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SYSTEMATIC STUDIES ON THE JAPANESE MACRUROUS
DECAPOD CRUSTACEA

3. On the Palinurid lobsters

Itsuo KUBO

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ZOOLOGY
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SYSTEMATIC STUDIES ON THE JAPANESE MACRUROUS
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3. On the Palinurid lobsters

Itsuo KUBO

(Received March 15, 1954)

After making possible investigations in regard to the Japanese Palinurid crayfishes or spiny lobsters, the present author has got some advanced knowledges for the taxonomy, fauna, geographical distribution, and morphological matters of this animal. Those may be mentioned briefly under such three, A-C, sections with headings given below.

- A. Some notes on the fauna of the Japanese *Panulirus*.
- B. Key to the species found in Japan.
- C. List of the species with synonym and some descriptions of the matters new to science.

The present author takes this opportunity of expressing his hearty thanks to Messrs. Masaharu IGARASHI, Tatsuyoshi MASUDA, Osamu UMEBAYASHI and Dr. Takashi INO, for their kindness offering valuable specimens, by which the present study is embodied. Acknowledgement is made to Mr. Hisatoshi MARUKAWA for his valuable suggestions of the geographical distribution of the Japan Sea coast of *Panulirus japonicus*. Thanks are also due to Mr. Jin HATTORI for his favour in preparation of photographs. The expense of this study was defrayed by the Grant in Aid for Fundamental Scientific Research of the Ministry of Education, to which the author offers his cordial thanks.

(A) Some notes on the fauna of the Japanese *Panulirus*

From Japan, five species have been known, namely, *Panulirus japonicus* (V. SIEBOLD), *P. versicolor* (LATREILLE), *P. dasyopus* (H. MILNE-EDWARDS), *P. polyphagus* (HERBST), and *P. homarus* (LINNAEUS)=*P. burgeri* (DE HAAN). Recently the present author has examined two other forms taken from Japan, which may be referred to *P. longipes* (A. MILNE-EDWARDS) and *P. penicillatus* (OLIVIER) as given later. Consequently the Japanese fauna of this animal becomes to be composed of seven species given above. Of these seven ones, *P. japonicus* commonly occurs southwards from about 35.5°N and 34.5°N on the Pacific and on the Japan Sea coasts respectively. But it rarely appears northwards to about 38.5°N on the Pacific coast. It may be said that this animal hardly inhabits the Japan Sea coast of the main Island of Japan. The animal, however, very rarely may be seen on the coast in question northwards to about 37°N, as we have a record of capture of this species from Nanao Bay, which is lying on a position approximately 37°10'N, 137°E (TOKUHISA, 1914). *P. versicolor* seems to occur

rather rarely, probably on the Pacific coast only. Especially the occurrence of adult form of this species from main Islands of Japan seems to be ascribed to very rare fact. Within the limit of the writer's knowledge, only a record of collection of the adult form is present (MAEDA, 1940). The rest appears to be rare. According to HOLTHUIS (1946), *P. dasyptus* has only two records known from Japan. A record has been made by DOFLEIN (1900), detailed locality unknown, and the other by PESTA (1915), locality Yokohama. On *P. homarus*, also two records have been done by DE HAAN (1841) and DOFLEIN (1906). DE HAAN's locality is unknown, DOFLEIN's one is Sagami Bay. *P. polyphagus* has only a record collected by DOFLEIN (1900) from Japan, locality unknown. It may be noted herewith that no record of collection from Japan has been made since the records given above with regard to these three species. *P. longipes* secured from Kominato fish market, Chiba Prefecture on August 19, 1952. This is the first record of collection of this species from Japan. *P. penicillatus* also firstly taken from Habu, Ōshima, about 100 Km southwards of Tokyo on September 26, 1953. This species has a record collected from Fusan (or Pusan), Korea by PESTA (op. cit.), but it has not been caught from Japanese waters before the capture given above.

