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DECAPOD CRUSTACEA OF
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Decapod Crustacea of Bermuda
Part II, Macrura

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DECAPOD CRUSTACEA OF BERMUDA.

PART II—MACRURA.

By A. E. VERRILL.

The collections of Bermuda Macrura, studied in the preparation of this article, came chiefly from the sources already acknowledged in Part I.* Nearly all the species are in the collections of the Museum of Yale University. Much the larger part were collected by myself and companions in 1898, 1901, and 1916. Many were also previously in the collections made by Mr. G. Browne Goode, J. M. Jones, Esq., and others. Many of the more obscure species have been studied, also, by Miss M. J. Rathbun, to whom I am likewise indebted for several photographs of rare species, contained in the U. S. National Museum.

No doubt many more species remain to be discovered, especially of the smaller shrimps. Many of these have very retiring habits, living in holes and crevices in dead corals, etc., or in the oscular cavities of large sponges. Others frequent the quiet waters of lagoons and mangrove swamps, where, owing to their transparency or protective colors, they are not easily seen. We did not have opportunities to use fine meshed seines in such places, which would, no doubt, have given good results. Owing to the absence of fresh-water streams, the various species of fresh-water shrimps and prawns, common in the West Indies, are entirely lacking.

Many more additions to the number of species are to be expected by dredging in deeper water, outside the reefs. Many of the species of Macrura have interesting and remarkable metamorphoses, the free-swimming larvæ (see plates III, IIIa, XII, XVII), being totally unlike the adults. This is particularly the case with the species of *Panulirus* (the common Bermuda lobster), *Syllarides*, *Stenopus*, etc. The Bermuda species have been very little studied in this way. With the facilities of the new Biological

* For Part I: see these Transactions, vol. xiii, pp. 299-474.

Station and public Aquarium, there are excellent opportunities to carry on such researches.

In the important memoir of Brooks and Herrick, on the metamorphoses of the *Macrura* (Mem. Nat. Acad. Sci., vol. v, 1891) the metamorphoses and structures of a few Bermuda species are given; viz., *Stenopus hispidus*; *Alpheus heterochaelis*; *A. packardii* (erroneously identified as *A. minus*), and *Synalpheus brevicarpus*. They found remarkable variations in the larval forms, supposed by them to be of the same species of *Alpheus* and *Synalpheus*. The most notable cases of this kind were due to erroneous identifications of the species of those difficult genera, as shown by Coutiere. Many more studies of that kind should be made on the numerous closely related species of that group.

On account of the existing confusion in the literature, and the inherent difficulties in determining the numerous species of *Alpheus* and *Synalpheus*, I have treated those genera in greater detail than most others, describing and figuring, with many structural details, all the species known to me from Bermuda, as well as some closely allied species from other American localities, hoping that students of their embryology will be enabled by this means to correctly name the species they may investigate hereafter. In other groups general figures, at least, are given of nearly all the species, and in most cases the structures of some of the appendages are also figured.

Hitherto some of these species have not been figured at all; others have been figured only in foreign works, many of them very imperfectly. The photographs and drawings, unless otherwise indicated, are by A. H. Verrill.

Suborder MACRURA. *Crawfishes, Lobsters, Shrimps, and Prawns.*

Key to the Tribes and part of the Families.

A.—Body not compressed. Rostrum depressed, sometimes wanting. First abdominal segment shorter and narrower than the following. Abdominal appendages (pleopods) not oar-shaped. The articulation between the carpus and propodus of the chelipeds is at two fixed points. Branchiæ filamentous.

Reptantia = *Trichobranchiata* = *Astacina* DeHaan.

B.—Abdomen or pleon large and strong with the segments overlapping. Carapace large and firm.

D.—None of the legs have chela, except the 5th pair in the adult female. No appendages on 1st segment of pleon; outer antennae

destitute of a scale. Uropods and telson thin and flexible distally, not spinose. Legs with six functional segments. Larva a phyllosoma.

Tribe *Scyllaridea* or *Loricata*.

E.—Carapace subcylindrical; outer antennæ elongated, with a long, tapered, multi-articulated, and rather rigid spinose flagellum. Orbits not excavated in the dorsal surface of the carapace.

Family *Palinuridae*.

EE.—Carapace much depressed or flattened; orbits excavated in its dorsal surface; outer antennæ short, flat, or squamiform, without a jointed flagellum; 5th pair of legs with small chelæ in the female.

Family *Scyllarida*.

DD.—First three pairs of legs chelate, the first pair largest. Outer antennæ elongated, usually with a basal scale and a long flexible flagellum. Uropods and telson rather rigid and usually spinose at the ends; outer lamella of uropods have a transverse suture. Legs have seven segments. Branchiæ numerous.

Tribe *Astacidea*.

F.—Last thoracic segment consolidated with the preceding one. First abdominal segment has a pleopod; in the male developed as a genital organ. Spermatheca external. Branchiæ 10 pairs. Larva a zoëa or Mysis-like (marine).

Family *Homarida*.

FF.—Last thoracic segment movable. Spermatheca in the form of an annulus. Branchiæ 17 or 18 pairs. Larva not a zoëa; similar to adult in form (fresh-water forms).

Family *Astacida*.

BB.—Abdomen or pleon elongated, weak, with the segments not overlapping. Carapace small. Third pair of legs not chelate; 1st and 2d pairs chelate.

Tribe *Thalassinidea*.

