

STUDIES ON THE *METANEPHROPS JAPONICUS* GROUP
(DECAPODA, NEPHROPIDAE),
WITH DESCRIPTIONS OF TWO NEW SPECIES

BY

TIN-YAM CHAN and HSIANG-PING YU

Graduate School of Fisheries, National Taiwan Ocean University, Keelung 20224,
Taiwan, R.O.C.

RÉSUMÉ

Les espèces du groupe *Metanephrops japonicus* sont revues par comparaison de spécimens déposés dans des musées de divers pays. Sept espèces sont reconnues, dont deux nouvelles. Une clef est établie pour ces Nephropidés et chaque espèce est également illustrée.

INTRODUCTION

The deep water clawed lobsters of the genus *Metanephrops* Jenkins, 1972, or the langoustine and scampi, are highly valued sea-food comparable to the Norway lobster *Nephrops norvegicus* (Linnaeus, 1758). Although the catches of the *Metanephrops* lobsters at present are far less than those of their European counterpart, they have received considerable interest recently (Anon., 1983; Davis & Wards, 1984; Holthuis, 1984; Shimizu et al., 1984; Williams, 1986; Chan & Yu, 1988). The genus *Metanephrops* is traditionally divided into four main species groups (De Man, 1916; Yaldwyn, 1954; Jenkins, 1972; Chan & Yu, 1987). The *M. japonicus* group is characterized by the big chelae spinulously ridged and the abdomen conspicuously sculptured. Members of this group are distributed in the Indo-West-Pacific mainly at depths of 250 to 450 m (i.e. in-between those of the *M. thomsoni* and *M. arafurensis* groups) and are fished throughout the area. The catches of some of them are also the highest of the genus. However, the relationships between the species of the *M. japonicus* group are generally poorly known mainly because they have not been seriously compared. This is reflected by that two more species of this group were recently described from the material previously identified as other species (see Chan & Yu, 1987; Macpherson, 1990). And there are still indications of more species present in the *M. japonicus* group (Holthuis, 1964; Jenkins, 1972; Chan & Yu, 1987).

From the limited ecological data and observations, it seems that these lobsters always live in burrows on muddy bottoms along the continental slope and have a similar biology (Berry, 1969; Jenkins, 1972; Ivanov & Krylov,

1980; Carter et al., 1983; Davis & Wards, 1984; Shimizu et al., 1984; Hiramoto, 1987). They appear to be highly susceptible to fishing pressure and the catches of several commercial species have already sharply declined in recent years (Mitani et al., 1984; Shimizu et al., 1984; Wallner & Phillips, 1988). Better managements of these clawed lobster stocks are thus of urgent concern and the present work presents a taxonomic account of the *M. japonicus* group necessary for their future studies.

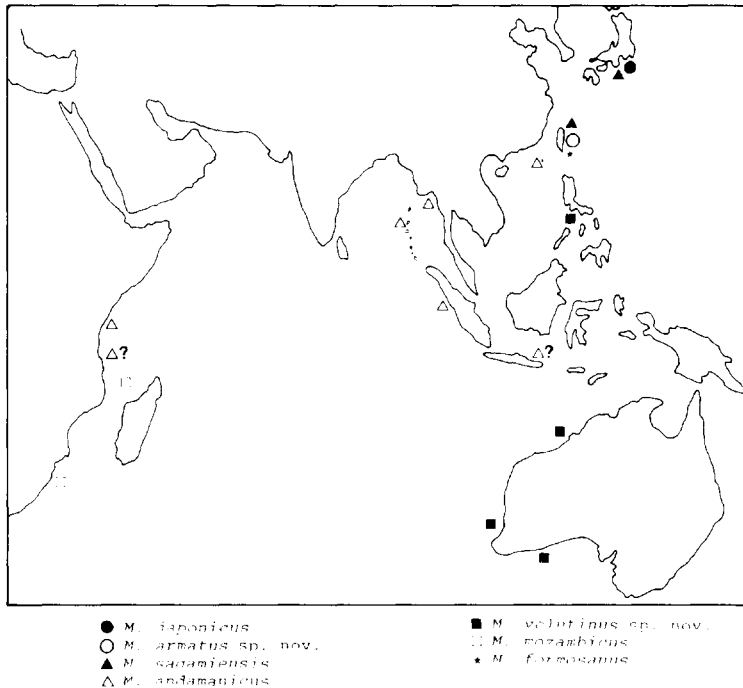


Fig. 1. The distribution of the species of the *Metanephrops japonicus* group in the Indo-West-Pacific. ? , records of specimens with uncertain identities.

The present study compared the material of the *M. japonicus* group from many Indo-West-Pacific localities deposited at museums of many countries. Two new species, namely *M. armatus* sp. nov. and *M. velutinus* sp. nov., are found from Taiwan and Philippine-Australia respectively. Therefore, altogether as many as 7 species are now contained in the *M. japonicus* group. It is also found that *M. andamanicus* (Wood-Mason, 1892) is actually quite rarely known and most of its previous records represented different species. Also different from previous opinion (Jenkins, 1972; Phillips et al., 1980), most of the species of this group appear to have a rather restricted distribution (fig. 1).

TABLE I

The relative development of the spines and abdominal sculpture amongst the species of the *Metanephrops japonicus* group

	Complexity of Abdominal Sculpture	Height of Dorsal Carina	Carapace Spines	Big Cheliped Spines
Most	<i>M. japonicus</i>	<i>M. japonicus</i>	<i>M. japonicus</i>	<i>M. japonicus</i>
	<i>M. armatus</i> *	<i>M. sagamiensis</i>	<i>M. armatus</i>	<i>M. armatus</i>
	<i>M. sagamiensis</i>	<i>M. andamanicus</i>	<i>M. sagamiensis</i>	<i>M. formosanus</i> **
	<i>M. andamanicus</i>	<i>M. velutinus</i>	<i>M. formosanus</i>	<i>M. sagamiensis</i>
	<i>M. velutinus</i>	<i>M. armatus</i>	<i>M. mozambicus</i>	<i>M. andamanicus</i>
	<i>M. mozambicus</i>	<i>M. mozambicus</i>	<i>M. andamanicus</i>	<i>M. mozambicus</i>
Least	<i>M. formosanus</i>	<i>M. formosanus</i>	<i>M. velutinus</i>	<i>M. velutinus</i>

| The differences are very slight and the orders are somewhat arbitrary. * For eroded form it is simpler than *M. andamanicus* (see text for detail). ** But weakestly ridged.

A general account on the relative development of the spines and abdominal sculpture amongst the species of the *M. japonicus* group is provided in table I. Although the characters of *M. japonicus* are always placed at the highest rank, the development of the different characters is not necessarily correlated. It should also be noted that sometimes large variations in the characters are present; particularly in the abdominal sculpture of *M. armatus* and the carapace spines in *M. andamanicus*. Furthermore, the characteristics of *M. formosanus* Chan & Yu, 1987, are actually intermediate between those of the *M. japonicus* and *M. thomsoni* groups (see "Remarks" and Chan & Yu, 1987). This suggests that a revision on the relationships between the species of the whole genus will be of interest.

MATERIAL AND METHODS

The specimens are deposited at the National Taiwan Ocean University (NTOU), Rijksmuseum van Natuurlijke Historie, Leiden (RMNH), Muséum National d'Histoire naturelle, Paris (MNHN), Taiwan Fisheries Research Institute, Keelung (TFRI), Western Australian Museum, Perth (WAM), National Science Museum, Tokyo (NSMT), British Museum [Natural History], London (BMNH). Unless otherwise stated, the measurements are the carapace length, measured from the orbital margin to the posterior border of the carapace. The specimens of *M. velutinus* nov. sp. and *M. mozambicus* Macpherson, 1990, deposited at MNHN are exactly the same as those very recently used by Macpherson (1990), and therefore, only brief descriptions are given of these lots.

Since the general appearances of the species in the *M. japonicus* group are very similar, only the distinguishing characters are described in detail. For

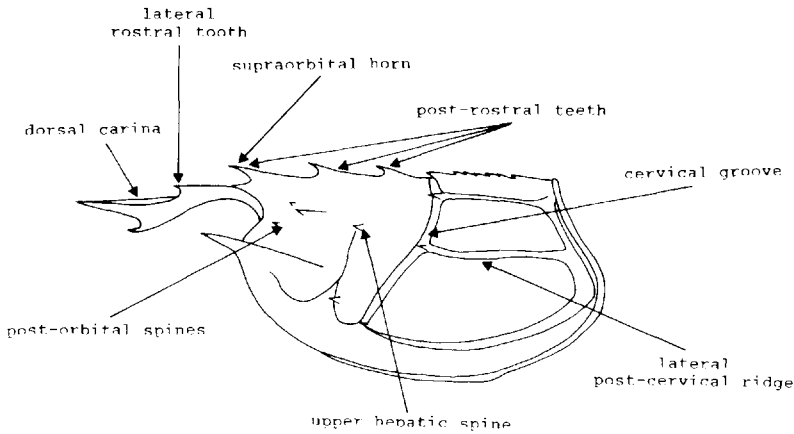


Fig. 2. A schematic carapace of the *Metanephrops japonicus* group showing the positions of the various parts.

detailed descriptions of the general characters of these lobsters, one is referred to Alcock (1894b, 1901), Chan & Yu (1987) and Macpherson (1990).

The terminology of the various body parts of the genus *Metanephrops* used in the literature is rather confused (Alcock, 1894b, 1901; De Man, 1916; Yaldwyn, 1954; Jenkins, 1972; Holthuis, 1984; Chan & Yu, 1987; Macpherson, 1990), particularly the two transverse grooves on the carapace. In the present paper no attempt is made to discuss this problem, but for convenience the various parts of the body mentioned in the text are indicated in figs. 2 and 3. Furthermore, the spines shown in the schematic carapace in fig. 2, except the number of post-rostral teeth, are those in normal arrangement of the carapace spines in the *M. japonicus* group (i.e., with three post-orbital spines) and they are called the “regular spines”. The supraorbital horn is the anterior-most post-rostral tooth. Its size and shape is of considerable taxonomic importance. The abdominal sculpture of *M. andamanicus* can be considered as typical of the group (fig. 3) and those of *M. japonicus* and *M. formosanus* are at the two extremes (table I). Although the median longitudinal ridges of the abdomen are broad and smooth in some species, they are generally called dorsal carinae for easier comparison. The main and posterior facades of the abdominal tergites are the submedian and posterior raised parts described by De Man (1916). Their shapes are important diagnostic characters of the species of the *M. japonicus* group.

Key to the species of the *Metanephrops japonicus* group:

- 1 Abdominal tergite V with distinct lateral spines and median ridge of tergite VI armed with paired spines dorsally 2
- No distinct lateral spine present at abdominal tergite V and median ridge of tergite VI dorsally smooth 3

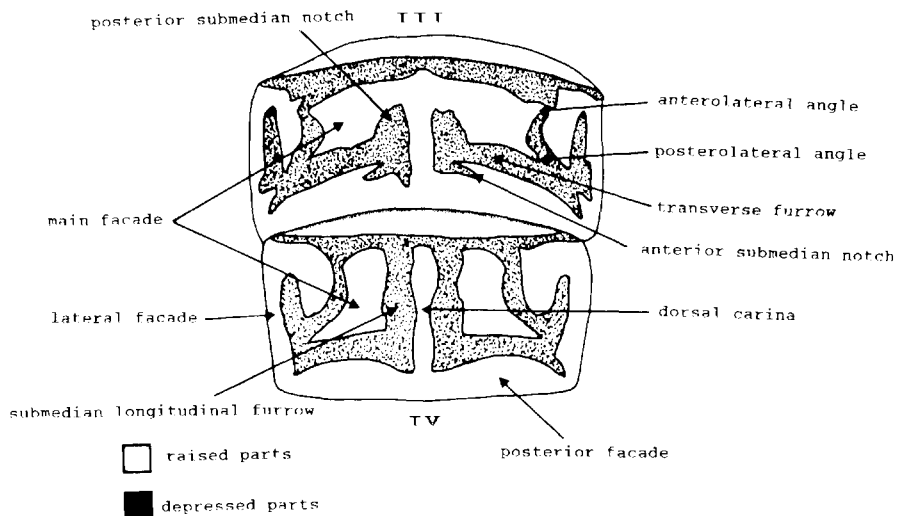


Fig. 3. The abdominal tergites III and IV of a 64 mm (cl. including rostrum) male *Metanephrops andamanicus* (Wood-Mason, 1892) from the Andaman Sea, showing the typical abdominal sculpturation and the positions of the various parts in the *Metanephrops japonicus* group. The sculpturation of the abdominal tergite II is similar to that of III while that of V is similar to that of IV.

