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A KEY TO THE PORCELLANID CRAB ZOEAE (CRUSTACEA: DECAPODA: ANOMURA) OF THE NORTH CENTRAL GULF OF MEXICO AND A COMPARISON OF MERISTIC CHARACTERS OF FOUR SPECIES[1]

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ABSTRACT A taxonomic key is provided for the two zoeal stages of five genera and six species of the Porcellanidae (Crustacea: Anomura) from the north central Gulf of Mexico. Measurements, carapace structures, and appendages are compared among zoeal specimens of *Euceramus praelongus* Stimpson, 1860; *Petrolisthes armatus* (Gibbes, 1850); *Polyonyx gibbesi* Haig, 1956; and *Porcellana sigsbeiana* A. Milne-Edwards, 1880. Positive correlations are noted between rostral spine length and carapace length in *E. praelongus* (zoeae I) and *P. sigsbeiana* (zoeae I) and in posterior spine lengths and carapace length in *E. praelongus* (zoeae I) and *P. gibbesi* (zoeae I).

INTRODUCTION

Porcellanid crab zoeae are conspicuous members of the plankton owing to their long rostral and posterior carapace spines. Kelly and Dragovich (1967) reported that porcellanid larvae formed the second most abundant group of zooplankton in Tampa Bay, Florida and accounted for 27.4 percent of the total number of zooplankters. Porcellanid zoeae and adults are major components of the diets of commercially important fish (Jillet 1968, Chesney and Iglesias 1979) and crabs (Gore et al. 1978, Gurriaran 1978). Lopez-Jamar Martinez (1977) noted the importance of porcellanid zoeae as predators on fish larvae.

The biology of porcellanid crabs is not well known, and information concerning porcellanids from the Gulf of Mexico is especially lacking. The objectives of the present study were to devise a key to porcellanid zoeae of the north central Gulf of Mexico, and compare meristic features of collected zoeae with those of previous findings.

MATERIALS AND METHODS

Zoeae of *Euceramus praelongus* Stimpson, 1860; *Polyonyx gibbesi* Haig, 1956; and *Petrolisthes armatus* (Gibbes, 1850) were removed from plankton samples collected from four stations bordering Mississippi Sound, Mississippi, by personnel of the Fisheries Section of the Gulf Coast Research Laboratory, Ocean Springs, Mississippi. Collections were obtained over a three-year period (October 1973 to September 1976) as part of a fisheries assessment and monitoring project, under the Commercial Fisheries Research and Development Act for the National Marine Fisheries Service. Specific information concerning sample collection and station locations were previously reported (Maris 1980, Maris and Fish, in preparation). Both zoeal stages of *Porcellana sigsbeiana* A. Milne-Edwards, 1880, were removed from continental shelf collections (Franks et al. 1972).

Individual zoeae were identified to stage of development using telson structures, pleopod development and rostral spine setation employing a binocular stereomicroscope. Appendages were mounted in Turtox CMCP 9AF and CMCP 10, and drawings were made using a drawing attachment.

Measurements were made using a calibrated ocular micrometer. Carapace length was measured from the anterior margin of the eye to the insertion of the posterior carapace spines. Rostral and posterior carapace spine length was measured from the distal tip to carapace attachment. Although carapace spine lengths are not taxonomically significant because of inherent variability in length, dependence on curvature and likelihood of breakage (Gore 1970), rostral and posterior carapace spine lengths were calculated as ratios to carapace length. Carapace length, being more constant and less prone to damage, was expressed as a direct measurement.

Each zoeal stage was treated individually, and easily observed, taxonomically significant structures were noted (rostral and posterior spines, carapace, telson, antenna and maxilliped 2). The term "seta" was used according to the definition of Gonor and Gonor (1973b). Notations for maxilliped setation formulas were presented as in Gore (1968).

Lebour's (1943) key with its modifications and a comparison among described zoeae mainly from laboratory rearings (Table 1) were initially used for species and stage separation. The key constructed includes certain species not collected in the current study but present in the northern Gulf of Mexico. The information for *Megalobrachium soriatum* (Say, 1818) came from Gore (1973b) and that for *Porcellana sayana* (Leach, 1820) from Brooks and Wilson (1881) and Gore (1971c, 1972a).

[1] This paper resulted from part of a thesis submitted to the Graduate School, University of Southern Mississippi, Hattiesburg, Mississippi 39401.

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TABLE 1.

Comparison of larval characteristics in the Porcellanidae mainly from laboratory rearings.[1]

