

are lighter olive with more numerous spots on the palm, becoming paler or yellowish green distally and on the digits, with the granules white. The ambulatory legs are bright blue, with about four orange or bright yellow bands, at the articulations on the proximal end of the segments, each yellow band preceded by a dark blue band;

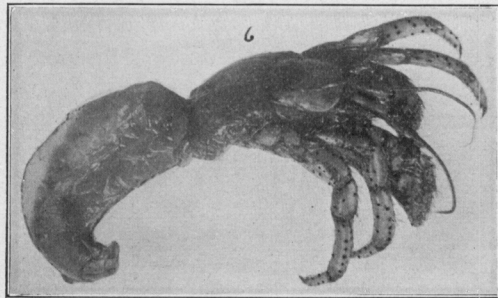


Figure 63.—*Clibanarius tricolor*, $\times 2$. Phot. A. H. V.

dactyls bright orange at base, followed by pale orange or whitish, and covered by small bright orange spots; tips of digits black, excavate within. Several variations were noticed. One differed from all others in having no blue color, except the blue ring that precedes the orange band on the legs, but the legs had the usual round orange spots. The chelæ were orange red with white granules and black tips.

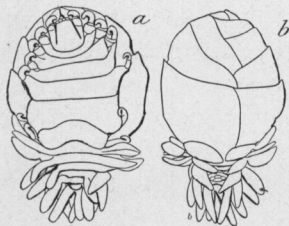


Figure 64.—*Stegias clibanarii*, female, much enlarged; *a*, ventral; *b*, dorsal view. After Richardson.

It is very abundant at Bermuda, among rocks and in tide pools at low-tide. It occupies many kinds of small gastropod shells, such as *Cerithium*, *Modulus*, *Littorina*, *Neritina*, *Anachis*, *Columbella*, *Natica*. Frequently it takes possession of various land shells, commonly washed ashore. It is sometimes infested by a parasitic isopod crustacean (*Stegias clibanarii* Richardson).*

* Proc. U. S. Nat. Mus., vol. xxvii, p. 59, 1904; Monograph of Isopods of N. America, p. 586, figs. 580, *a*, *b*, 1905.

Some of the specimens taken in June and July, 1903, by the members of the Biological Station, carried eggs.

Its range is from Florida to the Antilles. Porto Rico (Benedict); Bahamas (Rankin).

Clibanarius Verrillii Rathbun. *Spotted Hermit-Crab.*

Clibanarius Verrillii M. J. Rathbun, Amer. Journ. Science, ser. iv, vol. xi, p. 328, 1901. Verrill, these Trans., xi, p. 18, pl. viii, figs. 2, 3, 1901.

PLATE XXVII, FIGURE 5. PLATE XXVIII, FIGURE 6.

The following description was furnished by Miss Rathbun several years ago:

“The anterior or hard part of the carapace is a little longer than wide. The median projection of the front is moderately prominent, greater than a right angle; the lateral projections of the front are slightly marked and are broadly rounded. The sides of the carapace diverge posteriorly. The eye-scales are narrow-triangular and are tipped with a short spine. The eye-stalks are very slender and nearly as long as the anterior part of the carapace; they reach to the middle of the antennular flagella. The antennal acicle is slender and reaches to the middle of the last joint of the peduncle; the joint ends a little beyond the middle of the eye-stalk; the flagellum is about twice as long as the eye-stalk.”

“The chelipeds are similar in shape but noticeably unequal, the propodus of the right being $\frac{5}{6}$ the length of the left. The distal margin of the carpus of both chelipeds is in line with the end of the eyes. The merus of the larger cheliped is two-thirds as high as long; its outer surface is marked by a few short, faint rugose lines; the upper margin is similarly rugose. The carpus is furnished with rough granules above and along the distal margin; there is a large tubercle on the outer surface. The palm is subrectangular, about equally long and high; upper margin convex. The margins are rough with granules; the outer surface is nearly smooth. Both fingers are stout and deflexed, and gape widely; the inner margins are very unevenly toothed; the upper margin of the dactylus is bordered by two rows of sharp granules. The fingers are excavated at the tips, which are white.