(B) Key to the species found in Japan

The seven species known from Japan may be assorted into three groups, and those included in each group are arranged genealogically basing on the ideas given in the following lines. The presence of the transverse furrow of the abdominal terga, and the absence of the exopodite or multiarticulated flagellum of the exopodite of the third maxilliped, as well as the flagellum of the exopodite of the second maxilliped are apparently positive specialization. In the meanwhile, the absence and the interruption of the transverse furrow may be interpreted as primitive features on the basis of the following facts, which were revealed by OKADA and KUBO (1950). In *P. japonicus*, the transverse furrow of the pleon is not found to exist in the puerulus stage. But the Furrow becomes to be present with proceeding of the growth. It firstly appears in interrupted condition on the terga from the second to the fourth or sometimes to the fifth abdominal segments of the young smaller than 32.2 mm in body-length, and afterwards it becomes entire with advance of growth. It is generally known that the presence of the exopodite of the maxillipeds is recognized as a primitive trait. Hence the key is as follows:—

- a₁ Abdominal terga transversely furrowed
 - b₁ Transverse furrow of abdominal terga entire
 - c₁ Transverse furrow of abdominal terga with crenulate edge; antennular tergum afforded with 2 pairs of large spines; exopodite of third maxilliped absent..... *P. homarus* (LINNAEUS)=*P. burgeri* (DE HAAN).
 - c₂ Transverse furrow of abdominal terga with straight edge; exopodite of third maxilliped present
 - d₁ Antennular tergum carries 2 pairs of large spines, the lateral of which

- are coalested at base; exopodite of third maxilliped without flagellum..
 *P. penicillatus* (OLIVIER).
- d₂ Antennular tergum has a pair of large spines; exopodite of third maxil-
 liped with multiarticulated flagellum
- e₁ Antennal segment, to which antennae attach, carries on dorsal
 surface 2 principal spines; the area posterior to these 2 principal
 spines is either without or with some scattered spinules forming no
 set pattern. Abdomen usually not punctate, sometimes rather punc-
 tate. Ratio of B/A (see p. 98) runs 0.73-0.86 in adult larger than 112
 mm in body-length (41 mm in carapace-length).....
 *P. japonicus* (V. SIEBOLD).
- e₂ Antennal segment, from which antennae sprout, provided on dorsal
 surface with 2 main spines and 3 or 4 (SHEARD, 1949) pairs of spi-
 nules. These spinules are set immediately behind the 2 main spines
 in two rows of 3 or 4. Abdomen punctate. Ratio of B/A 0.93
 *P. longipes* (A. MILNE-EDWARDS).
- b₂ Transverse furrow of abdominal terga interrupted on median line; pro-
 vided with crenulate edge; exopodite of third maxilliped absent
 *P. dasyopus* (H. MILNE-EDWARDS).
- a₂ Abdominal terga not transversely furrowed
- f₁ Antennular tergum armed with a pair of large spines; exopodite of second
 maxilliped bears multiarticulated flagellum..... *P. polyphagus* (HERBST).
- f₂ Antennular tergum has two pairs of large spines; exopodite of second max-
 illiped has no flagellum; exopodite of third maxilliped absent or vestigial,
 usually absent *P. verticolor* (LATREILLE).

(C) List of species with synonym and some descriptions

(1) *Panulirus japonicus* (V. SIEBOLD)

Japanese name: Ise-ebi)

(Text-Fig. 1)

Panulirus japonicus, V. SIEBOLD, 1824, p. 15; DE HAAN, 1841, p. 158, Pls. 41-42.

Senec japonicus, ORTMANN, 1891, p. 26; BOUVIER, 1899, p. 173.

Puer pellucidus, ORTMANN, 1891, p. 37, Pl. 1, fig. 3.

Panulirus japonicus, DOFLEIN, 1900, p. 129; RATHBUN, 1902, p. 37, and 1906, p.

897, Pl. 5; GRUVEL, 1911, p. 28, text-fig. 11, Pl. 5, fig. 1; BALSS, 1914, p. 77;

DE MAN, 1916, p. 44; NAKAZAWA, 1917, p. 259, Pl.; PARISI, 1917, p. 8; MAKI

and TSUCHIYA, 1923, p. 79, Pl. 7, fig. 1; KUBO, 1938, p. 101-106, text-figs. 1-

4, Pl. 1; YOSHIDA, 1941, p. 31, Pl. 8, fig. 1; HOLTUIS, 1946, pp. 123-125, Pl.

11, fig. n (ubi synon); BARNARD, 1950, pp. 550-551, fig. 102, f.

Some descriptions may be given on spinulation of antennal segment and epistome, ratio of B/A (see below) of eye, colouration, and sex recognition of young form.