	Porcellana Group				*Petrolisthes* Group			
	Porcellana	*Pisidia*	*Polyonyx*	*Euceramus*	*Petrolisthes*	*Pachycheles*	*Megalobrachium*	*Neopisosoma*
Ratio of Mean Rostral Spine Length (mm): Mean Carapace Length (mm)								
Zoeae I	8.0	4.2–4.4	4.0–7.0	3.9–4.0	1.8–8.5	2.6–6.0	2.5–2.9	7.0
Zoeae II	6.3	3.5–4.2	3.5–6.0	3.2–4.0	1.5–10.0	2.9–5.0	1.7–3.5	7.0
Rostral Spine Armature	covered	covered	covered	only 2 ventral rows	covered	covered	sparsely covered ventrally	covered
Ratio of Mean Posterior Spine Lengths (mm): Mean Carapace Length (mm)								
Zoeae I	3.0	1.1–1.3	0.7–2.4	1.6–2.0	0.6–3.8	1.3–3.0	0.5–2.0	2.0
Zoeae II	4.5	1.0–1.1	0.4–1.6	1.1–1.3	0.4–3.9	1.2–2.0	0.6–2.0	1.5–2.0
Antenna[2] Zoeae I	exo>endo	exo > endo	exo > endo	exo>endo	exo>endo[4]	exo>endo	exo>endo	exo>endo
	exo<ant	exo<ant	exo=2 x ant	exo<ant	exo with 0–3 fine inner margin setae, 0–1 spines	exo with 3–4 lateral spines	exo with fine setae	exo with 3 distal spines
Zoeae II	exo=½ x ant exo<endo	exo = ½xant exo< endo	endo≥ant exo< endo[3]	exo=½ x ant exo<endo	exo<endo	exo<endo	exo<endo	exo<endo
Somites with pleopods	2–5	2–4	2–5	2–5	2–5	2–5	2–5	2–5

[1] *Porcellana*, Gore (1971c, 1972a); *Pisidia*, Shepherd (1969); *Polyonyx*, Knight (1966), Gore (1968), Shepherd (1969), Shenoy and Sankolli (1973b); *Euceramus*, Roberts (1968); *Petrolisthes*, Greenwood (1965), Gore (1970, 1971b, 1972a, b, c, 1975), Yaqoob (1974, 1977, 1979), Shenoy and Sankolli (1975), Huni (1979); *Pachycheles*, Knight (1966), MacMillan (1972), Gore (1973a) Shenoy and Sankolli (1973a); *Megalobrachium*, Gore (1971a, 1972a, 1973b); *Neopisosoma*, Gore (1977).

[2] exo – exopodite; endo – endopodite; ant – antennule.

[3] *Polyonyx gibbesi* Haig, 1956 zoeae II 2/3 endo=exo.

[4] *Petrolisthes galathinus* (Bosc, 1802) zoeae I exo=endo.

The measurement data were normally distributed, so parametric statistical tests were used for data analysis. A Pearson correlation (Zar 1974) was used to determine whether a linear relationship existed between rostral spine length and carapace length; or posterior spine lengths and carapace length, for any zoeal stage. A one-tailed t-test (Zar 1974) was employed to decide whether present measurements differed significantly from previous measurements.

Identified collections of all species and stages were deposited in the Museum of the Gulf Coast Research Laboratory (GCRL 1098–1105) and Invertebrate Zoology Collection, Department of Biology, University of Southern Mississippi.

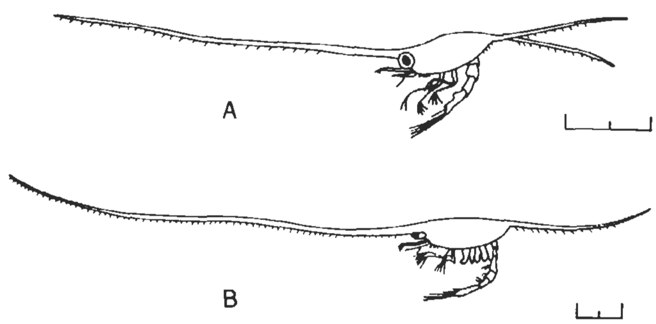

Figure 1. Representative whole specimens of porcellanid zoeae, using *Euceramus praelongus* as the example. A, zoeae I; B, zoeae II. Scale lines equal 0.5 mm.

RESULTS

General External Features of Porcellanid Larvae

Porcellanid crab zoeae are characterized by very long, tapering rostral and posterior carapace spines (Figure 1). The single rostral spine is usually not flattened, and can be from about two to eight times the carapace length. The two posterior spines are about one-half to four times the carapace length. The carapace is smooth and, in the genera considered herein, has no serrated edges. A triangular telson is present with several processes on the spatulate posterior margin. The outer pair of processes are short, smooth spines;

the second are reduced to fine setae as is typical in the Anomura; and the remainder are long, setose spines.

The antennal scale is reduced to an elongate spine. First and second pairs of maxillipeds are functional, but the third is not. Pereiopods, if present, are small and nonfunctional, although enlarging in later zoeal development. Five or six abdominal somites are present, but there are usually no uropods. Three to four pairs of pleopods are present in later stages, and the telson somite is without pleopods. All described species have two zoeal stages except for *Petrocheles spinosus* Miers, 1876, of New Zealand. Wear (1965) found that this species has five zoeal stages and exhibited several other galatheid features. *Petrocheles spinosus* thus appears to exhibit a link between the Porcellanidae and Galatheidae.

KEY TO PORCELLANID CRAB ZOEAE OF THE NORTH CENTRAL GULF OF MEXICO
(For comparison of features in key, see Figures 2–7)

1. Pleopods absent or present only as primorida; 5 pairs of plumose setae on telson; carapace length generally less than 1.5 mm; eyes sessile . . . . Zoeae I–2.

   Pleopods present and well-developed; 6 pairs of plumose setae on telson or 5 pairs and a median spine; carapace length generally greater than 1.5 mm; eyes mobile . . . . Zoeae II–7.