- | | | |
|-----|---|------------------------------|
| 2 | Raised parts of abdomen subdivided and with prominent dorsal carina present at tergite I | <i>M. japonicus</i> |
| - - | Raised parts at abdomen smooth and no distinct dorsal carina present at tergite I | <i>M. armatus</i> sp. nov. |
| 3 | Large chelae armed with large spines and abdomen completely lacking dorsal carina | <i>M. formosanus</i> |
| - | Large chelae without large spines and abdomen with dorsal carina | 4 |
| 4 | Usually at least one post-rostral carina armed with more than 3 teeth, spine at lateral lobe of abdominal tergite VI long and almost reaching posterolateral groove | <i>M. saganienis</i> |
| - | Always 3 pairs of post-rostral teeth present, spine at lateral lobe of abdominal tergite VI short and far from posterolateral groove | 5 |
| 5 | Raised parts at abdomen coarse and pubescent | <i>M. velutinus</i> sp. nov. |
| - | Raised parts at abdomen naked and smooth | 6 |
| 6 | Marked dorsal carina present at abdominal tergites II to V and with main facades of V well-separated from dorsal carina by a pair of submedian longitudinal furrows | <i>M. andamanicus</i> |
| - | Dorsal carina at abdomen almost level, that at tergite V essentially absent and lacking submedian longitudinal furrows | <i>M. mozambicus</i> |

SYSTEMATIC ACCOUNT

***Metanephrops japonicus* (Tapparone-Canevari, 1873) (pls. 1a, 3a, 5a, 7a)**

Nephrops japonicus Tapparone-Canevari, 1873: 5, pl. 1 [type-locality: Japan]; Ortmann, 1891: 6 (? p.p.); Ortmann, 1897: 272 (? p.p.), pl. 17 fig. 1; Doflein, 1902: 642 (? p.p.); De Man, 1916: 98 (key), 101; Balss, 1914: 84 (p.p.); Parisi, 1917: 15, fig. 4; Yoshida, 1941: 34, pl. 13 fig. 4; Yakulyn, 1954: 730; Burukovskii, 1983: 156 (key); Mitani et al., 1984: 11; Shimizu et al., 1984: 7.

- Nephrops sagamiensis* Parisi, 1917: 15 (p.p.).
Nephrops intermedius Balss, 1921: 176 (? p.p.).
Metanephrops japonicus — Jenkins, 1972: 162, figs. 2-4; Phillips et al., 1980: 65; Miyake, 1982: 77, pl. 26 fig. 3; Baba, 1986: 149, color photo 100; Hiramoto, 1987: 121, pl. 1.
 [Not] *Nephrops japonicus* — Balss, 1914: 84 (p.p.), pl. 1 fig. 2; Kubo, 1970: 98, pl. 49 fig. 2; Kubo, 1971: 629, fig. 1029; Takeda, 1982: 46, fig. 136 [= *M. sagamiensis* (Parisi, 1917)]; Chang, 1965: 49, fig. 40 [= *M. formosanus* Chan & Yu, 1987].
 [Not] *Metanephrops japonicus* — Chan & Yu, 1987: 172, 184 (key); Chan & Yu, 1988: 9, pl. 1B [= *M. armatus* sp. nov.].
 [? Not] *Nephrops japonicus* — Ortmann, 1891: 6 (p.p.); Ortmann, 1897: 272 (p.p.); Doflein, 1902: 642 (p.p.) [= *M. sagamiensis* (Parisi, 1917)].

Material examined:

Japan — "Albatross" sta 3738, Heta, Suruga Bay, Honshu, 306 m, 17 May 1900: 1 female 44.5 mm (RMNH); Owase, Mie Prefecture, December 1958: 1 female 28.5 mm (RMNH); Mimase, Kochi Prefecture, 18 May 1979: 1 male 40 mm (RMNH); Heta, Suruga Bay, Honshu, 21 October 1986: 4 males 28.5-69 mm, 3 ovigerous females 60.5-62 mm (RMNH); No date: 1 male 65 mm (MNHN); No date, M. Lessona coll.: 1 male 53 mm (MNHN); ? Tosa Bay, 1986: 1 large spec. (NSMT).

Description. — Rostrum with marked and sharply serrated dorsal carina, long and far overreaching antennal peduncle. Post-rostral teeth 5-7 (mostly 6) and often asymmetrical. Supraorbital horn with dorsal margin convex, slender and distinctly curving downwards and inwards, overreaching eye and very close to or even touching lateral rostral tooth. Carapace with teeth and spines well-developed. Upper hepatic spine prominent. Lateral post-cervical ridge conspicuously granular and with large to minute anterior spine. Additional spines and spinules often present near regular spines.

Big chelae usually subequal, generally long and slender but heavily ridged and densely covered with large spines; inner margin of palm serrated with numerous large spines and outer base of movable finger provided with a small tooth. Carpus of big cheliped almost entirely covered with large spines (in 6 rows); merus with dorsolateral margin having at least 4 large spines as well as many small spines and spinules posterior to distal tooth, inner margin sharply denticulate or tubercular.

Abdomen with articular surface naked and smooth. Non-articular surface with narrow but high dorsal carina and complicated sculpture; grooves deep and broad, raised parts naked but corrosive (i.e. grooved and subdivided). Tergite I with transverse furrow only narrowly interrupted at middle by prominent dorsal carina. Main facades of tergites II and III with large posterior submedian notches, subdivisions sometimes as inner transverse furrows, anterior margin nearly horizontal, anterolateral angle not projected and far from lateral facade. Main facade of tergite IV slightly shrunken and with inner margin markedly concave. Posterior facades of tergites II to IV with anterior submedian openings and distinctly subdivided into inner transverse furrows. Tergite V armed with large lateral spines, main facade strongly shrunken and somewhat "L"-shaped. Median ridge of tergite VI dorsally armed with 2 pairs

of large spines as well as some paired spinules and sharp tubercles. Posteriorly directed spines at tergite VI and tail-fan sharply elongated, with those at lateral lobes of tergite VI reaching postero-lateral grooves.

Coloration. — Color photographs of the present species have been provided by Anon. (1973: 67), Miyake (1982), Baba (1986) and Hiramoto (1987, from a live specimen). It appears that the coloration of *M. japonicus* is very similar to that of *M. armatus* but somewhat more orange-red.

Distribution. — Endemic to Japan from Choshi to east of Kyushu at depths of 200-439 m.

Remarks. — The spines and abdominal sculpture of *M. japonicus* are the best developed of the species in the *M. japonicus* group (table I), although its big chelae are rather long and slender but not broad and robust. The number of post-rostral teeth is generally the highest in *M. japonicus* and there are often extra spines present at various positions of the carapace (mostly in the post-orbital region and near the bases of post-rostral carinae). It is also the only species of the *M. japonicus* group with a distinctly serrated dorsal rostral carina and a pair of extremely long and curved supraorbital horns.

The most distinctive characters of *M. japonicus* are the presence of a prominent dorsal carina at the abdominal tergite I and the subdivided raised parts of the abdomen. Both of these characters are also very conspicuous in small individuals, although in the original figure provided by Tapparone-Canefri (1873) the abdominal sculpture is not clearly shown (also see De Man, 1916: 101). Only one specimen (RMNH) examined has the abdominal sculpture somewhat eroded and with the subdivisions at the main facade less evident.

M. japonicus is often confused with *M. sagamiensis* (cf. Miyake, 1982 and also see under Remarks of *M. sagamiensis*). Ortmann (1897) mentioned that his *M. japonicus* specimens showed sexual dimorphism in the abdominal sculpture. No such dimorphism is found in our material, nor in the other species of the *M. japonicus* group. Thus, it may be possible that there was also some mixture of *M. japonicus* and *M. sagamiensis* in Ortmann's (1897) sample, like in that of Balss (1914) (however, the figure provided by Ortmann (1897) is no doubt *M. japonicus*). The figures of *M. japonicus* provided by Kubo (1970, 1971) are certainly *M. sagamiensis* though his description in the 1971 text is closer to the true *M. japonicus*.

The size of *M. japonicus* is quite large. It is mainly fished in Chiba and Sagami Bay during the cold seasons and is highly valued (e.g., Miyake, 1982; Baba, 1986; Takeda pers. comm.). Preliminary biological studies and ecological observations on this lobster have been reported by several Japanese authors (e.g., Miyake, 1982; Shimizu et al., 1984; Mitani et al., 1984; Hiramoto, 1987). It appears that the stock of *M. japonicus* in Sagami Bay is not large and is subjected to high fishing pressures. Nevertheless, the size composition of the catch has not changed so far, but this may be due to that this lobster lives in separate size groups (Shimizu et al., 1984).

***Metanephrops armatus* sp. nov.** (pls. 1b, 3b, 5b,d, 7b, 9a,b)

Metanephrops japonicus — Chan & Yu, 1987: 172, 184 (key); Chan & Yu, 1988: 9, pl. 1B [non Tapparone-Canefri, 1873].

Material examined:

Holotype: 1 male 57 mm, north-eastern Taiwan, Su-Ao, I-Lan County, baby shrimp trawler, fish market, 300-400 m (from fishermen), 9 March 1990 (NTOU-90-3-9H).

Paratypes (Taiwan) — Tai-Shi, I-Lan County, baby shrimp trawler, fish market, 21 October 1984: 2 males 37 and 45.5 mm, 4 ovigerous females 40.5-44 mm, 1 female 41 mm (NTOU-84-10-21); 9 May 1989: 2 males 44 and 45 mm (NTOU-89-5-9); 13 June 1989: 1 male 48.5 mm (NTOU-89-6-13), 1 March 1990: 2 males both 48 mm (NTOU-90-3-1). Su-Ao, I-Lan County, baby shrimp trawler, fish market, 1 March 1985: 1 male 16.5 mm, 8 females 14-27 mm (NTOU-85-3-1); 9 March 1990: 5 males 19-51.5 mm, 1 ovigerous female 38.5 mm, 1 female 36.5 mm (NTOU-90-3-9). North-eastern coast, 24°55'14"N 122°04'19"E, 230-280 m, 5 May 1989: 2 females both 48 mm (TFRI-89-5-5). Tung-Kang, Ping-Tung County, July 1975: 1 male 25 mm (NTOU-75-5).

Description. — Rostrum, with high but almost smooth dorsal carina, long and distinctly exceeding antennal peduncle. Post-rostral teeth 4-8 (mostly 5 or 6) and often asymmetrical. Supraorbital horns, with dorsal margin convex, extending to 2/3 or to distal end of eyes, parallel with rostrum or curving inwards and directed slightly upwards or downwards but never distinctly curving downwards and always far from lateral rostral teeth. Spines on carapace well-developed. Upper hepatic spine prominent. Lateral post-cervical ridge granular and usually with conspicuous anterior spine. Additional spines or spinules sometimes also present near regular spines.

Big chelae generally subequal, broad, robust, strongly ridged and covered with large and small spines; inner margin of palm usually armed with 2 or 3 (rarely 1 or 4) regular spaced large spines as well as with many small spines, outer base of movable finger armed with a large tooth. Carpus of big cheliped armed with 6 rows of large and small spines; merus with dorsolateral margin generally armed with 1-3 (rarely 0 and 4 at one side) large spines as well as many small spines and spinules posterior to distal tooth, inner margin sharply granular to tubercular (in large individuals).

Articular surface of abdomen naked and smooth. Non-articular surface with broad to moderately broad but distinct dorsal carina (sometimes almost leveled at II but always markedly elevated at IV), sculpture sharp to slightly crenate; raised parts naked and smooth; grooves narrow or broad but always deep. Tergite I sometimes with rudimentary dorsal carina in anterior 1/3, but essentially lacking dorsal carina and with transverse furrow broadly to somewhat narrowly interrupted medially. Main facades of tergites II and III generally broad, posterior submedian notches absent to deep and narrow; anterior margin usually horizontal, anterolateral angle of tergite II from hardly to strongly projecting and sometimes even joined with lateral facade, that of tergite III never projecting. Main facade of tergite IV broad, inner margin

usually straight and sometimes close to or slightly joined with dorsal carina. Posterior facades of tergites II to IV with minute to moderately large anterior submedian notches. Tergite V with prominent lateral spines, main facade usually broad and sometimes also slightly joined with dorsal carina. Median ridge at tergite VI dorsally armed with 1 pair of large spines at subanterior end and sometimes (about 25%) another pair of smaller spines also present at subposterior end as well as some additional spinules and sharp tubercles. Posteriorly directed spines at tergite VI and tail-fan long and strong, with those at lateral lobes of tergite VI reaching posterolateral grooves.

