine</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Ventromedian spines of abdomen</td>
<td>Present on fifth and sixth segments.</td>
<td>Present on fifth and sixth segments.</td>
<td>Present on fifth and sixth segments.</td>
<td>Present on first five segments.</td>
<td>Present on first five segments.</td>
<td>Absent</td>
</tr>
<tr>
<td>Posterolateral spines of abdomen.</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Stage and structure</th>
<th>Parapenaeus</th>
<th>Penaeus</th>
<th>Sicynia</th>
<th>Solenocera</th>
<th>Trachypeneus</th>
<th>Xiphopeneus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROTOZOA (Continued)</strong></td>
<td><strong>MYXIS (Continued)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>POSTLARVAE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First to 6.0-MM. POSTLARVAE:</td>
<td>[First postlarva begins at about 8.0 mm.]</td>
<td>Straight</td>
<td>Curved</td>
<td>[First postlarva begins at about 7.0 mm.]</td>
<td>Curved</td>
<td>None examined.</td>
</tr>
<tr>
<td>Rostrum</td>
<td>Absent</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Anteromedian spine on first abdominal segment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sixth abdominal segment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0- to 12.0-MM. POSTLARVAE:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anteromedian spine of first abdominal segment.</td>
<td>All equal</td>
<td>All equal</td>
<td>Fifth pleopod shorter than first.</td>
<td>Fifth pleopod shorter than first.</td>
<td>All equal</td>
<td>All equal</td>
</tr>
<tr>
<td>Length of pleopods.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative lengths of endopod and exopod of fifth pedopod.</td>
<td>Approximately equal</td>
<td>Endopod absent or inferior.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pterygostomial spine</td>
<td>Present</td>
<td>Absent</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Antennal spine</td>
<td>Present</td>
<td>Absent</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>Antennules</td>
<td>Round</td>
<td>Round</td>
<td>Round</td>
<td>Flattened</td>
<td>Round</td>
<td>Round</td>
</tr>
<tr>
<td>Sulca of carapace</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Cervical sulcus</td>
<td>Absent</td>
<td>Brancho-cardiac sulcus</td>
</tr>
<tr>
<td>Elongate, straight</td>
<td>Elongate, straight</td>
<td>Short, straight</td>
<td>Medium, curved ventrally.</td>
<td>Medium, straight.</td>
<td>Medium, straight</td>
<td></td>
</tr>
<tr>
<td>Sixth abdominal segment.</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Anteromedian spine on first abdominal segment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Ray S. Wheeler and Robert F. Temple offered many helpful suggestions during the course of this study, and Daniel Patlan assisted with the drawings.

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