2. Fifth pair of long plumose setae off central prominence of telson; latter may have 2 fine hairs medially; telson length 1.5 times width . . . . *Porcellana* group–3.

   Fifth pair of long plumose setae on central prominence of telson; hairs on latter usually absent; telson length about equals width . . . . *Petrolisthes* group–6.

3. Three to 5 marginal spinules present on carapace just anterior to base of posterior spines; rostral spine with armature reduced to 2 ventral rows of anteriorly directed spinules . . . . *Euceramus praelongus*.

   Marginal carapace spines lacking or greatly reduced; rostral spine completely covered with setae . . . . 4.

4. Length of posterior spines approximately 2 times or less carapace length; antennal exopodite length twice endopodite length; posterior carapace margin with 2 small spinules . . . . *Polyonyx gibbesi*.

   Length of posterior spines approximately 3 or more times carapace length; antennal exopodite length less than twice endopodite length; posterior carapace margin lacking spinules . . . . *Porcellana* spp.–5.

5. Posterior carapace spines widely separated and divergent posteriorly; 1st and 2nd maxillipeds with distinct hook-like spine on basipodite; dorsal hump present on carapace . . . . *Porcellana sigsbeiana*.

   Posterior carapace spines not widely separated and typically parallel posteriorly; 1st and 2nd maxillipeds without hook-like spine on basipodite; dorsal carapace hump lacking . . . . *Porcellana sayana*.

6. Rostral spine distinctly upswept or sigmoid; posterior carapace spines armed ventrally with 2 or 3 large spines . . . . *Megalobrachium soriatum*.

   Rostral spine straight; posterior carapace spines armed ventrally with numerous small spinules. *Petrolisthes armatus*.

7. A 6th pair of long plumose setae added to central prominence of telson; mandibles without palps . . . . *Porcellana* group–8.

   A single median spine added to telson prominence; mandibles with palps . . . . *Petrolisthes* group–11.

8. Three to 5 marginal spinules present on posterior carapace; rostral spine with 2 ventral rows of setae . . . . *Euceramus praelongus*.

   Marginal carapace spines lacking or greatly reduced; rostral spine completely covered with setae . . . . 9.

9. Length of posterior spines less than 2.5 times carapace length; antennal exopodite length about 2/3 endopodite length; 3rd endopodal segment of 2nd maxilliped swollen, twice as long as other segments . . . . *Polyonyx gibbesi*.

   Length of posterior spines greater than 2.5 times carapace length; antennal exopodite length about 1/2 endopodite length; 3rd endopodal segment of 2nd maxilliped not swollen, about same size as other segments . . . . *Porcellana* spp.–10.

10. Posterior carapace spine attachments widely separated and divergent posteriorly; 1st and 2nd maxillipeds with distinct hook-like spine on basipodite; dorsal hump present on carapace . . . . *Porcellana sigsbeiana*.

Posterior carapace spine attachments not widely separated and typically parallel posteriorly; 1st and 2nd maxillipeds without hook-like spine on basipodite; dorsal carapace hump lacking . . . . *Porcellana sayana*.

11. Rostral spine distinctly upswept or sigmoid; posterior carapace spines armed ventrally with 1 small spine (rarely 2) . . . . *Megalobrachium soriatum*.

Rostral spine straight; posterior carapace spines armed ventrally with numerous small spinules. .*Petrolisthes armatus*.

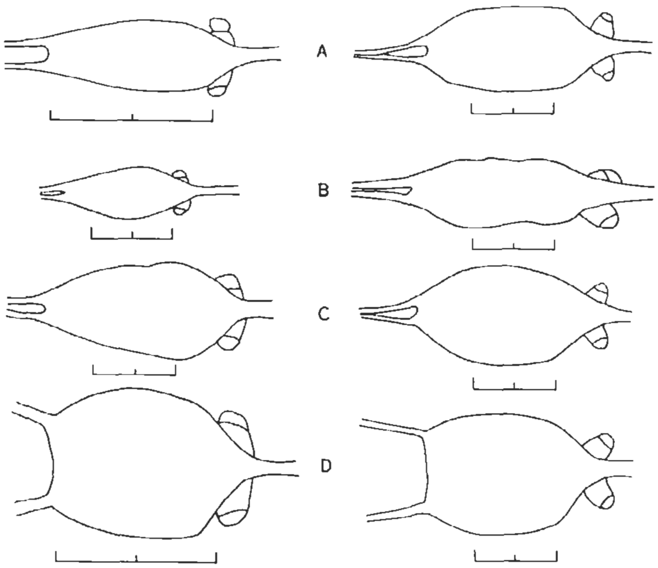

Figure 2. Dorsal region of carapace. Left column, zoeae I; right column, zoeae II. A, *Euceramus praelongus;* B, *Petrolisthes armatus;* C, *Polyonyx gibbesi;* D, *Porcellana sigsbeiana.* Scale lines equal 0.5 mm.