Coloration. — Body generally orange-pink. Carapace whitish ventrally and with some pink patches. Tips of rostrum, bases and tips of lateral rostral teeth, supraorbital horns, large spines at carapace, ventral 2/3 of orbital margin, area immediately below posteriormost post-orbital spine and lateral part of cervical groove, whitish. Eyes black-brown with golden reflections. Margins posterior to lateral rostral teeth orange-red. Antennal and antennular flagella red. Big chelipeds generally not banded (though sometimes slightly banded in juveniles) and with lateral surface pale pink (whitish in large specimens); tips of chelae and large spines whitish while hinges orange-red. Abdominal hinges and pleural borders white. Tail-fan deeper orange in color. Ventral surface and pleopods somewhat pale pink to white (large specimens). Eggs greenish blue to white, white when near hatching.

Type-locality. — Taiwan.

Distribution. — Taiwan only, at depths of 200-450 m and mostly more than 300 m (from fisherman).

Remarks. — The general appearance of the present form is quite similar to that of *M. japonicus* but the latter species is even more spiny and more complicatedly sculptured. The size of the Taiwanese material is noticeably smaller than that from Japan; and our assumption (Chan & Yu, 1987, 1988) that the smoothness of the abdomen of *M. japonicus* was size related, was caused by that we mistakenly thought our specimens of *M. armatus* to be *M. japonicus*. Later when we visited the National Science Museum in Tokyo, we were able to examine a *M. japonicus* specimen and found that there are large differences between the Taiwanese and Japanese populations. A subsequent visit by the first author to European museums enabled us to examine many more topotypic *M. japonicus* material of different sizes and determine that the Taiwanese form is actually distinct.

There is essentially no dorsal carina at the abdominal tergite I in *M. armatus*. Furthermore, the dorsal carinae at the abdominal tergites II and III are noticeably narrower and higher in *M. japonicus* than in *M. armatus*, with that of II sometimes even almost level in the latter. The main facades at the abdomen in *M. armatus* are smooth and completely lack subdivisions in specimens of all sizes. In *M. japonicus*, however, the main facades are conspicuously subdivided even in small specimens; the facades of tergites II and

III having large posterior submedian notches while those of tergites IV and V are somewhat shrunken. The posterior facades at abdominal tergites II to IV are also distinctly subdivided in *M. japonicus* and such subdivisions are generally absent in *M. armatus* (only rudimentary present in a male of 39.5 mm).

On the carapace, the supraorbital horns are extremely elongated and curved in *M. japonicus*, with those of large specimens even touching the lateral rostral teeth. Although the supraorbital horns in *M. armatus* sometimes also curve inwards, they never strongly curve downwards and are always far from the lateral rostral teeth. Moreover, the big chelipeds of *M. japonicus* are generally more spinose than those of *M. armatus*, though the latter are more robust and broad.

It is interesting that there are large variations in the abdominal sculpture in the present species (table I, pl. 5b, d). Most of the specimens from Ta-Shi have a rather eroded abdominal sculpture and in some of them it is even simpler than that of *M. andamanicus* (e.g., tergite II with an almost leveled dorsal carina, while the main facade has the anterolateral angles joined with the lateral facades and lacks posterior submedian notches). On the other hand, the material from Su-Ao generally has the abdominal sculpture sharp and more complicated than that of *M. sagamiensis* (e.g., with larger anterior submedian notches at the posterior facades). The holotype, which is from Su-Ao and is the largest specimen collected, has the abdominal sculpture intermediate between the two forms. Furthermore, it seems that the spines on the carapace are slightly better developed in those specimens having a smoother abdomen. Although the supraorbital horns are often parallel to the rostrum in the material from Ta-Shi, and curve inwards in those from Su-Ao, both forms are regularly found in these two nearby fish markets (both at the north-eastern coast). It is not known whether such differences in the abdominal sculpturation and supraorbital horns are depth-related.

M. armatus is generally larger than the other common *Metanephrops* lobsters in Taiwan, and therefore, it is more welcome and makes a better price (about NT\$300-400/kg in fish markets). However, its catch is smaller because this species is usually found in deeper and more rocky areas which are not easily accessible to local trawlers. Studies on the biology of this lobster are under way, but it seems that *M. armatus* is more difficult to keep in the laboratory than *M. formosanus*.

Etymology. — The Latin *armatus* is for the thick and spiny integument of this lobster. This name also has a similar meaning as the Taiwanese vernacular name “armoured lobster”.

***Metanephrops formosanus* Chan & Yu, 1987 (pls. 1c, 3c, 6d)**

Nephrops japonicus — Chang, 1965: 49, fig. 40 [non Tapparoni-Canevari, 1873].

Metanephrops formosanus Chan & Yu, 1987: 173, fig. 1, pls. 1-2 [type-locality: Taiwan]; Chan & Yu, 1988: 11, pl. 1D.

Material examined:

Taiwan (NFOU), taken by Baby shrimp trawlers; from fish markets: Tai-Shi, I-Lan County, 9-10 March 1973: 2 males 22 and 28.5 mm, 1 female 21.5 mm; 5 August 1982: 1 ovigerous female 31 mm; 3 February 1983: 3 males 20.5-35 mm, 2 females 25 and 28 mm, paratypes; 14 July 1984: 1 male 25.5 mm; 4 October 1984: 1 male 30 mm, holotype; 14 October 1984: 5 males 20-26 mm, 3 females 24-29 mm, paratypes; 21 October 1984: 1 female 33.5 mm, allotype; 21 October 1984: 2 males 36 and 36.5 mm, 1 female 16.5 mm, paratypes; 16 April 1988: 1 female 47.5 mm; 1 March 1990: 3 males 36-40.5 mm, 2 ovigerous females 34 and 39.5 mm. Su-Ao, I-Lan County, 16 March 1985: 1 male 32 mm, 2 females 20 and 29 mm, 1 juvenile 11 mm. Tung-Kang, Ping-Tang County, July 1975: 1 female 18.5 mm; 31 October 1984: 6 males 18-25 mm, paratypes. No Station no date: 1 male 29.5 mm, 1 female 28 mm.

Description. — Rostrum, almost lacking dorsal carina, long, and well exceeding antennal peduncle. Post-rostral carinae usually with 3 pairs of teeth (rarely 4 on one side). Supraorbital horn, with dorsal margin slightly convex, sharp and extending to 2/3 or end of eye, directed upwards and parallel with rostrum. Carapace with teeth and spines well-developed. Upper hepatic spine large and prominent. Lateral post-cervical ridge finely granular and usually with large anterior spine.

Big chelae generally broad and subequal, modestly ridged and sharply granular but distributed with some large and small spines; inner margin of palm armed with 2 to 4 large spines, outer base of movable finger with large prominent spine. Carpus of big cheliped generally tubercular and with few large spines mostly at distal end and often present at inner surface, merus with dorsolateral margin almost smooth and inner margin sharply granular.

Articular surface of abdomen naked and smooth. Non-articular surface completely lacking dorsal carina (rarely very slightly arched at IV) and with simple sculpture; raised parts markedly naked and smooth while grooves narrow and shallow (but distinct). Tergite I with short transverse furrows laterally. Tergite II usually with transverse furrow continuous but sometimes a slight constriction and rarely an interruption may be present in the middle; main facade completely joined with lateral facades (only with rudimentary lateral margins), lacking posterior submedian notch and with anterior margin horizontal. Sculpturation of tergite III similar to that of II but with transverse furrow medially interrupted (interruption broad to narrow and rarely almost absent). Tergites IV and V lacking submedian longitudinal furrows and with outer margins of main facade joined with lateral facades at posterior half. Posterior facades without anterior submedian notches. Small granule (sometimes sharp) often present at lateral margin of tergite V. Median ridge at tergite VI dorsally smooth. Posteriorly directed spines at tergite VI and tail-fan moderately long and sharp, with postero-median spine at tergite VI always short but those at lateral lobes sometimes reaching posterolateral grooves.

Coloration. — Body generally orange-pink. Eyes black-brown with golden reflections. Antennal and antennular flagella orange-red. Orbital margin, area immediately below posteriormost post-orbital spine and subventral of cervical

groove white. Ventral part of carapace and pereopods somewhat pinkish. Tips of rostrum, fingers of big chelae, large teeth on carapace and big chelipeds white, particularly the spine at outer base of movable finger. Abdomen only with pleural margins white. Tail-fan slightly deeper orange in color. Ventral surface and pleopods pink. Eggs blue and becoming dirty white when near hatching.

Distribution. — Endemic to Taiwan, at depths of 150-350 m, mostly around 250 m (from fishermen).

Remarks. — *M. formosanus* is unique in the *M. japonicus* group by the big chelae armed with large spines but the abdomen completely lacking a dorsal carina and having simple sculpture. However, the ridges at the big chelae in *M. formosanus* are the weakest in the *M. japonicus* group and the species thus is partly related to the *M. thomsoni* group. Although the characteristics of *M. formosanus* are somewhat intermediate between those of the *M. japonicus* and those of the *M. thomsoni* groups, it is generally more related to the former by the current definitions of the species groups (big chelae smooth or inconspicuously ridged and abdomen indistinctly sculptured for the *M. thomsoni* group).

There are also variations in the abdominal sculpture in this species. The transverse furrow at the abdominal tergite II is rarely interrupted medially while those of the tergites III and IV are rarely more or less continuous. Similar to *M. armatus*, the big chelipeds of *M. formosanus* are often slightly banded in juveniles. It is not known whether such banding also occurs in the juveniles of the other species of the *M. japonicus* group.

M. formosanus is the smallest species in the *M. japonicus* group. Nevertheless, this species constitutes the major catch of the *Metanephrops* lobsters in Taiwan (also see Chan & Yu, 1987, 1988). Its price is about NT\$150-300/kg (larger and fresher specimens are more expensive and more sought after) in fish markets and with the common names “armoured prawns” (Te Chia Shia), “small lobsters” (Sheau Long Shia) and “horny prawns” (Jeau Shia). Although *Metanephrops* lobsters are now very welcome in local restaurants, their catches are still rather small and not constant in Taiwan. This is probably due to the fact that the stocks of these lobsters are not large in Taiwan and their fishing grounds are not easily located (deep and near rocky areas, especially for larger individuals—information from fishermen). It appears that no significant change has yet been observed in the catches of *Metanephrops* lobsters in Taiwan, though numerous juveniles are often collected. Studies on the biology of this lobster, as well as the other common Taiwanese *Metanephrops* are under way and it appears that *M. formosanus* can perform quite well in the laboratory (but not ovigerous females) with a water temperature of about 15°C.

Metanephrops sagamiensis (Parisi, 1917) (pls. 1d, 3d, 5c, 7c)

Nephrops japonicus — Ortmann, 1891: 6 (? p.p.); Ortmann, 1897: 272 (? p.p.); Dolléin, 1902: 642 (? p.p.); Balss, 1914: 84 (p.p.), pl. 1 fig. 2; Kubo, 1970: 98, pl. 49 fig. 2; Kubo, 1971: 629, fig. 1029; Takeda, 1982: 46, fig. 136 [non Tapparone-Canevari, 1873].

Nephrops sagamiensis Parisi, 1917: 15 (p.p.) [type-locality: Sagami Bay]; Yaldwyn, 1954: 730.

Nephrops intermedius Balss, 1921: 176 (? p.p.); Yaldwyn, 1954: 730.

Metanephrops sagamiensis — Jenkins, 1972: 163, figs. 2-4 (p.p.); Phillips et al., 1980: 65 (p.p.); Miyake, 1982: 77, pl. 26 fig. 4; Baba, 1986: 151, color photo 101; Chan & Yu, 1987: 184 (key).

? *Nephrops sagamiensis* — Burukovskii, 1983: 156 (key).

Nephrops intermedium — Burukovskii, 1983: 156 (key).

[Not] *Nephrops sagamiensis* — Bruce, 1966: 535 [= *M. andamanicus* (Wood-Mason, 1892)].

[Not] *Metanephrops sagamiensis* — Jenkins, 1972: 163, figs. 2-4 (p.p.); Phillips et al., 1980: 65 (p.p.) [= *M. andamanicus* (Wood-Mason, 1892)].

Material examined:

Japan — Bungo Passage, between Shikoku and Kyushu, 350-400 m, Japan Marine Fishery Resource Research Center, 1986: 1 male 60 mm (NTOU, NSMT exchange) and 10 similar size spec. (NSMT); Mimase, Kochi Prefecture, 18 May 1979: 2 males 42 and 44 mm, 1 female 38 mm (RMNH).

Taiwan — Su-Ao, I-Lan County, baby shrimp trawler, fish market, 9 March 1990: 2 males 48.5 and 59 mm, 2 ovigerous female 47.5 and 48 mm, 1 female 43 mm (NTOU).