The smaller cheliped differs not only in being shorter and narrower, but in having the upper margin of the carpus and propodus cut into stout spines, increasing in size distally. A similar large spine is on the upper margin of the dactylus at the proximal third. The right cheliped is more hairy than the left, with long light hairs.

The propodus of the second pair of feet reaches the extremity of the large cheliped; the third pair reaches about to the middle of the dactylus of the second pair. Both these legs have a small spine at the lower outer distal angle of the merus, and a longer spine at the upper distal angle of the carpus. The dactyli are a little shorter than the propodi. These legs are furnished sparingly with hairs."

Colors.—In formalin a pinkish-white or yellowish-white ground-color with small roundish spots of bright yellowish-red or orange which are most numerous along the upper and distal margins of the segments of the legs, where they tend to form irregular transverse bands. There are four bands on each of the propodal and terminal joints of the second and third pairs of legs; chelæ and eye-stalks spotted with red." (M. J. Rathbun.)

Total length about 40^{mm}. It becomes much larger.

Bermudas, 4 large and 1 small specimen (coll. Dr. F. V. Hamlin); Yale Mus. and U. S. Nat. Mus."

"This species is nearer *Clibanarius* than it is to any other described genus, and while it perhaps possesses all the essential characters of that genus, it differs notably from the usual form of *Clibanarius* in the inequality of the chelipeds."

No locality, except Bermuda, has been recorded for this rather conspicuous species.

Clibanarius hebes Verrill, sp. nov.

FIGURES 65, 66.

Carapace constricted at the cervical suture; front part shield-shaped, longer than broad; anterior edge five-angled; central tooth small, acute, a little more prominent than those at the base of the antennæ, with the intervening margin a little concave; lateral angles very obtuse and farther back; surface glossy, with small scattered punctæ over the middle, becoming larger and raised on slight rough elevations laterally, each bearing one or several hairs; the one next the cervical suture, on each side, is larger in the form of a small low rounded tubercle. Posterior part with marked longitudinal sunken lines and scattered punctæ; the sides hairy. Eye-stalks slender, about as long as the width of the front of the carapace, shorter than its length; eye-scales small, oblique-ovate, pointed, close together. Peduncle of antennæ nearly as long as eye-stalks. Antennæ longer than ambulatory legs; the aciculum is narrow, tapered, acute at tip, reaching slightly beyond the penultimate joint of the peduncle, fringed on the inner edge and tip with long hairs.

Chelipeds granulated and hairy, nearly equal in size and form; the distal end of the carpus is about even with the ends of the eyes; merus strongly compressed above proximally, and punctate; carpus covered with sharp granules, bearing one or several slender, pale hairs; on upper side they form two rows of larger acute granules; each row ends distally in a small acute denticle. Chelæ not angular, nor tapered, covered all around with rather small, sharp, nearly equal, hair-bearing granules, which tend to form irregular longitudinal rows; their hairs are pale and slender and too few to conceal the granules; the digits, which are blunt and thick, end in broad, evenly rounded, strong, black nails; lateral edges of digits with sharp white denticles. Ambulatory legs rather long, all about equal,

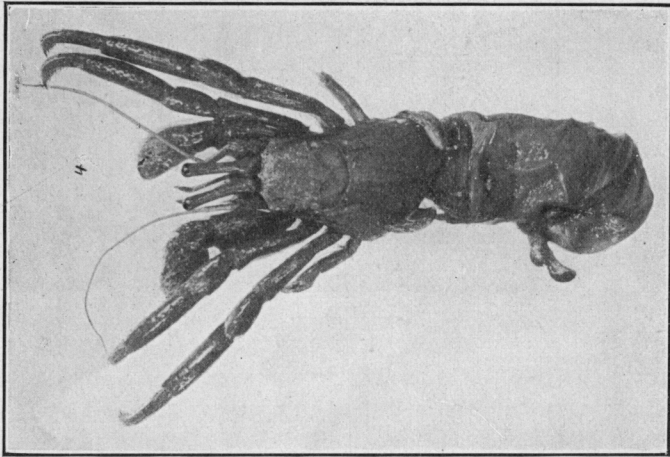


Figure 65.—*Clibanarius hebes*. Type, dorsal view; \times about $1\frac{1}{2}$. Phot. A. H. V.

glossy when dry, covered with small, rather sparse punctæ, which bear few slender, pale hairs; the merus joint of all the legs is compressed.