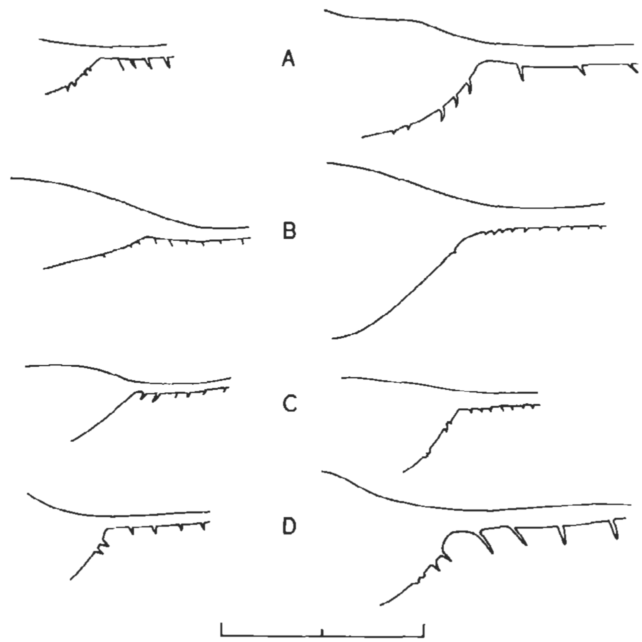

Figure 4. Posterior region of carapace and posterior spines. Left column, zoeae I; right column, zoeae II. A, *Euceramus praelongus;* B, *Petrolisthes armatus;* C, *Polyonyx gibbesi;* D, *Porcellana sigsbeiana.* Scale lines equal 0.5 mm.

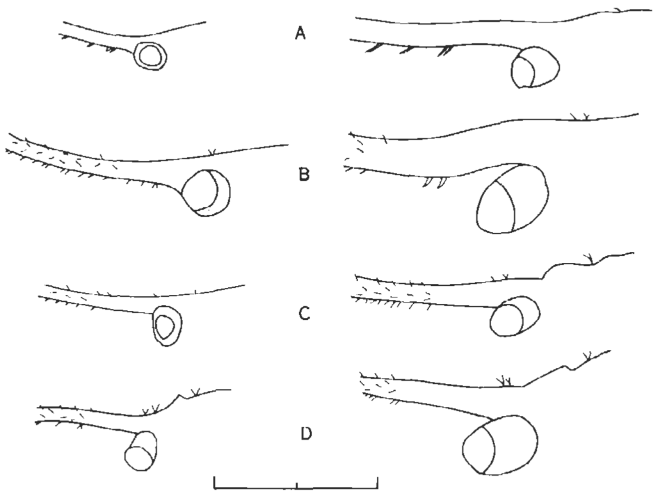

Figure 3. Anterior region of carapace and rostral spine. Left column, zoeae I; right column, zoeae II. A, *Euceramus praelongus;* B, *Petrolisthes armatus;* C, *Polyonyx gibbesi;* D, *Porcellana sigsbeiana.* Scale lines equal 0.5 mm.

DISCUSSION

Gurney (1938) first noticed differences in telson structures between zoeae of *Porcellana* and *Petrolisthes*. Lebour (1943) devised a general classification of porcellanid zoeae according to telson structures.

Greenwood (1965) included *Pisidia* in Lebour's *Porcellana* group, and noted that *Petrolisthes novaezelandiae* Filhol, 1885, and *P. elongatus* (H. Milne-Edwards, 1837) were exceptions to the proposed groupings. These two species exhibit telson structures, among other features, that do not correspond to Lebour's classification system. Knight (1966) added *Polyonyx* to the *Porcellana* group, *Pachycheles* to the *Petrolisthes* group, and mentioned a relationship between telson length/width ratio. Roberts (1968) placed *Euceramus* in the *Porcellana* group, and Gore (1971a) included *Megalobrachium* in the *Petrolisthes* group. Gore (1971a) stated that *Minyocerus* was possibly in the *Porcellana* group, and later indicated that *Clastotoechus* possibly belonged to the *Petrolisthes* group (Gore 1977). *Neopisosoma* was placed in the *Petrolisthes* group by Gore (1977).

Wear (1966) created a third group, for *Petrocheles*. Gore (1972a, c) formed a fourth group, the *Petrolisthes platymerus* group, containing *P. platymerus* Haig, 1960, and