Description. — Rostrum, with low and almost smooth dorsal carina, well exceeding antennal peduncle. Post-rostral teeth 3-5 but mostly 4 and usually (at least on one side) with more than 3. Supraorbital horns, with dorsal margin convex, moderately long and extending to slightly beyond 1/2 or 2/3 of eyes, straight or slightly curving inwards and downwards. Carapace with spines well-developed. Upper hepatic spine prominent. Lateral post-cervical ridge granular and with anterior spine small to absent.

Big chelae subequal, broad, prominently ridged and covered with short but stout spines; inner margin of palm without large spines and outer base of movable finger sometimes with a tubercle. Carpus of big cheliped provided with rows of sharp tubercles as well as a few large spines which are mostly placed at the distal end and also are present at the inner surface; merus with dorsolateral margin armed with several small but conspicuous spines posterior to distal tooth, inner margin granular to sharply tubercular.

Articular surface of abdomen naked and smooth. Non-articular surface with broad but high dorsal carina and sharp sculpture; raised parts naked and smooth while grooves deep and broad. Tergite I, sometimes with very rudimentary dorsal carina anteriorly, with transverse furrow broadly interrupted medially. Main facades of tergites II and III with large to moderately large posterior submedian notches; anterior margin often oblique and medially protruded, anterolateral angle generally not projected and far from lateral facade, while posterolateral angle strongly projected laterally and extending to far beyond anterolateral angle. Posterior facades of tergites II to IV with small

to minute anterior submedian notches. Main facade of tergite IV broad, well-separated from dorsal carina and with outer margin oblique. Tergite V without lateral spine but sometimes with minute tubercle; main facade broad and well-defined, also well-separated from dorsal carina. Median ridge of tergite VI dorsally smooth. Posteriorly directed spines at tergite VI and tail-fan long and strong, with those at lateral lobes of tergite VI almost reaching posterolateral grooves.

Coloration. — Body generally orange-red. Eyes black-brown with golden reflections. Distal half of supraorbital horns, tip of rostrum, orbital margin and area immediately below posteriormost post-orbital spine whitish. Lateral rostral teeth white but with tips orange. Cervical groove paler colored and with ventral parts white. Ventral part of carapace also paler colored and only with ventral border whitish. Hinges at abdomen white. Abdominal pleura pink-red and with margins white. Big chelipeds somewhat banded with paler colors (sometimes indistinct) at base of palm and distal part of merus; distal parts of fingers (maximally to distal 2/3) and tips of large teeth whitish. Ventral surface and pleopods pink-white to pink. Tail-fan deeper orange in color. Eggs blue, becoming white and blue when near hatching.

Distribution. — Japan and northern Taiwan, from Sagami Bay to north-eastern Taiwan at depths of 300-400 m (mostly around 350 m).

Remarks. — When Parisi (1917) described the present species, he included all Balss's material identified as *M. japonicus* in 1914 as the types. However, there was actually a mix up of *M. japonicus* and *M. sagamiensis* in Balss' samples (see Balss, 1921). Later Balss (1921) also recognized this and named the different form *M. intermedius*. However, Prof. Holthuis kindly informed us that there is also indication of some possible mix up in the type series of *M. intermedius* with *M. japonicus* (more details see Holthuis in press). However, the selection by Prof. Holthuis of the specimen illustrated in Balss (1914, pl. 1 fig. 2) as the lectotype of both species, definitely makes *M. intermedius* an objective synonym of *M. sagamiensis*.

As De Man (1916: 101) had noticed, the general appearance of *M. sagamiensis* (referred to by him as Balss's (1914) *M. japonicus*) is surprisingly similar to *M. andamanicus*. The difference in the length of the rostrum between the two species mentioned by De Man (1916) is found to be rather slight and variable. Also different from De Man's (1916) interpretation, the supraorbital horns of *M. sagamiensis* are much shorter than those of *M. japonicus* and only occasionally slightly curved. The big chelipeds are generally slightly more spinulose in *M. sagamiensis* than in *M. andamanicus*. The different spinulation at the inner margin of the merus used in Chan & Yu (1987) to separate the two species proved to be quite variable and size-related.

Nevertheless, in *M. sagamiensis* at least one of the paired post-rostral carinae is armed with more than 3 teeth (only in one ovigerous female from Taiwan the posteriormost teeth are somewhat indistinct). But there are always 3 pairs

of post-rostral teeth present in *M. andamanicus*. The abdominal sculpturation of the two species is also somewhat different, particularly at the tergites II and III. The anterior margins of the main facades at the abdominal tergites II and III are often distinctly oblique in *M. sagamiensis* but usually horizontal in *M. andamanicus*. While the anterolateral angles of these two facades are hardly projected in *M. sagamiensis*, they are strongly projected (especially at II) and sometimes even joined with the lateral facades in *M. andamanicus*. Moreover, the posteriorly directed spines at the abdominal tergite VI and tail-fan are conspicuously shorter in *M. andamanicus* (the difference is very apparent in large individuals). The above differences are found to be quite constant, and therefore, it is justified to treat the two species as distinct (also see Balss, 1925).

Bruce (1966) (followed by Jenkins, 1972 and Phillips et al., 1980) reported *M. sagamiensis* from the north of South China Sea. When the first author (C.) examined the *Metanephrops* collection at the Fisheries Research Station in Hong Kong some years ago, a severely damaged specimen of either *M. sagamiensis* or *M. andamanicus* was found (having no label and in a condition that was too poor for correct identification). From the distribution (fig. 1) of these two species and the fact that all the material from Tungsha Tao belongs to *M. andamanicus*, it is highly likely that this specimen is *M. andamanicus* instead of *M. sagamiensis*.

It is interesting that actually *M. sagamiensis* but not *M. japonicus* is found in Taiwan (see Chan & Yu, 1988). The characters of *M. sagamiensis* are rather constant and the material from Taiwan is almost identical with that from Japan. In Japan, *M. sagamiensis* appears to be more abundant than *M. japonicus* in Tosa Bay and more south (Miyake, 1982; Baba, 1986). In Taiwan, *M. sagamiensis* is uncommon and only found on the north-eastern coast. It is caught with *M. armatus* and can be easily distinguished from the other Taiwanese *Metanephrops* lobsters by its redder coloration and the distal half of the fingers of the big chelae being whitish. Morphologically, *M. sagamiensis* can be readily separated from *M. japonicus* and *M. armatus* by the abdominal tergite V lacking a pair of lateral spines and the dorsally unarmed median ridge at the abdominal tergite VI. *M. sagamiensis* is generally larger than *M. armatus* but smaller than *M. japonicus*.

***Metanephrops andamanicus* (Wood-Mason, 1892) (pls. 2a, c, 4a, c, 6a, 7d)**

- Nephrops andamanicus* Wood-Mason, 1892: pl. 4 [type-locality: Andaman Sea]; Alcock, 1894a: pl. 8 fig. 5; Alcock, 1894b: 226; Ortmann, 1897: 272; Balss, 1925: 207; Yaldwyn, 1954: 730 (p.p.); Burukovskii, 1983: 157 (key).
Nephrops thomsoni var. *andamanica* — Alcock, 1901: 153.
Metanephrops andamanicus — Jenkins, 1972: 162, figs. 2-4 (p.p.); Ivanov & Krylov, 1980: 288 (p.p.); Phillips et al., 1980: 65 (p.p.); Holthuis, 1984: NEPH Metan2, unnumbered fig. (p.p.); Chan & Yu, 1987: 184 (key).
Nephrops sagamiensis — Bruce, 1966: 535 [non Parisi, 1917].

- Metanephrops sagamiensis* — Jenkins, 1972: 163, figs. 2-4 (p.p.); Phillips et al., 1980: 65 (p.p.) [non Parisi, 1917].
- [Not] *Nephrops andamanica* — Barnard, 1926: 127; Barnard, 1950: 528, fig. 99a; Kensley, 1981: 29 [= *Metanephrops mozambicus* Macpherson, 1990].
- [Not] *Nephrops andamanicus* — Yaldwyn, 1954: 730 (p.p.); Berry, 1969: 5, fig. 1; Crosnier & Jouannic, 1973: 13 [= *Metanephrops mozambicus* Macpherson, 1990].
- [Not] *Metanephrops andamanicus* — Jenkins, 1972: 162, figs. 2-4 (p.p.); Ivanov & Krylov, 1980: 288 (p.p.); Phillips et al., 1980: 65 (p.p.); Holthuis, 1984: NEPH Metan2, unnumbered fig. (p.p.); Williams 1986: 9, fig. 11 [= *Metanephrops mozambicus* Macpherson, 1990].
- [Not] *Nephrops andamanicus* — Holthuis, 1964: 71 [= *M. velutinus* sp. nov.].
- [Not] *Metanephrops andamanicus* — Phillips et al., 1980: 65 (p.p.); Carter et al., 1983: 4, unnumbered figs.; Anon., 1984: 46, fig. 1; Davis & Ward, 1984: 42, figs. 1, 3-5; Bremner, 1985: 39, figs. 1-3; Wallner & Phillips, 1988: 36, figs. 2-3; Macpherson, 1990: 294, figs. 2c-d, 3c-d [= *M. velutinus* sp. nov.].
- [?] *Nephrops andamanicus* — De Man, 1916: 99, pl. 3 fig. 15.
- [?] *Metanephrops andamanicus* — Bianchi, 1985: 148, unnumbered fig.

Material examined:

Andaman Sea — 342-749 m: 1 female 74 mm (cl. including rostrum; BMNH, Indian Museum exchange); 11°31'40"N 92°46'50"E, 348-370 m: 1 male 64 mm (cl. including rostrum; BMNH, Indian Museum exchange); 1 more spec. from Indian Museum (BMNH).
Burma, S.W. Rangoon, 250-320 m, 1983: 1 female 44.5 mm (RMNH).

Kenya — R.V. "Prof. Mesyatsev" stn 9, 3°02.7'S 40°30.5'E, 300 m, 22 December 1975: 1 male 62 mm, 1 ovigerous female 60 mm (RMNH); 3°01'S 40°32'E, 300 m, 15 August 1979: 1 male 68.5 mm (RMNH); Mombasa, 3°42'5"S 39°55'7"E, 350-360 m, "F. Mennes" stn 20, 23 March 1981: 1 male 61 mm (RMNH).

Tungsha Tao (Pratas, northern part of South China Sea) — 405-441 m, October 1989: 10 males 31-69.5 mm, 5 females 45.5-61.5 mm (IFRI).

Description. — Rostrum, with low and smooth dorsal carina, just exceeding to distinctly overreaching antennal peduncle. Always 3 pairs of post-rostral teeth present. Supraorbital horns with dorsal margin slightly convex to almost straight, short but stout and reaching from 1/3 to 2/3 of eyes, generally directed upwards and outwards but sometimes parallel with rostrum and even slightly curving inwards. Carapace rather obese in large individuals. Spines and tubercles on carapace from well-developed to small. Upper hepatic spine large or almost absent. Lateral post-cervical ridges finely granular to almost smooth and with or without anterior spine.

Big chelae generally broad, from subequal to strongly asymmetrical, distinctly ridged and covered with sharp tubercles; inner margin of palm without large spines and outer base of movable finger sometimes with a small tubercle. Carpus of big cheliped generally bluntly tubercular in addition to the presence of a few large spines which are mostly placed at the distal end and rarely are also present on the inner surface; merus with dorsolateral margin granular to tubercular and inner margin sharply granular to tubercular.

Articular surface of abdomen generally naked and smooth. Non-articular surface with broad to somewhat narrow but marked dorsal carina and shallow sculpture; raised parts naked and smooth while grooves broad but shallow. Tergite I sometimes with rudimentary dorsal carina at anterior 1/2, with

transverse furrow broadly interrupted medially. Main facades of tergites II and III broad and with large to moderately large posterior submedian notches; anterior margin usually horizontal (rarely slightly oblique), antero- and postero-lateral angles strongly projected laterally and sometimes joined with lateral facades (most often at II). Main facade of tergite IV well-defined but rather longitudinally elongated and often with outer margin somewhat right-angled. Posterior facades of tergites II to IV with small to large anterior submedian notches. Tergite V without lateral spine but sometimes with a minute tubercle, main facade generally broad and sometimes with margins poorly defined. Median ridge at tergite VI dorsally smooth. Posteriorly directed spines at tergite VI and tail-fan short (very short in large individuals), with those at lateral lobes of tergite VI far from the posterolateral grooves.

Coloration. — Body generally orange-red. Eyes black-brown with golden reflections. Antennal and antennular flagella red. Orbital margin to base of supraorbital horn and entire cervical groove covered with broad white bands (posterior half of rostrum also white in small individuals). Ventral part of carapace white and pink. Abdominal hinges white. Color at posterior borders of abdominal tergites deeper. Tail-fan also deeper colored but with posterior margin somewhat whitish. Big cheliped usually very slightly banded but sometimes distinctly banded with red and white in females. Pereiopods white or pink while pleopods pink to pink-red (color descriptions from photographs of Tungsha Tao material). Eggs dark blue when near hatching (Alcock, 1894b, 1901).