Antennal segment, which bears antennae, armed on dorsal surface with two principal spines near anterior border and 3-5 spinules set in a row near

frontal edge. The area posterior to the principal spines has no spinules in most cases, but sometimes possesses some scattered spinules.

Epistome is armed with many distolateral spinules besides a distomedian and 2 distolateral spines. Distolateral spinules are 2-4 (mostly 3) in number on each side.

Ocular segment grows exponentially in length relative to carapace-length (Fig. 3, *A*). Corneal diameter measured from anterior border to the posterior one also increases exponentially, though there is some extent of variation (Fig. 3, *B*). Ratio of *B/A* ranges from 0.73 to 0.86 in adult larger than 112 mm in body-length (41 mm in carapace length), *A* is the length of ocular joint, *B* the corneal diameter measured by the same method noted above. This ratio is likely to show considerable variation, especially in younger specimens (Fig. 3, *C*).

Colouration: plainly redish brown in most cases, rather frequently more or less greenish or redish. Sometimes punctate with small whitish or yellowish spots on body. This spots are similar to those of *Panulirus longipes* in general feature, but less in number. In the present investigation, the writer has exa-

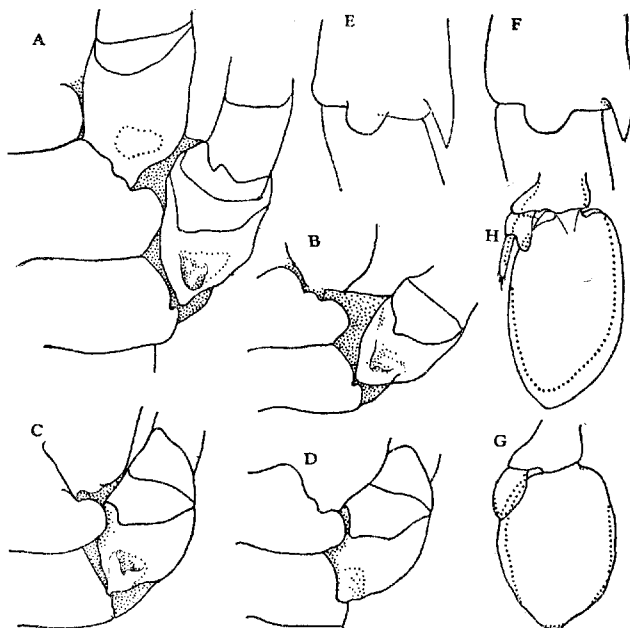


Fig. 1. *Panulirus japonicus* (V. SIEBOLD). *A*, ventral aspect of basal parts of fifth leg, especially showing sexual aperture of a male, 49.4 mm in body-length, 12.9 mm in carapacial length, $\times 9$; *B*, the same as in *A*, male, 66.1 mm long, 21.8 mm in c. l., $\times 3$; *C*, the same as in *A*, male, 70.5 mm long (23.1 mm in c. l.), $\times 3$; *D*, the same as in *A*, female, 71.2 mm long, 23.2 mm in c. l., $\times 3$; *E*, showing propodal spine of fifth leg of a male, 70.5 mm long, 23.1 mm in c. l., $\times 13.5$; *F*, the same as in *E*, female, 71.2 mm long, 23.2 mm in c. l., $\times 13.5$; *G*, second pleopod (posterior view) of a female, 71.2 mm long, and a male, 70.5 mm long (broken line), $\times 3$; *H*, third pleopod, the same as in *G*, $\times 3$. All figures are based on specimens obtained from Kominato, Chiba Prefecture.

mined several specimens furnished with such spots on body and blotches on pereopods.

Sex recognition: in adult form, sex recognition of this animal is easy on basis of well developed primary and secondary sexual characters. But in young form, it is no easy task as the sexual dimorphism is not yet well defined. So far as the present investigation goes, the feature of external opening of sexual organs seems to afford the best clue for sex recognition of young form. In the material at the writer's disposal, a male measuring a length of 49.4 mm in body-length (12.9 mm carapace-length) is found provided with well defined external opening of vas deferens (Fig. 1, *A*) by aid of a magnifying-glass. Since the sex recognition of the young form of this lobster appears to be possible by this point at least on them larger than that given in this place. Also pleopods give an important trait for sex recognition of this animal. Exopodite of the third pleopod of female, 71.2 mm long, is observed a little larger in comparison to that of a male, 70.5 mm in body-length (23.2 mm in carapace-length) (Fig. 1, *H*). Accordingly the sex recognition basing on this matter seems to be considerably difficult. In this connection, it may be written herein that the spinous protuberance of propodus of the fifth leg, which makes in female an incomplete chela with the dactylus, shows no difference in size and feature in such male and female as 70.5 mm and 71.2 mm long respectively (Fig. 1, *E*, *F*). Therefore this trait is also not available for the purpose in question.