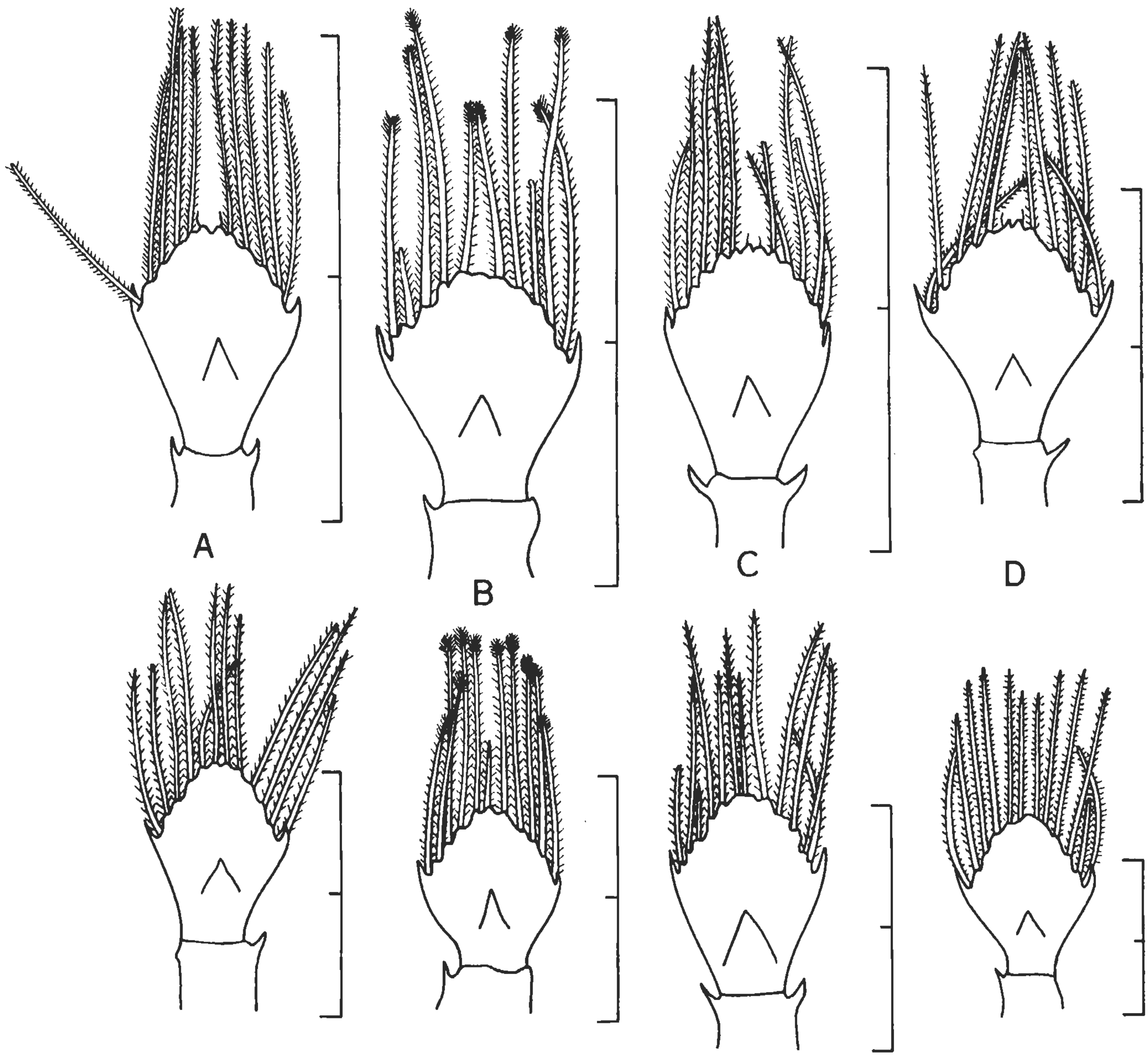

Figure 5. Telson structures. Top row, zoeae I; bottom row, zoeae II. A, *Euceramus praelongus;* B, *Petrolisthes armatus;* C, *Polyonyx gibbesi;* D, *Porcellana sigsbeiana.* Scale lines equal 0.5 mm. Note: certain setae were broken on specimens used in drawings.

tentatively *P. elongatus.* The only other exception to Lebour's classification remains *P. novaezelandiae.*

Larval measurements among four species were compared in Table 2. *Petrolisthes armatus* had the longest carapace lengths for both zoeae I and II, while *Polyonyx gibbesi* had the shortest carapace lengths. *Porcellana sigsbeiana* and *P. armatus* showed the largest and smallest carapace spine lengths (rostral and posterior)/carapace length ratios, respectively. Positive correlations between rostral spine length and carapace length were noted for *Euceramus praelongus* (zoeae I) and *P. sigsbeiana* (zoeae I); posterior spine lengths and carapace length for *E. praelongus* (zoeae I) and *P. gibbesi* (zoeae I).

Zoeae from the present study (planktonic) were compared with zoeae obtained from laboratory rearings, using a one-tailed t-test (Table 3). Measurements on zoeae from the field collections were often slightly larger than those from the laboratory-reared specimens, a fact noted by other authors. All field measurements (except one) differed significantly from ones obtained in the laboratory. Le Roux (1966) found larvae of *Pisidia longicornis* (Linnaeus, 1777) from natural environments larger than those reared in the laboratory. Gore (1968) noted similar size discrepancies in larvae of *P. gibbesi;* specimens from natural environments usually had the longest carapace and rostral spines. Improved conditions in the natural environment, as compared to

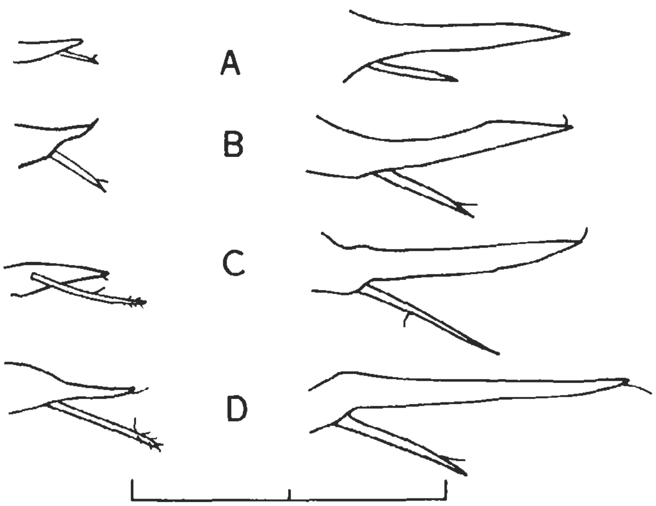

Figure 6. Antenna. Left column, zoeae I; right column, zoeae II. A, *Euceramus praelongus;* B, *Petrolisthes armatus;* C, *Polyonyx gibbesi,* D, *Porcellana sigsbeiana.* Scale lines equal 0.5 mm.