Distribution. — Indian Ocean and South China Sea but known with certainty only from Kenya, Andaman Sea, Burma, N.E. Sumatra and Tungsha Tao (see Remarks). Depths 250-749 m but mostly at 300-450 m.

Remarks. — The big chelipeds and abdominal sculpturation of the material from the different localities are very similar to each other. However, there are large variations in the development of the carapace spines and abdominal dorsal carina, particularly within the material from Tungsha Tao. The Indian Ocean material generally has the teeth and spines on the carapace well-developed and has a distinct (though sometimes small in the Kenya material) upper hepatic spine. The carapace spines, including the rostrum, are generally conspicuously less developed (particularly in large individuals) in the Tungsha Tao material, and the upper hepatic spine is sometimes (about 1/2) reduced to a small tubercle or rarely almost absent. The lateral post-cervical ridge is conspicuously granular and usually with a distinct anterior spine (except in some Kenya specimens) in the Indian Ocean material. While this ridge is finely granular and sometimes even almost smooth in the material from Tungsha Tao and rarely has a minute anterior spine. The abdominal dorsal carina of the Indian Ocean material is generally broad but both broad and somewhat narrow dorsal carinae are found in the Tungsha Tao material (about 2:1). Although the general appearance of some specimens from Tungsha Tao and the Indian Ocean is almost identical, an extensive com-

parison of more material from a range of localities, particularly from the topotypic area, will be of interest.

Although *M. andamanicus* has been widely reported in the Indo-West-Pacific (e.g., Berry, 1969; Jenkins, 1972; Phillips et al., 1980; Ivanov & Krylov, 1980; Holthuis, 1984; Davis & Wards, 1984; Williams, 1986; Macpherson, 1990), most of the previous records, including those of specimens fished commercially in the southern Indian Ocean, actually represent other species of the *M. japonicus* group (see *M. velutinus* and *M. mozambicus*). Of the male from the Bali Sea reported by De Man (1916) it is not certain whether it is the true *M. andamanicus* because of its intermediate locality and the illustrated carapace is similar to both the Tungsha Tao material and *M. velutinus* from the Philippines. Since De Man (1916: 101) had implied that the abdominal sculpture of his male was very similar to Wood-Mason's (1892) illustration, the Bali Sea specimen is tentatively assigned to *M. andamanicus*. However, it should be noticed that both Holthuis (1964) and Macpherson (1990) had also stated that their materials agreed well with the descriptions and figures of Wood-Mason (1892) and Alcock (1894a, b, 1901) but it is now found that their material is actually a different species.

The present study shows that *M. andamanicus* is actually quite poorly known. So far only three good topotypic specimens have been found by us in the British Museum (Natural History). The small female from Burma at the Rijksmuseum van Natuurlijke Historie, which we could have on loan, lacks big chelipeds and is not in a good condition. Prof. Holthuis informed us that the type of *M. andamanicus* (in Calcutta) is in a poor condition (Holthuis, in press). Without the abundant material from Tungsha Tao, the determination of the characteristics of *M. andamanicus* would be rather difficult and the separation of the closely related *M. velutinus* and *M. mozambicus* from it might have been impossible. More data on the distribution of these three closely related species will be of interest.

The size of *M. andamanicus* is quite large, and experimental trawlings at Tungsha Tao and probably Kenya (Ivanov & Krylov, 1980) showed that it may be of commercial potential. The coloration of *M. andamanicus* is distinct in the entire cervical groove being covered by a broad white band. Alcock (1894b, 1901) mentioned that the large chelipeds were banded in the present species. In the material from Tungsha Tao, however, only some females are distinctly banded. Such color pattern is quite similar to that of *M. thomsoni* (Bate, 1888) and probably this was one of the reasons why Alcock (1901) treated *M. andamanicus* as a variety of *M. thomsoni*.

***Metanephrops velutinus* sp. nov.** (pls. 2b, 4b, 6c, 8a, c, d)

Nephrops andamanicus — Holthuis, 1964: 71 [non Wood-Mason, 1892].

Metanephrops andamanicus (sensu Holthuis, 1964) — Jenkins, 1972: 162, figs. 2-4; Chan & Yu, 1987: 184 (key).

Metanephrops andamanicus — Phillips et al., 1980: 65 (p.p.); Carter et al., 1983: 4, unnumbered

figs.; Davis & Ward, 1984: 42, figs. 1, 3-5; Anon., 1984: 46, fig. 1; Bremner, 1985: 39, figs. 1-3; Wallner & Phillips, 1988: 36, figs. 2-3; Macpherson, 1990: 294, figs. 2c,d, 3c,d [non Wood-Mason, 1892].
 [?] *Nephrops andamanicus* — De Man, 1916: 99, pl. 3 fig. 15 [non Wood-Mason, 1892].

Material examined:

Holotype. — Philippines, "Musorstom 2" stn CP75, 13°51'N 120°30'E, 300-330 m, 1980: 1 male 48.5 mm (NTOU-PM1, MNHN exchange). Paratypes (Philippines) — Mindoro, "Musorstom 1, 2 and 3", 300-702 m; 8 males, 3 ovigerous females, 16 females (MNHN, details see Macpherson, 1990).

Western Australia — Great Australian Bight, South by West of Eucla, "Endeavour", 126.5°E, 238-348 m, 1909-1914: 1 male (E6250) 55.5 mm, 1 female (E6253) 45.5 mm (RMNH). N.W. Beagle Bay, "Soela", 15°13'S-15°15'S 121°08.9'E-121°06.5'E, 352 m, 11 February 1984, 1 ovigerous female 47 mm (WAM); N.W. Cape Leveque, "Soela", 14°49'S-14°50.8'S 121°36.1'E-121°35.6'E, 356 m, 12 February 1984, 1 female 52 mm (WAM); W. Broome, "Soela", 17°59.3'S-17°54'S 118°23'E-118°29'E, 389-390 m, 24 February 1984, 1 male 46 mm, 2 females 26.5, 33 mm (WAM).

Description. — Rostrum with low and smooth dorsal carina, slightly to distinctly exceeding antennal peduncle; 3 pairs of post-rostral teeth present. Supraorbital horns sharp and slender, with dorsal margin straight or nearly straight, extending to about middle of eye and directed upwards and outwards. Carapace with teeth well-developed but spines rather small. Upper hepatic spines small to completely absent. Lateral part of post-cervical ridge very finely granular and with or without minute anterior tubercle.

Big chelae subequal to strongly asymmetrical but generally broad, conspicuously ridged and covered with blunt tubercles; inner margin of palm lacking large spines and outer base of movable finger sometimes with a blunt tubercle. Carpus of big cheliped generally tubercular in addition to a few large spines which are mostly at distal end, but none at inner surface; merus with dorsolateral margin granular and inner margin sharply granular to tubercular.

Articular surface of abdominal somites anteriorly naked and smooth but the posterior 1/2 to 2/3 distinctly pubescent. Non-articular surface entirely covered with velvet-like hairs and with raised parts coarse. Dorsal carina narrow but conspicuous, also covered with pubescence. Sculpture on tergites obscured by pubescence, with grooves broad but shallow. Tergite I with short transverse furrows laterally. Main facades of tergites II and III broad and with moderately large posterior submedian notches; anterior margin horizontal to slightly concave, antero- and postero-lateral angles strongly projected and joined with lateral facades. Main facades of tergites IV and V broad (that of IV somewhat longitudinally elongated) but with margins sometimes indistinct. Lateral spine absent at tergite V but sometimes with a minute tubercle. Posterior facades of tergites II to IV with or without minute anterior submedian notches. Median ridge at tergite VI unarmed dorsally. Posteriorly directed spines at tergite VI and tail-fan sharp but short, with those at lateral lobes of tergite VI far from posterolateral grooves.

Coloration. — Several not very clear color photographs of the Western Australian material are provided by Carter et al. (1983) and Bremner (1985). It appears that the body of this species is generally orange-pink and the eggs are dark blue.

Type-locality. — Philippines, 13°51'N 120°30'E, 300-330 m.

Distribution. — Only known with certainty from the Philippines and Western Australia (from Cape Leveque to Eucla). Depths 238-702 m and mostly at 350-450 m (Carter et al., 1983; Davis & Ward, 1984; Wallner & Phillips, 1988).

Remarks. — The Western Australian material identified as *M. andamanicus* has long been suspected to be different from the typical form although they closely resemble each other (Holthuis, 1964; Jenkins, 1972; Chan & Yu, 1987; Bruce pers. comm.). However, the lacking of enough topotypic material hindered further comparisons. The availability of many *M. andamanicus* from different localities in the present study makes a full comparison of the two forms possible.

It is found that the Philippine material is very similar to that from Western Australia. In both the abdomen is entirely covered with velvet-like hairs even at the posterior 1/2 to 2/3 of the articular surface and dorsal carina (the Philippine population seems to be even more hairy than the Western Australian specimens). Dr. G. Morgan, Western Australian Museum, kindly helped us to check more material from various Western Australian localities and it seems that all specimens belong to the pubescent form. On the other hand, all *M. andamanicus* from the other localities have the articular surface and the raised parts at the non-articular surface of the abdomen naked and smooth. Only in some specimens from Tungsha Tao the posterior border of the articular surface at the abdominal tergite I is covered with pubescence. Moreover, the raised parts of the abdomen are rather coarse and the carapace (including the scaphocerite) is also more pubescent in the Philippine-Australian material.

Although the upper hepatic spine is generally absent (rarely as a rudimentary granule) in the Western Australian material (also see Holthuis, 1964), a small but distinct upper hepatic spine is sometimes present in the Philippine population (also see Macpherson, 1990). Since there are also large variations in the development of the upper hepatic spine in *M. andamanicus* (particularly those from Tungsha Tao), this character is unsuitable for separating the Philippine-Australian form from *M. andamanicus* as suggested by Holthuis (1964) and Chan & Yu (1987). There are some general differences in the size and shape of the teeth and spines on the carapace between the two forms. However, they are also rather variable and unreliable for distinguishing the two.

Nevertheless, the heavily pubescent abdomen of the Philippine-Australian form is very conspicuous and readily separates it from *M. andamanicus*. Thus, the Philippine-Australian form is treated as distinct. It should be noted that in a very recent report Macpherson (1990) treated the Philippine material as the

typical *M. andamanicus*. But Dr. Macpherson kindly informed us that in this work (1990) he assumed that the pubescence in the Andaman Sea specimens (BMNH) was removed for illustrations or examinations.

M. velutinus, which appears slightly larger than *M. armatus*, is fished commercially on the North West Shelf of Australia since 1985 (Wallner & Phillips, 1988, under the name of *M. andamanicus*). Its price is higher than that of the spiny lobsters in Australia and many are used for export; however, the demand of the local market has greatly increased recently (Bremner, 1985; Ward, Phillips pers. comm.). However, probably due to the low recovery rate of this lobster and the fact that the fishing gear is more selective for ovigerous females, the catch of the species has fallen significantly in the last few years (Wallner & Phillips, 1988). The biology of *M. velutinus* has been dealt with by Carter et al. (1983), Davis & Ward (1984), Anon. (1984), Bremner (1985) and Wallner & Phillips (1988).

Etymology. — The velvet-like pubescence which entirely covers the abdomen of this species is unique in the genus and earns it the name *velutinus*.

Metanephrops mozambicus Macpherson, 1990 (pls. 2d, 4d, 6b, 8b)

Nephrops andamanica — Barnard, 1926: 127; Barnard, 1950: 528, fig. 99a; Kensley, 1981: 29 [non Wood-Mason, 1892].

Nephrops andamanicus — Yaldwyn, 1954: 730 (p.p.); Berry, 1969: 5, fig. 1; Crosnier & Jouanin, 1973: 13 [non Wood-Mason, 1892].

Metanephrops andamanicus - Jenkins, 1972: 162, figs. 2-4 (p.p.); Ivanov & Krylov, 1980: 228 (p.p.); Phillips et al., 1980: 65 (p.p.); Holthuis, 1984; NEPH Metan 2, unnumbered fig. (p.p.); Williams, 1986: 9, fig. 11 [non Wood-Mason, 1892].

Metanephrops mozambicus Macpherson, 1990: 296, figs. 2a-b, 3a-b [type-locality: Madagascar]. [?] *Metanephrops andamanicus* — Bianchi, 1985: 148, unnumbered fig. [non Wood-Mason, 1892].

Material examined:

Madagascar (Mozambique Channel) — "Vauban" stn CH19, 12°38'S 48°15.5'E, 393-403 m, 18 January 1972: 1 ovigerous female 47.5 mm, paratype (NTOU, MNHN exchange); "Vauban", "Macarcignes III" and north of Tuléar, 310-605 m: 14 males, 3 ovigerous females, 9 females, holotype, allotype and paratypes (MNHN, details see Macpherson, 1990).