Distribution: Indopacific, known from Japan, Hawaiian Island, and Tahiti to New South Wales (Australia), and Natal (South Africa).

***Panulirus longipes* (A. MILNE-EDWARDS)**

(New Japanese name: Kanoko-ise-ebi)

(Pl. III, Text-figs. 2-3)

Palinurus longipes, A. MILNE-EDWARDS, 1868, p. 87, Pl. 21; RICHTERS, 1880, p. 161.

Palinurus (Panulirus) longipes, MIERS, 1880, pp. 379-380.

Panulirus japonicus, GRUVEL, 1911, pp. 28-29 (part), Pl. 5 fig. 3; HOLTHUIS, 1946, pp. 123-125 (part).

Panulirus longipes, SHEARD, 1949, pp. 1-45.

A female is examined. It is taken from Kominato fish market, Chiba Prefecture, on August 19, 1952, by Mr. Tatsu-yoshi MASUDA of the Kominato Marine Biological Laboratory of the Tokyo University of Fisheries. The specimen, on which the present description is based, measured a length of 137 mm in body-length (46 mm in carapacial length).

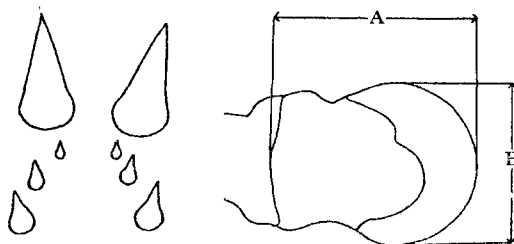


Fig. 2. Showing arrangement of spines and spinules of dorsal surface of antennal segment of *Panulirus longipes* (A. MILNE-EDWARDS) (Left), $\times 3$; and schematic showing of measurement method of eye (Right).

Antennal segment, from which antennae shoot out, has two principal spines and three pairs of spinules arranged in two rows of three immediately behind the principal spines. The spinules become larger in size posteriorly, and the width of the rows becomes wider backwards as seen in Fig. 2, Left.

Eye measures 6.5 mm (B) in length between anterior and posterior rims of cornea. Ocular segment is 7.0 mm (A) in length measured dorsally. Proportion of B/A is 0.93.

Life-colour of the specimen is as follows according to Mr. T. MASUDA, by

whom the specimen is obtained. Body is of cobalt blue in ground colour. Tip of frontal spines and that of spines lying anterior to cervical groove is of an orange colour. Whilst tip of spines laid down posterior to cervical groove is white. Abdomen is set forth with many whitish spots. A larger spot, ranged from 2 to 2.5 mm in longer diameter, is present near anterior base of pleuron of each abdominal segment. Other spots are smaller in size, about 1 mm in radius. Abdominal pleura are deep red coloured on anterior base and on posterior margin. Ventral surface of thorax is irregularly stained with orange and white colours. Eye stalks yellowed in upper surface. All pereopods are also of a cobalt blue likewise in body, but are orange in coxa, basis, dactylus, and both proximal and distal ends of all other pedal segments. Regarding to telson and uropods, posterior edge of calcified portion is red, and soft parts are brown.

The present specimen well agrees to the figure given by GRUVEL (op. cit.) and to the description made by MIERS (1880) in general respects. Only difference is that the thoracic legs