laboratory conditions, may account in part for the observed size differences. Food availability, temperature fluctuations, diel light, and essential chemical concentrations in the water are but a few of the possible factors which may influence size.

Rostral spines are completely covered with setae in all species and stages except *E. praelongus,* which has only two ventral rows of spinules. Posterior carapacial spines in all species and stages are similar, with two posterior spines, each with a single row of spinules (Figures 3–4). Carapace length exceeds width and posterior spine attachments are not widely separated except in *P. sigsbeiana* which has a nearly rectangular carapace and widely separated posterior spine attachments (Figure 2).

The anterior dorsal region of the carapace is devoid of setation in zoeae I of *E. praelongus,* and a single seta is found in zoeae II of *E. praelongus* (Figure 3). A single pair of setae occurs in *P. armatus* (zoeae I) and two pairs are found in *P. armatus* (zoeae II) and *P. gibbesi* (zoeae I). Three pairs of setae occur in *P. gibbesi* (zoeae II) and *P. sigsbeiana* (zoeae I and II). Roberts (1968) did not mention carapace setation for *E. praelongus.* Gore (1970) found three pairs of dorsal carapace setae in zoeae I and II of *P. armatus.* Gore (1968) stated that *P. gibbesi* (zoeae I) had three pair of setae. Zoeae II of *P. gibbesi* and both stages of *P. sigsbeiana* have dorsal carapace setation similar to previous studies. Gore (1968)

TABLE 2.

Comparison of Porcellanid Zoeal Measurements (Values in parentheses are means ± standard deviation); r = Pearson Correlation Coefficient; p = Significance Level; N.S. = not significant (p <0.05).

	Euceramus praelongus	*Petrolisthes armatus*	*Polyonyx gibbesi*	*Porcellana sigsbeiana*
Zoeae I				
Carapace Length (mm)	0.84–1.06 (0.95±0.06)	1.30–1.36 (1.34±0.03)	1.00–1.26 (1.15±0.07)	0.84–0.96 (0.92±0.05)
Rostral Spine Length/Carapace Length	4.25–5.02 (4.59±0.25)	4.23–4.42 (4.31±0.08)	5.04–7.61 (6.16±0.53)	9.13–9.76 (9.42±0.26)
	r = +0.6343 p = 0.001	r = +0.7253 N.S.	r = +0.3801 N.S.	r = +0.9663 p = 0.034
Posterior Spine Lengths/Carapace Length	1.60–2.07 (1.83±0.12)	1.19–1.36 (1.26±0.07)	1.44–2.04 (1.64±0.15)	3.04–3.48 (3.33±0.20)
	r = +0.6082 p = 0.001	r = +0.2353 N.S.	r = +0.5394 p = 0.005	r = +0.4036 N.S.
Sample Size	25	4	25	4
Zoeae II				
Carapace Length (mm)	1.54–1.94 (1.75±0.11)	1.92–2.28 (2.12±0.11)	1.54–1.90 (1.74±0.11)	1.78–1.98 (1.90±0.06)
Rostral Spine Length/Carapace Length	4.44–6.25 (5.39±0.52)	4.33–6.21 (5.32±0.45)	5.96–9.06 (7.45±0.83)	8.24–10.66 (9.27±0.58)
	r = –0.1100 N.S.	r = +0.2384 N.S.	r = +0.1779 N.S.	r = +0.1243 N.S.
Posterior Spine Lengths/Carapace Length	1.44–2.00 (1.67±0.17)	1.17–1.88 (1.62±0.17)	1.38–2.23 (1.79±0.26)	2.50–3.23 (2.97±0.14)
	r = –0.0902 N.S.	r = +0.2620 N.S.	r = +0.0024 N.S.	r = +0.3955 N.S.
Sample Size (n)	25	25	25	25