Mozambique — 1965: 1 male and 2 ovigerous females, paratypes (MNHN, same as those of Macpherson, 1990).

Description. — Rostrum almost lacking dorsal carina, long and well exceeding antennal peduncle. Three pairs of post-rostral teeth present. Supraorbital horns with dorsal margin very slightly convex, sharp and extending to about 1/2 of eye, directed upwards and parallel to rostrum. Carapace with teeth and spines well-developed. Upper hepatic spine large and prominent. Lateral post-cervical ridge finely granular and with anterior spine small or absent.

Big chelae broad and subequal, clearly ridged and covered with sharp tubercles; inner margin of palm without large spines and outer base of movable

finger sometimes with a small tubercle. Carpus of big cheliped generally bluntly tubercular in addition to a few large spines which are placed mostly at the distal end but none on the inner surface; merus with dorsolateral margin granular and inner margin sharply granular.

Articular surface of abdomen naked and smooth. Non-articular surface markedly naked and smooth, with broad and almost level dorsal carina and somewhat eroded sculpture; raised parts naked and smooth while grooves broad but shallow. Tergite I with short transverse furrows laterally. Main facades of tergites II and III broad and with lateral margin more or less joined with lateral facade, anterior margin horizontal and posterior submedian notches minute. Main facade of tergite IV broad and somewhat right-angled, with inner and outer margins more or less joined with other raised parts. Posterior facades of tergite II and VI with small to minute anterior submedian notches. Tergite V without lateral spine but sometimes with a small granule, essentially lacking dorsal carina and submedian longitudinal furrows; outer margin of main facade more or less joined with lateral facade. Median ridge of tergite VI dorsally smooth. Posteriorly directed spines at tergite VI and tail-fan moderately long but with those at lateral lobes of tergite VI failing to reach posterolateral grooves.

Coloration. — From a photograph of the Madagascar material, the color of this lobster appears to be much paler than that of *M. andamanicus* and with the body generally orange-pink.

Distribution. — Mozambique Channel from Natal, South Africa, to Mozambique and Madagascar. Depths 187-842 m, mostly at 400-500 m.

Remarks. — When describing the present species, Macpherson (1990) mainly discussed the differences between the Madagascar and Philippine material. It is now found that the Philippine form is actually not *M. andamanicus* but a new species *M. velutinus*. Since *M. mozambicus* is more closely related to *M. andamanicus* than to *M. velutinus*, most of the characteristics suggested by Macpherson (1990) become inappropriate to separate *M. mozambicus* from *M. andamanicus*.

The main difference between *M. mozambicus* and *M. andamanicus* is that the dorsal carina and the other sculpturation of the abdomen of the former species is somewhat eroded. In the Madagascar form, the dorsal carinae at the abdominal tergites II to IV are almost level (only that of III is readily noticeable to the touch) and it is completely absent at V. Furthermore, the submedian longitudinal furrows (i.e. in the position of the dorsal carina) at the abdominal tergite V are almost absent and they are more or less discontinuous at tergite IV. On the other hand, the dorsal carina in *M. andamanicus* is conspicuously elevated at the abdominal tergites II to V and the main facades of the tergites IV and V are generally well-separated from the dorsal carina. The dorsal carina at abdominal tergite II in some Kenya specimens is rather low, but it is still distinct to the touch. Furthermore, a pair of large posterior subme-

dian notches are always present at the main facades of abdominal tergites II and III in *M. andamanicus* but they are minute in the Madagascar form. Since the differences discussed above are found to be very constant, it is justified to continue treating the Mozambique Channel material as a different species.

It is interesting that the figures of "*M. andamanicus*" provided by Berry (1969) from South Africa, Holthuis (1984) from the Western Indian Ocean and Bianchi (1985) from Tanzania have the abdominal sculpture somewhat intermediate between the Madagascar and the typical forms. Prof. Holthuis kindly informed us that his 1984 and Bianchi's (1985) figures were copied from the original illustration of Wood-Mason (1892). It is highly likely that Berry's (1969) figure was incorrectly illustrated because Dr. Macpherson told us that the South African material (which he had seen in Cape Town) is almost identical with the Madagascar population. Furthermore, Barnard (1950) stated that the transverse furrow at abdominal tergite I was uninterrupted in the South African material and most probably this is also incorrect.

The somewhat eroded abdominal sculpture of *M. mozambicus* shows some similarities to that of *M. formosanus*. But these two species can be readily separated by the large chelae of the latter being armed with many large spines. Moreover, the abdominal sculpturation of *M. formosanus* is even simpler and has the transverse furrow at tergite II usually continuous.

M. mozambicus appears to occur only in the Mozambique Channel. All the specimens from Kenya examined in this study are the true *M. andamanicus*. However, it is not known to which species the Tanzania material belongs. It will be of interest to know the exact distribution of these two species in the Western Indian Ocean. *M. mozambicus* is fished commercially in South Africa (e.g. Holthuis, 1984; Williams, 1986 under the name of *M. andamanicus*) and experimental trawling in Madagascar also showed that it may be of commercial potential there (Crosnier & Jouannic, 1973). The amount of *M. mozambicus* landed, is perhaps the largest in the genus and the stock of this lobster appears to be not affected yet (see Holthuis, 1984; Williams, 1986). The size of *M. mozambicus* is similar to that of *M. velutinus*. It is also mainly used for export and is more expensive than spiny lobsters (Carter et al., 1983). The biology of *M. mozambicus* was dealt with by Berry (1969) and Von Cosel (1987, cf. Macpherson, 1990).

ACKNOWLEDGEMENTS

This contribution forms part of a project for the study of the Decapod Crustacea of Taiwan, supported by a research grant of the National Science Council, R.O.C.

Grateful acknowledgement is extended to Prof. L. B. Holthuis of the Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands for discussions with the first author on many aspects of the *M. japonicus* group and providing

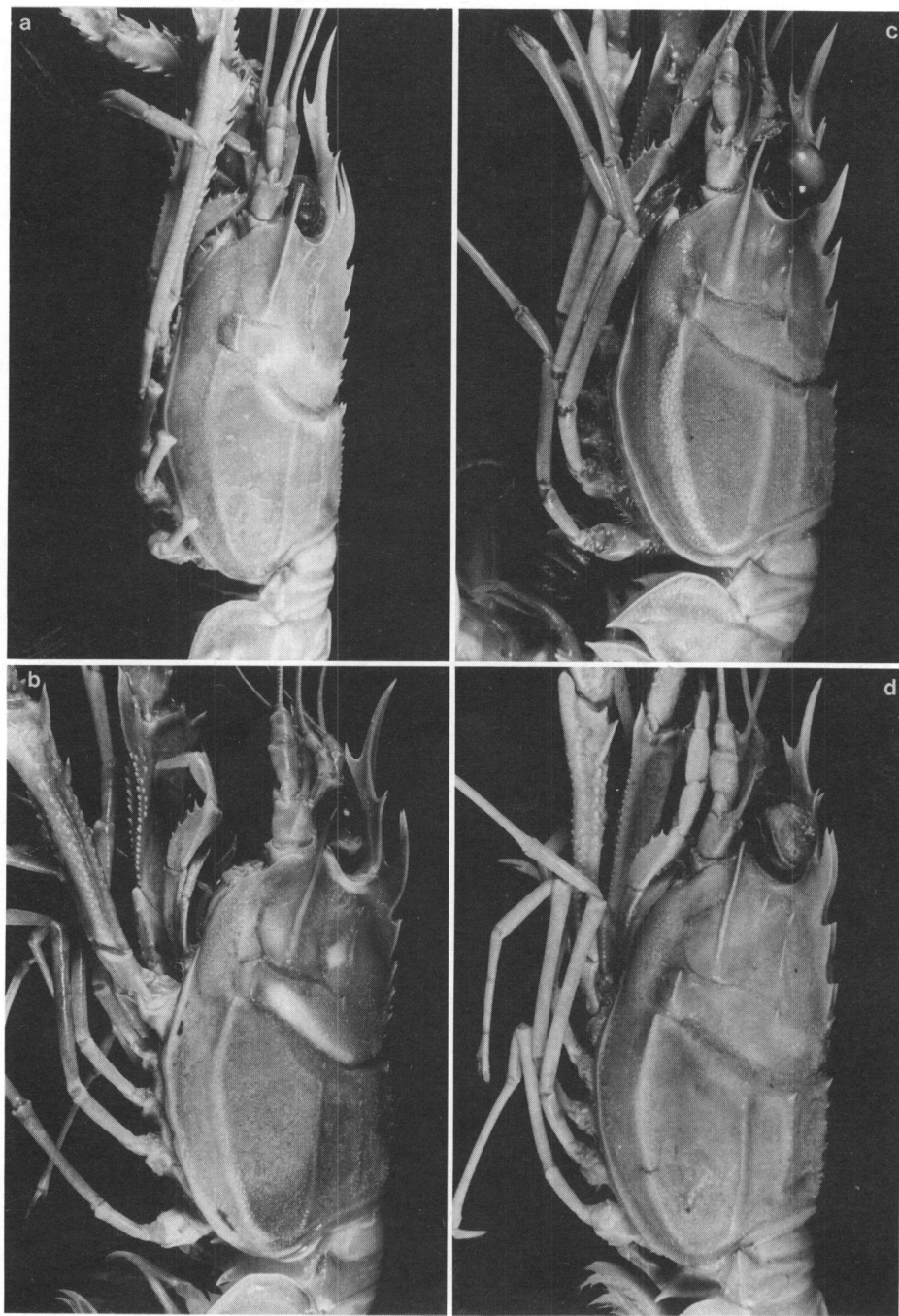
with us his lobster catalogue manuscript as well as many other valuable information and references. Special thanks is extended to Dr. A. Crosnier of the Muséum National d'Histoire naturelle, Paris, France for providing much valuable information and for allowing the first author to examine the collection in his museum and for the exchange of some material; Dr. E. Macpherson of the Instituto de Ciencias del Mar, Barcelona, Spain for enthusiastically discussing with us the relationships between the species of the *M. andamanicus* complex and for reviewing part of our manuscript, also lending us the photographs of a topotypic *M. andamanicus* specimen; Mr. D. A. Lee of the Taiwan Fisheries Research Institute, Keelung, for lending us all his *Metanephrops* material and their photographs. We also wish to thank Dr. C. H. J. M. Fransen of the Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands for allowing the first author to examine his collection and for the loan of some specimens; Dr. G. Morgan of the Western Australian Museum, Perth, Australia, for sending us some material and helping us to check on more Western Australian material; Dr. A. J. Bruce of the Northern Territory Museum of Arts and Sciences, Darwin, Australia for discussing with us the Western Australian form; Prof. J. Forest of the Muséum National d'Histoire naturelle, Paris, France, for regenerating a *M. japonicus* specimen for the first author to examine; Mr. P. Clark of the British Museum (Natural History), for allowing the first author to examine the collection at his museum; Dr. M. Takeda of the National Science Museum, Tokyo, for allowing us to examine his collection and giving us a *M. sagamiensis* specimen; Mr. J. Y. Shy of our laboratory for drawing the figures and the Ministère des Affaires Étrangères, Paris, France, for providing a short-term research grant to the first author to study in the Muséum National d'Histoire naturelle and making the present work possible.