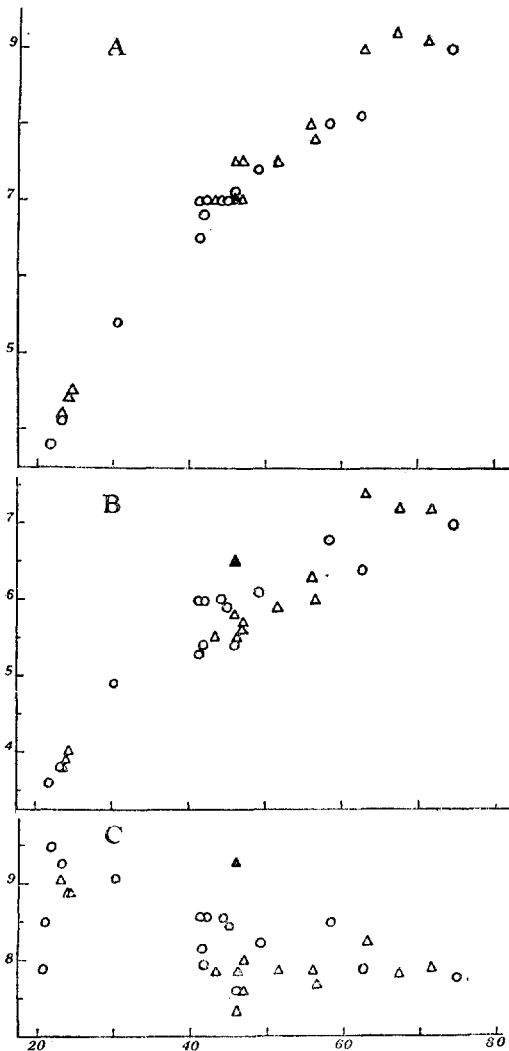


Fig. 3. Length of ocular segment (A), cornea-diameter (B) (See text), and B/A (C) in relation to carapace-length (Abscissa). Unit of length, mm. Circles, male; triangles, female. Soft marks, *Panulirus japonicus*; solid marks, *Panulirus longipes*.

of the specimen at the author's disposal have no blotches which are present on the photograph given by GRUVEL. But such discrepancy appears to the writer to be slight. Besides the present specimen is well in accordance to the description set forth by SHEARD (1949) in the respect of possession of spinules arranged in two rows immediately behind the two main spines of antennal segment. So that the present author identifies the specimen at his disposal to the species, *P. longipes*.

GRUVEL (op. cit.) has united the present species to *P. japonicus*. Also HOLTHUIS (op. cit.) has of late conjoined it to *P. japonicus* because of that the difference found on the colouration only between the two forms may be referred to a local variation. The present author, however, is inclined to think that it is better to split *P. longipes* from *P. japonicus* by reason that the former has well defined morphological characteristics as given in the key besides different colouration.

Distribution: Indopacific. Records in literature are: New Hebrides, Coral Sea (MIERS, 1880); Christmas Islands (CALMAN, 1909); Western Australia (SHEARD, 1949); Mauritius (RICHTER, 1880; MIERS, 1880; MONOD and PETIT, 1929); Zanzibar (A. MILNE-EDWARDS, 1868).

Panulirus versicolor (LATREILLE)

(Japanese name: Goshiki-ebi)

(Pl. V)

Palinurus versicolor, LATREILLE, 1804, p. 394.

Palinurus fuscatus, DE HAAN, 1841, p. 159, Pl. 43-44, fig. 2.

Panulirus ornatus taeniatus, GRUVEL, 1911, p. 48, Pl. 6, fig. 3.

Panulirus versicolor, DD MAN, 1916, p. 55, Pl. 2, fig. 7; MAKI and TSUCHIYA, 1923, p. 83; ESTAMPADOR, 1927, p. 497; HOLTHUIS, 1946, pp. 142-145, Pl. 7, fig. j, Pl. 9, b, Pl. 11, fig. e, f, m (ubi synon); 1953, p. 50; KUBO, 1950, pp. 91-98, figs. 1-4 (for puerulus); BARNARD, 1950, p. 553.

Three specimens were examined. Of which, one is a large adult male, 305.5 mm in body-length (106.0 mm in carapacial length), obtained from Hachijō Islands lying near 35°N, 140°E, in 1953 by Mr. Osamu UMEBAYASHI (Pl. V). Other two ones are young. One of which measures a length of 60.4 mm in body-length (21 mm in carapace-length), taken from the waters about 2 m deep at Misaki, Kanagawa Prefecture by Mr. Nagao ASANO. The other one, 47 mm long (16 mm in carapace-length) was fished by a lobster-net, a kind of gill-net, from Habu, Ōshima, ca. 100 km southwards of Tokyō, on September 7, 1953 by Mr. M. IGARASHI.