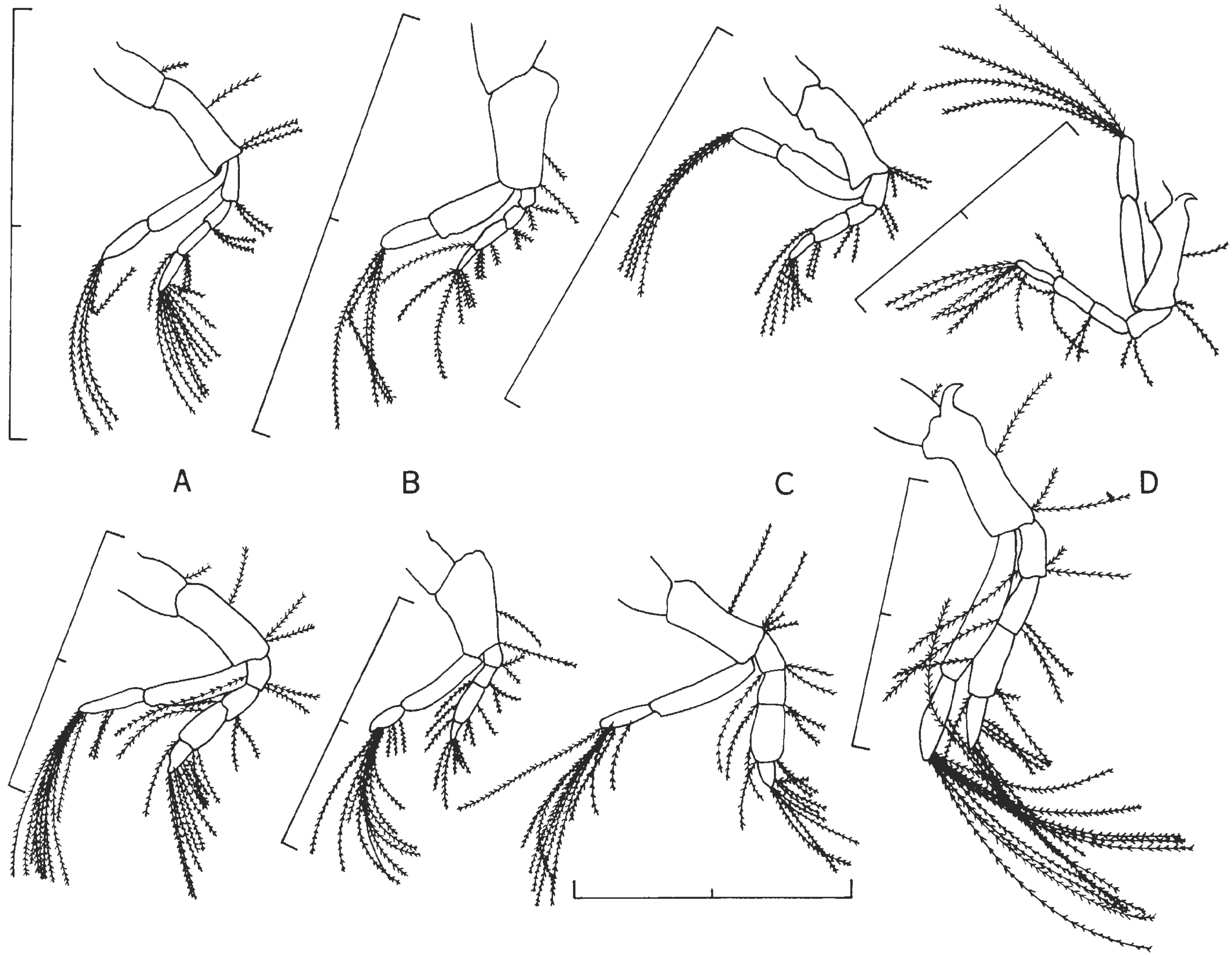

Figure 7. Maxilliped 2. Top row, zoeae I; bottom row, zoeae II. A, *Euceramus praelongus;* B, *Petrolisthes armatus;* C, *Polyonyx gibbesi;* D, *Porcellana sigsbeiana.* Scale lines equal 0.5 mm.

TABLE 3.

Comparisons of Porcellanid Zoeal Measurements Obtained from the Present Study and Previous Studies; values are means ± standard deviation (in present study); significance level (p) indicates results of a one-tailed t-test; n = sample size; N.S. = not significant ($p > 0.05$).

Species	Measurement	Present Study	Previous Studies	Significant Level
Euceramus praelongus			(Roberts 1968)	
zoeae I (n = 25)	Carapace Length (mm)	0.95±0.06	1.02	($p < 0.005$)
	Rostral Spine Length/Carapace Length	4.59±0.25	4.17	($p < 0.005$)
	Posterior Spine Lengths/Carapace Length	1.83±0.12	1.78	($p < 0.05$)
zoeae II (n = 25)	Carapace Length (mm)	1.75±0.11	1.80	($p < 0.025$)
	Rostral Spine Length/Carapace Length	5.39±0.52	3.68	($p < 0.0005$)
	Posterior Spine Lengths/Carapace Length	1.67±0.17	1.07	($p < 0.0005$)
Petrolisthes armatus			(Gore 1970)	
zoeae I (n = 4)	Carapace Length (mm)	1.34±0.03	1.6	($p < 0.0005$)
	Rostral Spine Length/Carapace Length	4.31±0.08	up to 4	($p < 0.0005$)
	Posterior Spine Lengths/Carapace Length	1.26±0.07	about 1	($p < 0.0005$)
zoeae II (n = 25)	Carapace Length (mm)	2.12±0.11	2.0	($p < 0.0005$)
	Rostral Spine Length/Carapace Length	5.32±0.45	up to 5	($p < 0.001$)
	Posterior Spine Lengths/Carapace Length	1.62±0.17	about 1	($p < 0.0005$)
Polyonyx gibbesi			(Gore 1968)	
zoeae I (n = 25)	Carapace Length (mm)	1.15±0.07	1.2	($p < 0.001$)
	Rostral Spine Length/Carapace Length	6.16±0.53	up to 7	($p < 0.0005$)
	Posterior Spine Lengths/Carapace Length	1.64±0.15	1.4–1.8	N.S.
zoeae II (n = 25)	Carapace Length (mm)	1.74±0.11	1.7	($p < 0.05$)
	Rostral Spine Length/Carapace Length	7.45±0.83	about 6	($p < 0.0005$)
	Posterior Spine Lengths/Carapace Length	1.79±0.26	up to 1.6	($p < 0.001$)
Porcellana sigsbeiana			(Gore 1971c)	
zoeae I (n = 4)	Carapace Length (mm)	0.92±0.05	1.12	($p < 0.0005$)
	Rostral Spine Length/Carapace Length	9.42±0.26	up to 8	($p < 0.0005$)
	Posterior Spine Lengths/Carapace Length	3.33±0.20	about 3	($p < 0.0025$)
zoeae II (n = 25)	Carapace Length (mm)	1.90±0.06	1.93	($p < 0.01$)
	Rostral Spine Length/Carapace Length	9.27±0.58	up to 6.3	($p < 0.0005$)
	Posterior Spine Lengths/Carapace Length	2.97±0.14	up to 4.5	($p < 0.0005$)