REFERENCES

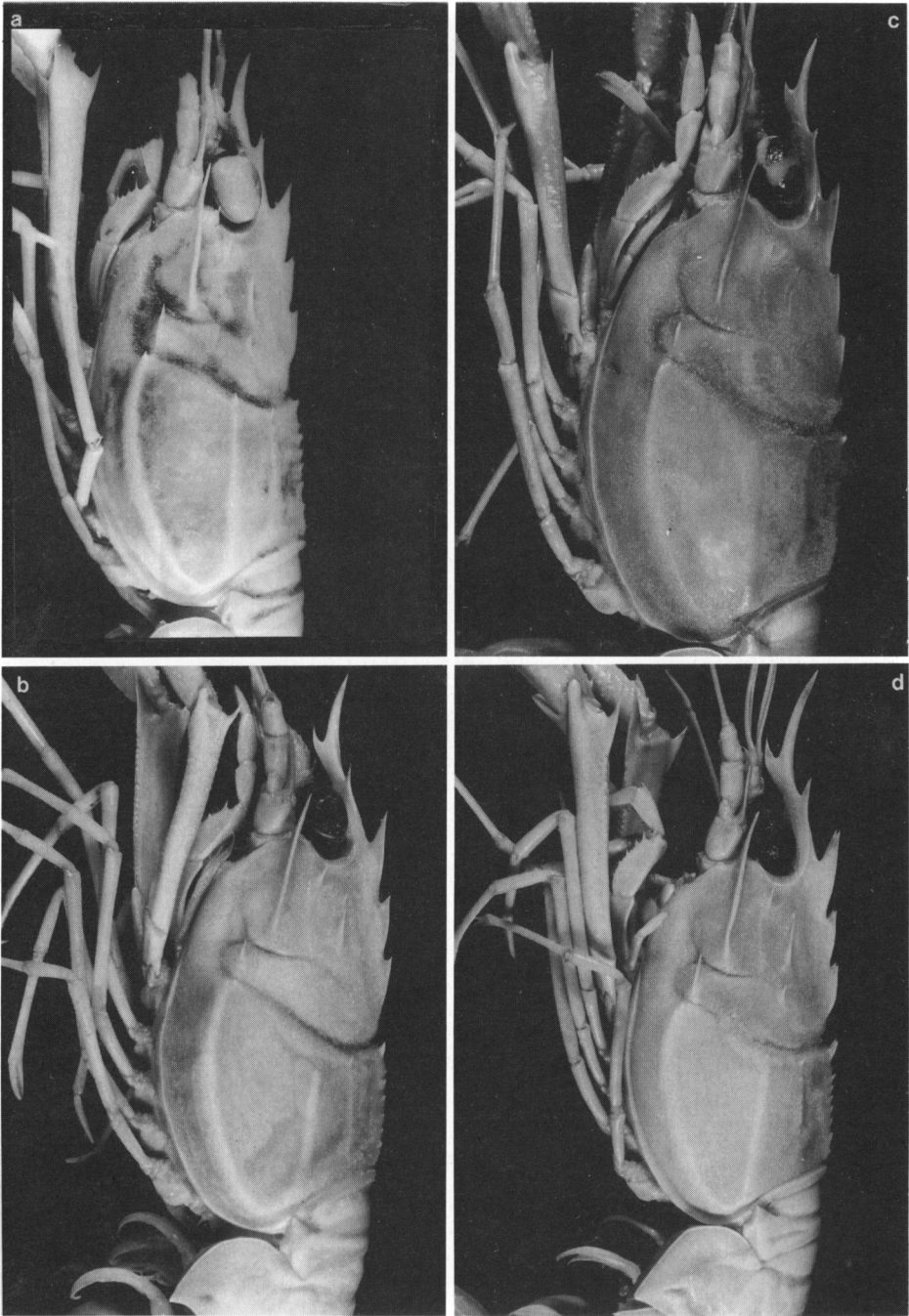
- ALCOCK, A., 1894a. Crustacea. Part II. Illustrations of the zoology of the Royal Indian marine surveying steamer Investigator: pl. 8. (Calcutta).
 —, 1894b. Natural history notes from H.M. Indian marine survey steamer Investigator, commander R. F. Hoskyn, R.N. commanding. Series II., No. 1. On the results of deep-sea dredging during the season 1890-91. Ann. Mag. nat. Hist., (6) 13: 225-245.
 —, 1901. A descriptive catalogue of the Indian deep-sea Crustacea Decapoda Macrura and Anomala in the Indian Museum. Being a revised account of the deep-sea species collected by the Royal Indian marine survey ship Investigator: i-iv, 1-286, pls. 1-3. (Calcutta).
 ANONYMOUS, 1973. Picture encyclopedia, (ed. 3) 6: 1-239, unnumbered figs. and pls. (Gakken, Tokyo, in Japanese).
 —, 1983. CSIRO finds scampi and carid prawns on NW shelf. Australian Fisher., 42 (3): 13, unnumbered fig.
 —, 1984. Biology of *Metanephrops* species. Australian Fisher., 43 (8): 46-47, figs. 1-3.
 BABA, K., 1986. Reptantia Macrura, Anomura and Brachyura. In: K. BABA, K.-I. HAYASHI & M. TORIYAMA (eds.), Decapod crustaceans from continental shelf and slope around Japan: 1-336, figs. 1-22, colour photogr. 1-176. (Jap. Fish. Res. Conserv. Ass., Tokyo).

- BALSS, H., 1914. Ostasiatische Decapoden II. Die Natantia und Reptantia. In: F. DOFLEIN (ed.), Beiträge zur Naturgeschichte Ostasiens. Abh. Bayer. Akad. Wiss., (2) (suppl.) **10**: 1-101, figs. 1-50, pl. 1.
- , 1921. Diagnosen neuer Decapoden aus den Sammlungen der Deutschen Tiefsee-Expedition und der japanischen Ausbeute Dofleins und Haberers. Zool. Anz., **52**: 175-178.
- , 1925. Macrura der Deutschen Tiefsee-Expedition. I. Palinura, Astacura und Thalassinidea. Wiss. Ergebn. Deutschen Tiefsee-Exped., **20**: 189-216, figs. 1-16, pls. 1, 2.
- BARNARD, K. H., 1926. Report on a collection of Crustacea from Portuguese East Africa. Trans. Roy. Soc. South Africa, **13**: 119-129, pls. 10-11.
- , 1950. Descriptive catalogue of South African decapod Crustacea. Ann. South African Mus., **38**: 1-837, figs. 1-154.
- BERRY, P. F., 1969. The biology of *Nephrops andamanicus* Wood-Mason (Decapoda, Reptantia). South African Ocean. Res. Inst. Invest. Rep., **22**: 1-55, figs. 1-26.
- BIANCHI, G., 1985. FAO species identification sheets for fishery purposes. Field guide to the commercial marine and brackish-water species of Tanzania: i-xiii, 1-199, unnumbered figs., pls. 1-32. (Rome, FAO).
- BREMNER, H. A., 1985. CSIRO food researchers look at scampi. Australian Fisher., **44** (3): 39-42, figs. 1-5.
- BRUCE, A. J., 1966. Distribution of the genus *Nephrops* (Crustacea, Decapoda, Macrura) in the Indo-Pacific region. Nature, London, **209** (5022): 535.
- BURUKOVSKII, R. N., 1983. Key to shrimps and lobsters. Russian translation series, **5**: i-xi, 1-174, figs. 1-189. (A. A. Balkema, Rotterdam).
- CARTER, D., J. G. H. MAXWELL & C. BOWTELL, 1983. "Cautious optimism" over potential scampi fishery on NW shelf. Australian Fisher., **42** (11): 2-12, unnumbered figs. and pls.
- CHAN, T. Y. & H. P. YU, 1987. *Metanephrops formosanus* sp. nov., a new species of lobster (Decapoda, Nephropidae) from Taiwan. Crustaceana, **52** (2): 172-186, fig. 1, pls. 1-2.
- , 1988. Clawed lobsters (Crustacea, Decapoda, Nephropidae) of Taiwan. Bull. Inst. Zool., Academia Sinica, **27** (1): 7-12, pl. 1.
- CHANG, C. M., 1965. Edible Crustacea of Taiwan: i-ii, 1-60, figs. 1-50. (Chinese-American joint commission on rural reconstruction. Taipei, Taiwan; in Chinese).
- CROSNIER, A. & C. JOUANNIC, 1973. Note d'information sur les prospections de la pente continentale malgache effectuées par le N.O. "Vauban". Doc. scient. Cent. ORSTOM Nosy Bé, **42**: 1-18, fig. 1, pls. 1-4.
- DAVIS, T. L. O. & T. J. WARD, 1984. CSIRO find two new scampi grounds off the North West Shelf. Australian Fisher., **43** (8): 41-45, figs. 1-6, unnumbered pls.
- DOFLEIN, F., 1902. Ostasiatische Decapoden. Abh. Bayer. Akad. Wiss., (2) **21**: 613-670, figs. 1-4, pls. 1-6.
- HIRAMOTO, K., 1987. Observations on the behaviour and ecology of the Japanese lobster, *Metanephrops japonicus*, in Sagami Bay. Jamstecr Deepsea Research, **1987**: 121-126, figs. 1-4, pl. 1. (In Japanese).
- HOLTHUIS, L. B., 1964. On some species of the genus *Nephrops* (Crustacea Decapoda). Zool. Meded. Leiden, **39**: 71-78, fig. 1.
- , 1984. Lobsters. FAO species identification sheets, Western Indian Ocean (Fishery Area 51), **5**: unnumbered pp. & figs.
- , in press. FAO species catalogue. Lobsters of the world.
- IVANOV, B. G. & V. V. KRYLOV, 1980. Length-weight relationship in some common prawns and lobsters (*Macrura*, *Natantia* and *Reptantia*) from the Western Indian Ocean. Crustaceana, **38** (3): 279-289.
- JENKINS, R. J. F., 1972. *Metanephrops*, a new genus of late pliocene to recent lobsters (Decapoda, Nephropidae). Crustaceana, **22** (2): 161-177, figs. 1-4, pls. 1-2.
- KENSLEY, B., 1981. On the zoogeography of southern African decapod Crustacea, with a distribution checklist of the species. Smithsonian Contrib. Zool., **338**: i-iii, 1-64, fig. 1.
- KUBO, I., 1970. *Macrura*. In: Y. K. OKADA & T. UCHIDA (eds.), Encyclopedia Zoologica illustrated in colours. (ed. 10) **4**: 93-113, pls. 49-56. (Hokuryukan, Tokyo; in Japanese).
- , 1971. *Macrura*. In: Y. K. OKADA, S. UCHIDA & T. YCHIDA (eds.), New illustrated encyclopedia of the fauna of Japan. (ed. 3) **2**: 591-629, unnumbered figs. (Hokuryukan, Tokyo; in Japanese).