As noted already in the section A, only an authentic record for the capture of adult of this species from the main Islands of Japan has been done by MAEDA (1940, p. 45). His specimen, that is landed at Ōsaka fish market, is very large in size (actual size not recorded) according to his photograph, and sex unknown. The puerulus of this species occurs in costal waters of Izu Peninsula as given by KUBO (1950).

Distribution: Indopacific, ranging from Japan to Fiji, Australia, Natal,

and Persian Gulf. Misaki (ca. 35°9'N, 139°38'E) may be the northern limit of the geographical distribution of this species.

***Panulirus penicillatus* (OLIVIER)**

(Japanese name: Shima-ise-ebi)

(Pl. VI)

Astacus penicillatus, OLIVIER, 1791, p. 343.

Senex penicillatus, ORTMANN, 1891, p. 28.

Panulirus penicillatus, BATE, p. 82, Pl. 12, fig. 2; GRUVEL, 1911, p. 31, Text-fig. 13, Pl. 2, fig. 4; DE MAN, 1916, p. 45, Pl. 2, fig. 6; MAKI and TSUCHIYA, 1923, p. 81; HOLTHUIS, 1946, p. 125-128 (ubi Synon); 1953, p. 50; BARNARD, 1950, p. 550, fig. 102, e.

Examined a male, 146 mm in body-length (54.6 mm in carapacial length). It is taken from Habu, Ōshima (Izushichitō) on September 26, 1935 by Mr. M. IGARASHI. This makes the first record of this species from Japan.

Distribution: Indopacific, ranges from Japan (Ōshima, Izushichitō) to Hawaiian Islands, Galapagos Islands, Tahiti, Madagascar, Mozambique, and Red Sea. The Japanese locality given above is likely to be northern limit of the geographical distribution of this species.

***Panulirus homarus* (LINNAEUS)**

(Japanese name: Kebuka-ise-ebi)

Cancer homarus, LINNAEUS, 1760, p. 633.

Palinurus burgeri, DE HAAN, 1841, p. 159, Pls. 43-44, fig. 1.

Panulirus burgeri, DOFLEIN, 1906, p. 198; GRUVEL, 1911, p. 32, text-fig. 14, Pl.

1, fig. 6; BARNARD, 1950, pp. 548-549, fig. 102, e, d.

Panulirus dasyppus, DE MAN, 1916, p. 48; 1924, p. 52.

Panulirus homarus, HOLTHUIS, 1946, pp. 128-134 (ubi synon).

From Japan, only several records of collection of this species are known according to HOLTHUIS (1946, p. 134). Those records were made by DE HAAN (1841), HERKLOTS (1861), DOFLEIN (1906), and others. DOFLEIN taken it from Sagami Bay, but detailed locality of other investigators are unknown. Since above records, this species has not been known from Japan.

Distribution: Indopacific, ranging from East Pacific Ocean (Marquesas Islands) to Red Sea and East coast of South Africa.

***Panulirus dasyppus* (H. MILNE-EDWARDS)**

(Japanese name: Samehada-ise-ebi)

Palinurus dasyppus, H. MILNE-EDWARDS, 1837, p. 300.

Senex dasyppus, ORTMANN, 1891, p. 33.

Panulirus dasyppus, DOFLEIN, 1900, p. 131; GRUVEL, 1911, p. 34, text-fig. 15, Pl.

2, fig. 5; BALSS, 1914, p. 77; PARISI, 1917, p. 8; MAKI and TSUCHIYA, 1923,

p. 86; HOLTHUIS, 1946, pp. 134-136 (ubi synon); BARNARD, 1950, p. 549.
non *Panulirus dasypus*, DE MAN, 1916, p. 48; 1924, p. 52.

This species has been known from Japan by DOFLEIN (1900) and PESTA (1915). PESTA caught it from Yokohama (HOLTHUIS, 1946, pp. 135-136). DOFLEIN's locality is unknown. This animal seems to be rare in Japan because of this lobster has not been taken from Japan since the time of DOFLEIN and PESTA.

Distribution: Indopacific, known from Japan and Formosa to New Guinea, Madagascar, Natal (South Africa) and Sokotora (Arabian Sea).

Panulirus polyphagus (HERBST)

Cancer (Astacus) polyphagus, HERBST, 1793, p. 90, Pl. 32.

Palinurus fasciatus, FABRICIUS, 1798, p. 401; H. MILNE-EDWARDS, 1837, p. 295.