AA.—Body usually more or less compressed. Rostrum usually compressed or slender; sometimes absent. Abdominal appendages (pleopods) oar-shaped. Articulation between the carpus and propodus of the chelipeds at only one fixed point. Branchiæ various.

Tribe *Natantia* (or *Caridea*, sense extended).

REPTANTIA Boas=TRICHOBRANCHIATA.

SCYLLARIDEA Stobbing=LORICATA Heller (*pars*).

Body convex, either depressed or subcylindrical, with a strongly thickened shell. Antennules usually have two flagella. Antennæ may either have or lack a long flagellum; antennal scale lacking; first joint of peduncle united to epistome. Gills trichobranchiate;

first four legs have a branchial plume or podobranchia on the epipodial plate of the first joint, and also have arthrobranchiæ; last four thoracic segments have pleurobranchiæ. Thoracic legs have but six functional joints; none have chelæ except the last pair of the female. No pleopods on the first abdominal segment in either sex. Telson and urópods have the distal part thin and flexible, not spinose.

The larvæ are remarkable for their large size and thin, foliate structure. They are of the form called Phyllosoma. Their entire body is wide and exceedingly thin and transparent, in life,—hardly thicker than thin paper with long, slender bifid legs, all colorless and transparent except the eyes, which are far apart on long stalks. (See plates 3, 3A.)

They apparently live at the surface a long time in this form and have several moults, changing gradually to forms more like the adult. Such larvæ were infrequently taken by us in the Gulf Stream and adjacent waters off our coasts, coming no doubt from much further south.

The most common kinds (plates 3, 3A, figs. 1-3a) are supposed to belong to *Panulirus argus*, but none were taken old enough to prove this. Our figures represent three stages of this species (see under *P. argus*). Another quite different species (plate 3A, fig. 4) may belong to *Scyllarus* or one of the species of *Scyllarides*, but its origin is very uncertain. This differs from the others in having the large thin prethorax or head portion relatively longer, and instead of being regularly elliptical or slightly oval its borders are incurved in front of the middle, so that the anterior part is not half as wide as the widest part; the eye-stalks are longer, the eyes rounder. The thorax proper is wider than in the other species and its posterior incurvature or sinus is much wider and deeper; the abdomen is bud-like with no segments developed in this stage, though the legs are all fully developed and bifid, while in the other species, with the abdomen in a similar state, the fifth pair of legs can be seen only as minute rudiments (pl. 3, fig. 1; pl. 3A, fig. 2A). In this species (pl. 3A, fig. 1) the third maxillipeds (mp''') are shorter and not bifid as they are in the others. The other mouth organs (m) are, however, more developed than in the others, while the antennules and antennæ (a', a'') are less developed and much shorter than in the youngest stage of the other species. The latter will be described under *P. argus*, below.

Family **PALINURIDÆ** Dana. *Spiny Lobsters; Sea Crawfishes.*

Palinurini Latreille, 1802. Leach, 1814.

Palinuride Dana, Crus. U. S. Expl. Exped., p. 519, 1852. Gray. Ortmann, 1896. Rathbun, 1901, p. 398, etc.

Body subcylindrical; thorax not depressed. Eyes not enclosed in orbits formed within the edge of the carapace. Antennæ not flattened; furnished with a large and long, rather rigid, multi-articulate and usually spinose flagellum. Fifth leg of female chelate.

Panulirus White. *Spiny Lobsters.*

Panulirus White, List Crust. British Mus., p. 69, 1847.

Ocular segment is exposed and flexible. No rostrum or central tooth. Antennules with rather long, slender exposed flagella. Antennæ long, very large and rigid, spinose; a stridulating organ at their bases. Larva is a *Phyllosoma*. (See plate 3, 3A.)

Panulirus argus (Latr.) White. *Bermuda Lobster; Sea Crust-fish.*

Panulirus argus Latreille, Ann. Mus. Hist. Nat. Paris, iii, p. 593, 1804. Nouv. Dict. Hist. Nat., xvii, p. 296. Olivier, Encyc. viii, p. 663. Lamarck, Hist. An. sans. Vert., v, p. 210, 1815. Desmarest, Consid. gen. sur les Crust., p. 185. H. Milne-Edw., Hist. Nat. Crust., ii, p. 300, (Antilles). Heller, Reise Freg. Novarra., Crust., p. 95, 1865 (Analytical table).

Panulirus argus White, List Crust. Brit. Mus., p. 69, 1847. Smith, these Trans., ii, p. 39, 1869, (Brazil). Rankin, op. cit., 1900, p. 536. Bate, Voyage Chall., vol. xxiv, p., 76, 1888. M. J. Rathbun, Brach. and Macr. Porto Rico, p. 98, 1901. Verrill, these Trans., xi, p. 705, fig. 56, and pl. xciv, fig. 1, 1902; The Bermuda Is., I, p. 293, fig. 56, pl. xciv, fig. 1, 1902, (habits and history).

Panulirus americanus Stone, in Heilprin, The Bermuda Is., p. 149. (? non. M. Edw.)

TEXT FIGURE I, PLATE I: FIGURE 1. PLATE II: FIGURES 1, 2. PLATE III: FIGURES 1, 2 (supposed larvæ). PLATE IIIA: FIGURES 2-6 (larvæ). PLATE VIII: FIGURES 2, 2a. PLATE IX: FIGURE 1 (stridulating organ). By A. H. V.

The following description is mainly from medium sized males (No. 4101, 4102, Yale Mus.) preserved in formal and dried.

The carapace, in large specimens, has the areas well defined by wide grooves; the cervical groove is conspicuous. The frontal