Color of chelipeds and legs, in alcohol, nearly uniform bright orange; eye-stalks, antennæ and front of carapace a lighter tint of the same. There are no traces of bands, vittæ, nor spots of other colors.

The largest specimen (see figure 65) has the anterior part of the carapace 7^{mm} long; 6^{mm} wide; posterior part 8^{mm} long; 9^{mm} wide; length of eye-stalks, 9^{mm} ; length of chelæ, 7^{mm} ; diameter, 3^{mm} ; length of first ambulatory legs, 26^{mm} .

Two small specimens were collected about 1877, by Dr. F. V. Hamlin (Yale Mus., 3294); a much larger specimen, which is the one figured, was taken in the summer of 1903, by the party of the Bermuda Biological Station, at Coney Island.

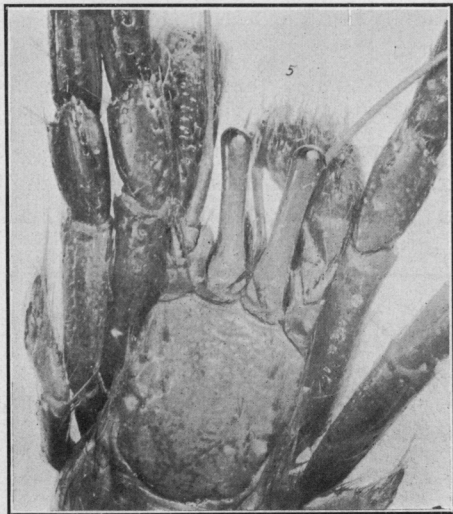


Figure 66.—*Clibanarius hebes*, anterior parts, \times about 4. Phot. A. H. V.

Geographical Distribution; Origin of the Bermudian Decapod Fauna.

In the preceding article 78 species, subspecies, or named varieties, have been discussed, of which 16 have not been previously recorded from Bermuda. Among these, 9 are described as new.

Of the total number, 72, equal to 93 per cent., have been recorded also from the Florida Keys or the West Indies, or from both, demonstrating the close faunal relations of the two regions. The macruran Decapoda and other groups show similar relations.*

About 53 of the forms (about 68 per cent.) range from Florida to Pernambuco, Brazil, or farther south.

A considerable number, about 25 species, or 31 per cent., extend their range north of Florida to the coast of South Carolina or farther north, the greater portion of these reaching Cape Hatteras. Six or seven reach southern New Jersey.

* The true *Macrura* of Bermuda (not included in this article) consist of 35 species. Of these 31 species (or 88 per cent.) belong also to the West Indian fauna, a large part of them ranging south to Brazil. Eight of the species are

Two species, *Callinectes sapidus*, *Eupanopeus Herbstii* and its var. *obesus*, range northward to southern New England, as permanent residents.

Several others occur occasionally or sporadically on this coast, being carried northward by the Gulf Stream, or by shipping, but fail to become naturalized so far north, owing to the cold of winter.

It is evident, therefore, that the Bermuda Decapod Crustacean fauna is an offshoot or colony from the West Indian fauna, with only a slight admixture of species from other regions. In this respect the Crustacea agree with the Anthozoa, Mollusca, Echinoderms, Fishes, etc.

Of the total number, only seven species and subspecies are, so far as now known, peculiar to the Bermudas. These are all recently described forms and no doubt most of them will soon be discovered, also, in the West Indies. They are as follows:—

<i>Sesarma Ricordi</i> , var. <i>terrestris</i> , nov.	<i>Petrolisthes armatus</i> , var. <i>pallidus</i> , nov.
<i>Eupanopeus Herbstii</i> , var. <i>minax</i> , nov.	<i>Munida Beanii</i> , sp. nov.
<i>E. bermudensis</i> , var. <i>sculptus</i> , nov.	<i>Clibanarius Verrillii</i> Rathbun.
	<i>Clibanarius hebes</i> , sp. nov.

widely distributed free-swimming forms which extend their range even to the Indian and Pacific Oceans; 3 have been found on the west coast of Africa; 2 on the southern coasts of Europe; 9 species reach the Carolina coasts; 1 ranges to New England; 3 to the Pacific coast of North America.