Panulirus fasciatus, GRUVEL, pp. 41-43, text-fig. 19, Pl. 5, fig. 2.

Panulirus polyphagus, HOLTHUIS, 1946, pp. 136-138 (ubi synon).

In regard to this species, only a record of collection from Japan is done by DOFLEIN (1900). Its detailed locality is unknown. This form also seems to be very rare in Japan, if it would be present, as this species has not been caught from Japanese waters since the record of DOFLEIN.

Distribution: Indopacific, extending from East Pacific (Tahiti) to Great Barrier Reef, Natal (South Africa), and Baluchistan (Arabian Sea).

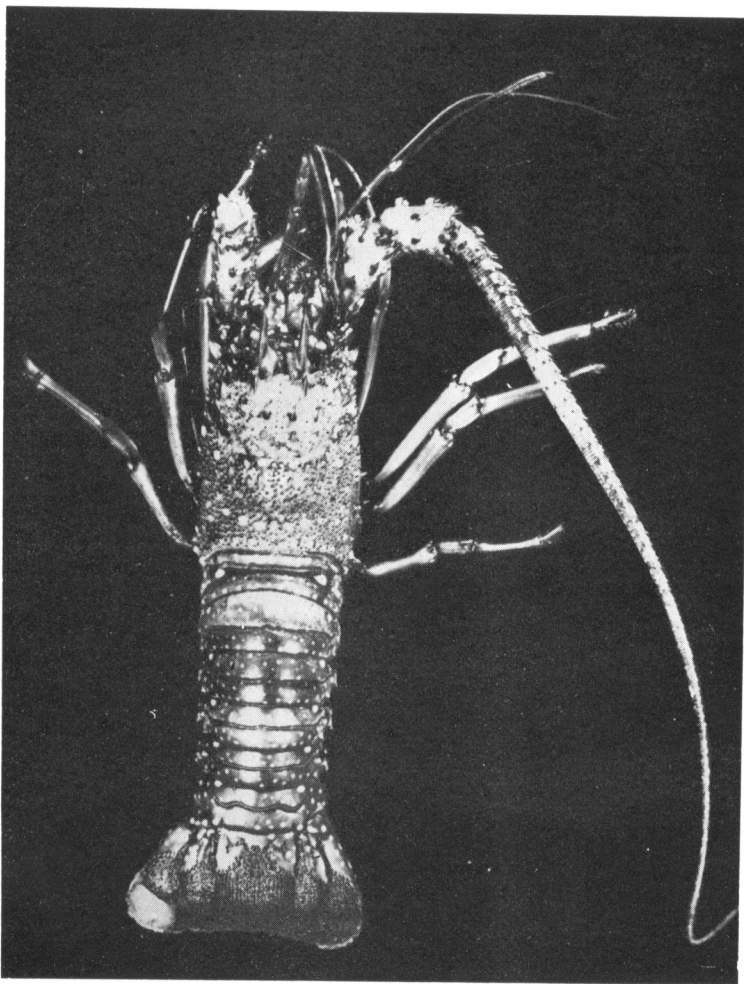
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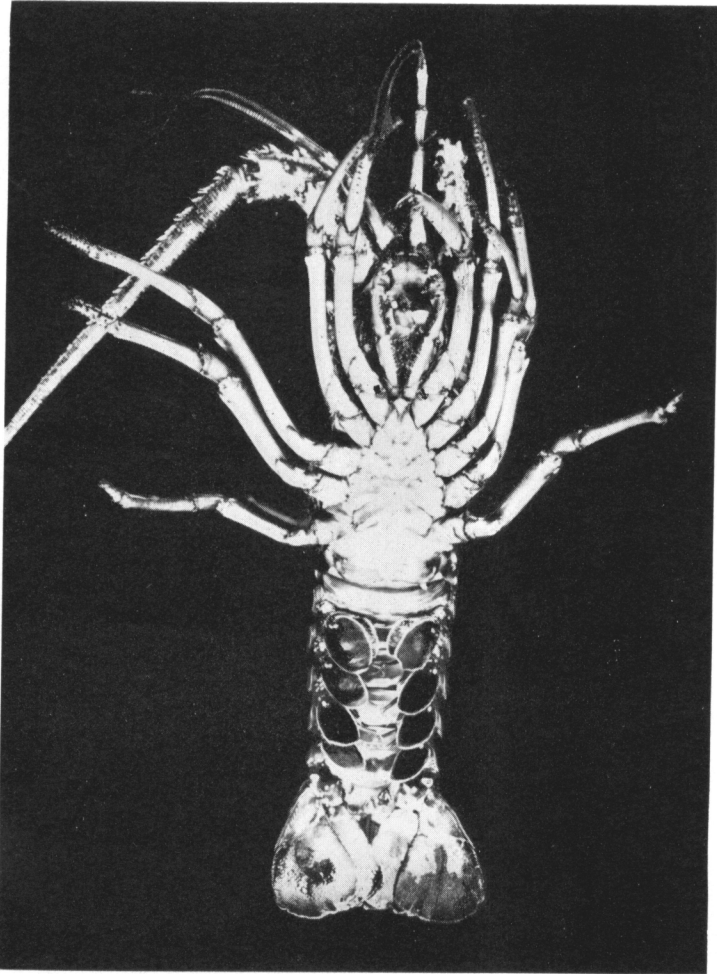
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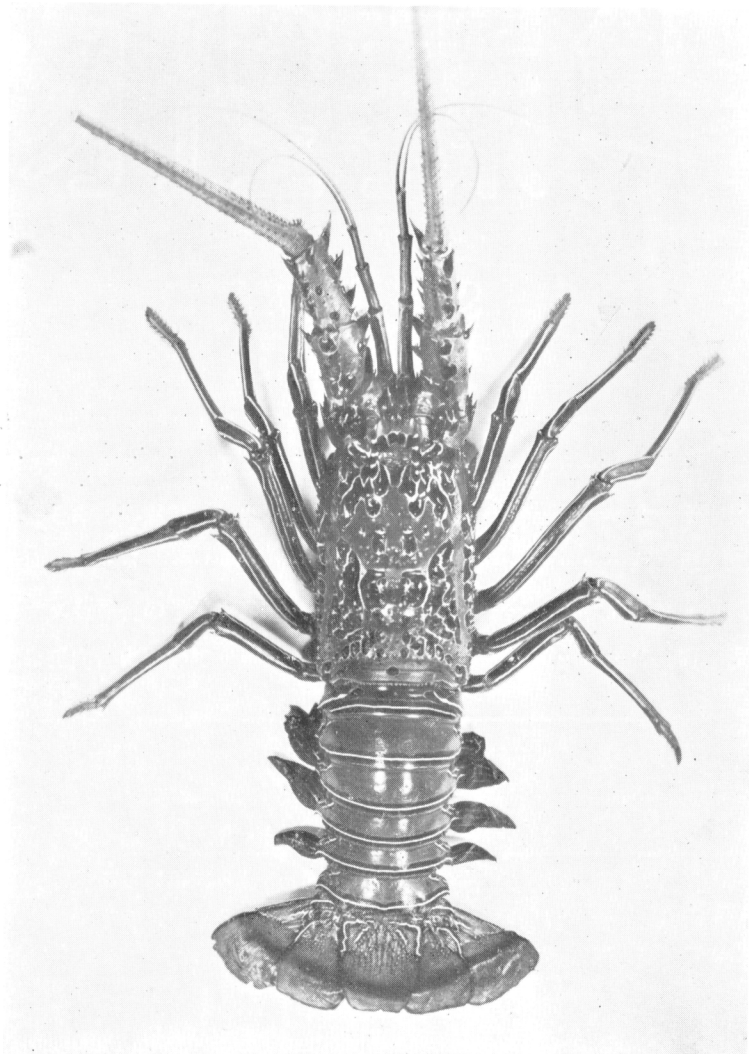
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Pl. III. Dorsal aspect of a female of *Panulirus longipes* (A. MILNE-EDWARDS),
137 mm in body-length (46 mm in carapecial length).



Pl. IV. Ventral view of the same specimen given in Pl. III.



Pl. V. Dorsal aspect of a male of *Panulirus versicolor* (LATREILLE), 305.5 mm in body-length, 106.0 mm in carapace length, taken from Hachijō jima.

Pl. 6. *Panulirus penicillatus* (OLIVIER), male, 146 mm long, 54.6 mm in carapace length (A-D), and third maxilliped of *P. longipes* given in Pl. 3. A, dorsal aspect; B, dorsal aspect of frontal parts especially showing four spines of antennal segment; C, ventral view of frontal parts especially showing spinulation of epistome.