mentioned that carapace setation was possibly taxonomically important, but with further examination decided that carapace setation was unreliable for species identification (Gore 1971a).

Zoeae of *E. praelongus, P. gibbesi,* and *P. sigsbeiana,* from the present study, exhibited telson characteristics of Lebour's (1943) *Porcellana* group, and *P. armatus* showed *Petrolisthes* group features (Figure 5). These findings verify previous reports and show the continued usefulness of Lebour's key.

Antennal exopodites are slightly longer than endopodites in zoeae I of *E. praelongus* and *P. sigsbeiana* (Figure 6). Exopodite length is twice endopodite length in *P. armatus* and *P. gibbesi.* Endopodite length exceeds exopodite length for all species in zoeae II. No setation is present in zoeae II of *E. praelongus* and zoeae I of *E. praelongus* have a single seta on the exopodite. Zoeae I of *P. armatus* have a single antennal endopodite seta and a pair of exopodite setae. All other species and stages studied have a single endopodite and exopodite seta.

Table 4 compares maxilliped 2 setation for zoeae from present and previous studies with many differences noted in setation formulas (Figure 7). Gonor and Gonor (1973a) found, in a study of four porcellanid species, that setation of larval appendages (maxillae and maxillipeds) varied considerably between individuals of the same species and stage. Their conclusion was that setation formulas alone are not reliable enough to characterize species or genera or to indicate relationships, at least among their four examined species. Thus, setation differences between zoeae from the present study and other studies are probably not taxonomically significant.

TABLE 4.

Comparison of meristic variation of Maxilliped 2 setation; standard formula notation is according to Gore (1968).

Species	Segment	Present Study	Previous Studies	Species	Segment	Present Study	Previous Studies
Euceramus praelongus			(Roberts 1968)	*Polyonyx gibbesi*			(Gore 1968)
zoeae I	coxopodite	1	1	zoeae I	coxopodite	naked	naked
	basipodite	1+2	1+2		basipodite	1+3(1+2)	1–2,3
	endopodite	2,2,2,10+I	2,2,2,10+I		endopodite	2,2,2,7–10+I	2,2,2,10+I
	exopodite	4	4		exopodite	4	4
zoeae II	coxopodite	1	1	zoeae II	coxopodite	naked	naked
	basipodite	1+2	1+2		basipodite	1+3(1+2)	1+3
	endopodite	2+I,2+I,2+I,12+I	2+I,2+I,2+I,14+I		endopodite	2+I,2+I,2+I,8–12+I	2+I,2+I,2+I,12+I
	exopodite	2+9	2+9		exopodite	11–12	12
Petrolisthes armatus			(Gore 1970)	*Porcellana sigsbeiana*			(Gore 1971c)
zoeae I	coxopodite	naked	naked	zoeae I	coxopodite	naked	naked
	basipodite	1+1	1+1 or 1+2		basipodite	1+2	1+2
	endopodite	2,2,1+2,5+I	2,2,1+2,5+I		endopodite	2,2,2,7+I	2,2,2,7+I
	exopodite	4	4		exopodite	4	4
zoeae II	coxopodite	naked	naked	zoeae II	coxopodite	1	1
	basipodite	1+1	1+1		basipodite	1+2	1+2
	endopodite	2,2+I,1+2+I,5+I	2,2+I,1+2+I,5+I		endopodite	2+I,2+I,2+I,9+I	2+I,2+I,2+I,9+I
	exopodite	3+12	12–15		exopodite	11–12	12

Meristic variations in telson setation, carapace armature and biramous appendages were noted as important taxonomic tools by Gurney (1938) and Lebour (1943), and continue to be useful in larval systematics. Even though variations in appendate setal counts alone may not be taxonomically significant, adequate analysis of such variations might be a method of distinguishing larvae from different populations of the same species (Gonor and Gonor 1973a). As more information is obtained, meristic variation may become even more significant in comparing decapod larvae of different genera or species.

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