Of the total number, 4 have not yet been found in the W. Indies, but one of these is a new species, recently discovered, and another is, perhaps, not correctly named.

The marine Isopods, which have been well worked up by Miss Richardson, afford a much larger proportion of species peculiar to Bermuda, so far as now known, but that is largely due to the fact that the West Indian Isopods have not been very thoroughly collected and studied.

Dr. B. W. Kunkel has found, among the 45 species of Bermuda Amphipods, a considerable proportion, 20-21, of Mediterranean species, but the West Indian Amphipods are little known. Twenty species, so far as now known, are peculiar to Bermuda, (*Science*, vol. xxvii, p. 489, 1908.)

The Bermuda Entomostraca have not been much studied. Among the parasitic species Mr. Chas. P. Wilson has recently identified the following: *Nesipus curticaudis* Dana; *Pandarus Cranchii* Leach (from shark); *Lepeophtheirus dissimulatus* Wilson (stomach of hamlet grouper).

In the spring of 1898 we found an undetermined Ostracode Crustacean abundant in the rain-water tanks at Bailey Bay.

The three species of Stomatopoda are all West Indian forms.

The following 24 species range northward on the American coast to or beyond South Carolina, as permanent residents:—

<i>Ocypode arenarius</i> , (to N. Jersey.)	<i>Portunus Sayi</i> .
<i>Planes minutus</i> , (to N. Jersey.)	<i>Achelous anceps</i> .
<i>Plagusia depressa</i> .	<i>A. Gibbesii</i> .
<i>Cycloxanthops denticulatus</i> .	<i>A. spinimanus</i> , <i>Smithii</i> .
<i>Eupanopeus Herbstii</i> , (to C. Cod.)	<i>A. Sebæ</i> .
<i>E. Herbstii obesus</i> , (to C. Cod.)	<i>A. Ordwayi</i> .
<i>E. occidentalis</i> .	<i>A. depressifrons</i> .
<i>Eurytium limosum</i> , (to N. Jersey.)	<i>Stenorhynchus sagittarius</i> .
<i>Eriphia gonagra</i> .	<i>Podochele Riisei</i> .
<i>Callinectes ornatus</i> .	<i>Mithrax forceps</i> .
<i>C. sapidus</i> , (to C. Cod.)	<i>Macroceloma trispinosum</i> .
	<i>Calappa flammea</i> .
	<i>Petrolisthes armatus</i> .

Several of the species, mostly grapsoids, are found in most, or all, tropical seas, as well as in the West Indies. They are as follows:—

<i>Grapsus grapsus</i> .	<i>Plagusia depressa</i> .
<i>Geograpsus lividus</i> .	<i>Percnon planissimum</i> .
<i>Pachygrapsus transversus</i> .	<i>Domestia hispida</i> .
<i>Planes minutus</i> .	<i>Petrolisthes armatus</i> .

Of these the most widely distributed is probably *Planes minutus*, which, in the Atlantic, ranges from Nova Scotia to the Straits of Magellan, and in the Pacific from California to New Zealand, etc.

Nearly all the widely distributed species, included in the last list, are found on the West Coast of Africa. But some additional species, common to Bermuda and the W. Indies, are also found on the West African coast. Namely :

<i>Goniopsis cruentatus</i>	<i>Calappa flammea</i>
<i>Callinectes marginatus</i> , <i>larcatus</i>	<i>C. gallus</i> , <i>galloides</i>
<i>Stenorhynchus sagittarius</i>	<i>Hippa cubensis</i>

On page 313, *Cardisoma guanhumi* is also given as occurring in West Africa. Stimpson, Ortman and other writers have recorded it from there, but Miss Rathbun (1900) places all such records under *C. armatum* Herkl. The Pacific Coast record is also probably erroneous.

Probably the locality, Ascension I., given for *Gecarcinus lateralis*, on p. 310, is erroneous, the species found there being *G. lagostoma* M.-Edw.

Aside from the widely distributed grapsoid crabs, found in all tropical seas, very few of the Bermuda species are found on the Pacific coasts of Central and North America. But many others are represented there by closely allied species or subspecies.* The species that have been considered identical or distinguishable only as varieties by recent good authorities are as follows :

<i>Goniopsis cruentatus</i>	* <i>Percnon planissimum</i>
* <i>Grapsus grapsus</i>	* <i>Domecia hispida</i>
* <i>Geograpsus lividus</i>	<i>Epialtus bituberculatus</i> (varieties)
* <i>Pachygrapsus transversus</i>	* <i>Calappa gallus</i> (varieties)
* <i>Planes minutus</i>	<i>Cyeloës Bairdii</i> (varieties)
* <i>Plagusia depressa</i>	* <i>Petrolisthes armatus</i>

Those preceded by an asterisk are circumtropical.

It is well known that a considerable number of species of Mollusca, Echinoderms, Anthozoa, etc., as well as Crustacea, are common to West Africa, Brazil, and the West Indies. Such species may have originated on the African coast and from thence migrated across the Atlantic to South America, and thence northward to the W. Indies, Florida, and Bermuda, during recent geological times. All the species of Decapod Crustacea having this wide range exist for a considerable length of time as free-swimming larval forms, in the zoëa and megalops stages. These larval forms may be carried long distances by the prevailing oceanic currents, especially in the regions of the trade winds.

It is scarcely admissible to suppose that they could have traveled in the opposite directions, against the currents, unless by human agency, in recent times.

Many Crustacea, including the higher and more active forms, especially the grapsoid and canceroid crabs, are in the habit of hiding among the clusters of barnacles, etc., attached to the bottoms of vessels, and in this way they may be carried across the oceans in any direction, so long as the temperature of the water is suitable for their existence. In this way many tropical species reach the New England coast in summer, but die out during the winter.

* Mr. Walter Faxon has given, in parallel columns, comparative lists of the closely related species occurring on the two coasts. See Mem. Mus. Comp. Zoology, vol. xviii, pp. 235-237, 1895.

Several species of crabs and shrimps habitually live among floating *sargassum*, or attached to floating driftwood. This is the case especially with *Planes minutus*, *Portunus Sagi*, and some others. That they have migrated to Bermuda in this way is very evident, for they do so constantly, day by day, at the present time.

But the majority of the species common to Bermuda and the West Indies do not have such habits, and must have migrated northward in the free-swimming larval stages. The direction of the Gulf Stream and prevailing wind currents are favorable for the transportation of free-swimming animals from the Bahamas, Cuba, etc., to the Bermudas.

On the other hand, very few if any strictly East American species have established themselves in the Bermudas, notwithstanding the constant passage of vessels in that direction for nearly three hundred years. Perhaps the temperature of the Gulf Stream is too high to allow such species to be carried across it, or they may not be able to endure the summer temperature of the Bermuda waters.

There are, likewise, no Decapod species of European or Mediterranean origin known in the Bermuda fauna, though such are known to occur in other orders, especially in those groups that habitually cling to the foul bottoms of vessels.

The chances of many species being introduced into Bermuda waters by this means have been unusually good, for the great dry dock has existed at the naval station for many years. And long before that, even from the first settlement, the sheltered harbors and beaches of Bermuda have been favorite places for the beaching of vessels to clean their bottoms.

It would be of great scientific interest, as well as evident economical benefit, to experiment with the introduction of edible East American and West Indian crustacea that do not now exist at the Bermudas. Among those that might succeed are the large Southern Rock Crab (*Menippe mercenaria*); the West Indian Rock Crab (*Carpilius corallinus*); the southern variety of the Edible Blue Crab (*Callinectes sapidus*), and many others. Probably their fertilized eggs could be transported far more easily than the adults, and in vastly greater numbers. With suitable arrangements at the new Bermuda Biological Station, such eggs could easily be hatched and the young liberated in great numbers, in suitable places.

It would probably be useless to attempt to introduce those species that are restricted to our coast north of Cape Hatteras, such as the common lobster, but there seems to be no reason why any species