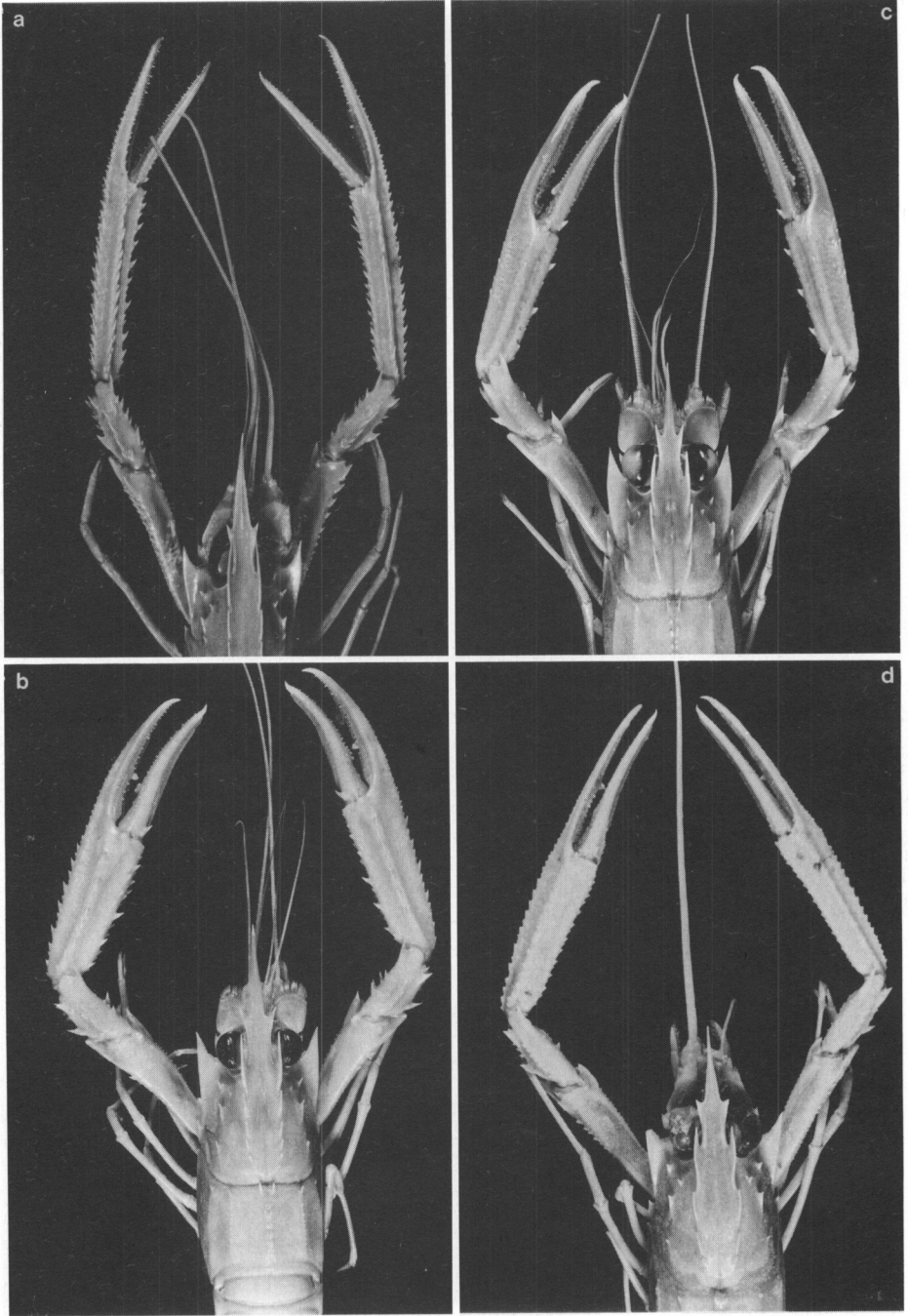
- MACPHERSON, E., 1990. Crustacea Decapoda: On a collection of Nephropidae from the Indian Ocean and Western Pacific. In: A. CROSSNER (ed.), *Résultats des Campagnes MUSORSTOM*, Vol. 6. *Mém. Mus. nat. Hist. nat. Paris*, (A) **145**: 289-329, figs. 1-17.
- MAN, J. G. DE, 1916. The Decapoda of Siboga Expedition. Part III. Families Eryonidae, Palinuridae, Scyllaridae and Nephropsidae. *Siboga Exped. Monogr.*, **39(a)**(2): 1-122, pls. 1-4.
- MITANI, I., T. SHIMIZU & M. KAMEI, 1984. Some biological aspects of Japanese lobster, *Nephrops japonicus*, in Sagami Bay-II. *Kanagawa Fish. Exp. Stn. Res. Rep.*, **6**: 11-16, figs. 1-7. (In Japanese).
- MIYAKE, S., 1982. Japanese crustacean decapods and stomatopods in color. I. Macrura, Anomura and Stomatopoda: i-vii, 1-261, unnumbered figs., pls. 1-56. (Hoikushua, Osaka; in Japanese).
- ORTMANN, A., 1891. Die Decapoden-Krebse des Strassburger Museums, mit besonderer Berücksichtigung der von Herrn Dr. Döderlein bei Japan und den Liu-Kiu-Inseln gesammelt und z.Z. im Strassburger Museum aufbewahrten Formen. III. Theil. Die Abteilungen der Reptantia Boas: Homaridea, Loricata und Thalassinidea. *Zool. Jb. Syst.*, **6**: 1-58, pl. 1.
- , 1897. Carcinologische Studien. *Zool. Jb. Syst.*, **10**: 258-372, pl. 17.
- PARISI, B., 1917. I Decapodi giapponesi del Museo di Milano. V. Galatheida e Reptantia. *Atti Soc. Ital. Sci. Nat.*, **56**: 1-24, figs. 1-7.
- PHILLIPS, B. F., J. S. COBB & R. W. GEORGE, 1980. General biology. In: J. S. COBB & B. F. PHILLIPS (eds.), *The biology and management of lobsters*, **1**: 1-82, figs. 1-23. (Acad. Press, New York).
- SHIMIZU, T., I. MITANI & M. KAMEI, 1984. Some biological aspects of Japanese lobster, *Nephrops japonicus*, in Sagami Bay-I Fluctuation of resource based on catch data. *Kanagawa Fish. Exp. Stn. Res. Rep.*, **6**: 7-10, figs. 1-4. (In Japanese).
- TAKEDA, M., 1982. Keys to the Japanese and foreign crustaceans, fully illustrated in colors: i-vi, 1-284, unnumbered figs., pls. (Hokuryukan, Tokyo; in Japanese).
- TAPPARONE-CANEFRI, C., 1873. Ritorno ad una nuova specie di *Nephrops*, genere di Crostacei decapodi Macruri. *Mem. R. Accad. Sc. Torino*, (2) **28**: 1-7, pl. 1.
- WALLNER, B. & B. PHILLIPS, 1988. From scampi to deepwater prawns: developments in the North West Shelf deepwater trawl fishery. *Australian Fisher.*, **9**: 34-38, figs. 1-3.
- WILLIAMS, A. B., 1986. Lobsters-identification, world distribution, and U.S. trade. *Mar. Fish. Rev.*, **48** (2): 1-36, figs. 1-80.
- WOOD-MASON, J., 1892. Crustacea. Part I. Illustrations of the zoology of the Royal Indian marine surveying steamer Investigator: pls. 1-5. (Calcutta).
- YALDWYN, J. C., 1954. *Nephrops challengerii* Balss, 1914 (Crustacea, Decapoda, Reptantia) from New Zealand and Chatham Island waters. *Trans. R. Soc. New Zealand*, **82** (3): 721-732, figs. 1-2.
- YOSHIDA, H., 1941. Important marine shrimps and lobsters of Tyosen (Korea). *Bull. Fish. Exp. Stn. Tyosen.*, **7**: 1-36, figs. 1-15, pls. 1-13. (In Japanese).



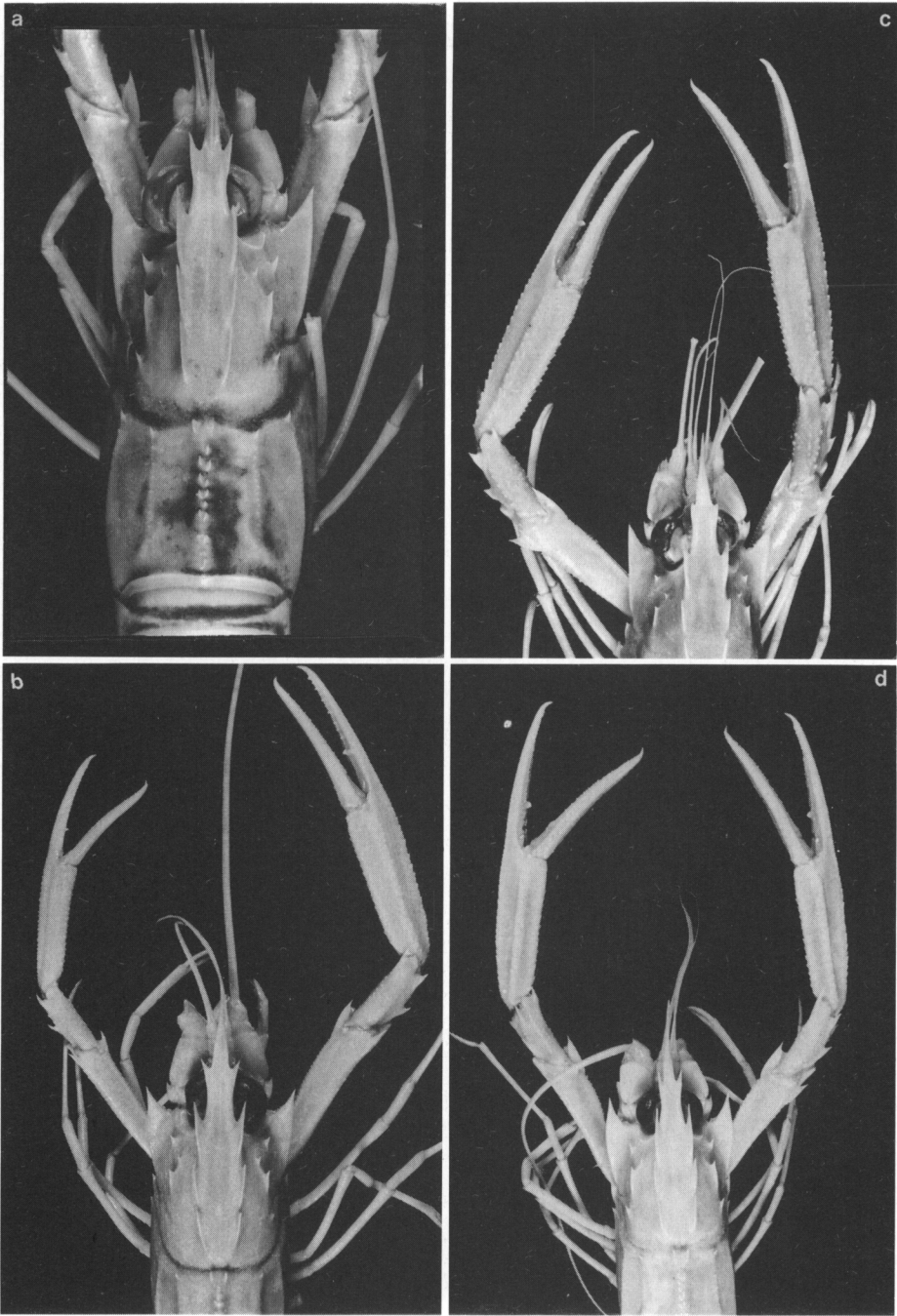
Pl. 1. Lateral view of carapace. a, *Metanephrops japonicus*, 44.5 mm, female, Japan; b, *M. armatus* sp. nov., holotype male, 57 mm, Su-Ao, Taiwan; c, *M. formosanus*, 37 mm, male, Taiwan; d, *M. sagamiensis*, 60 mm, male, Japan.



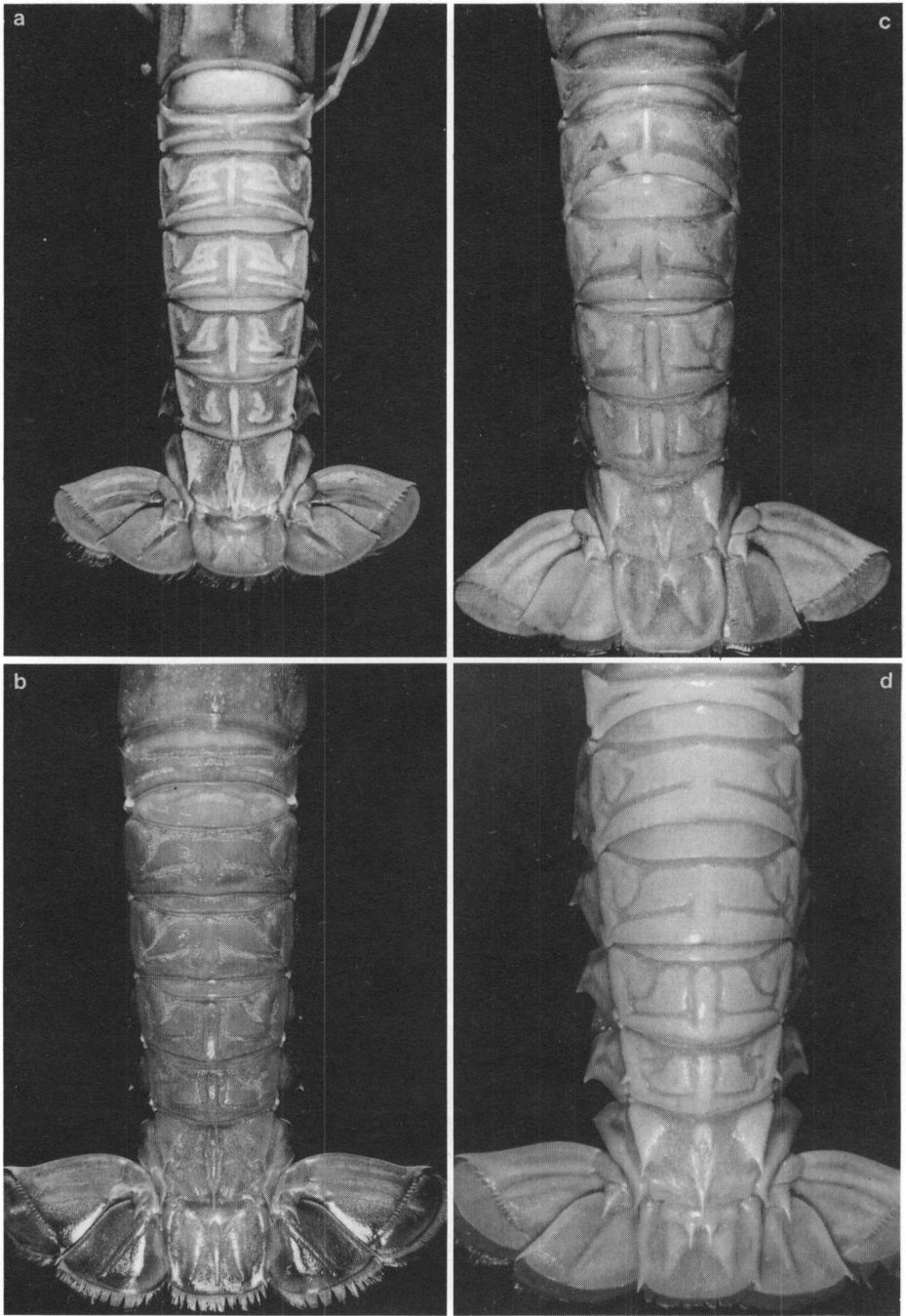
Pl. 2. Lateral view of carapace. a, *Metanephrops andamanicus*, 64 mm (cl. including rostrum), male, Andaman Sea; b, *M. velutinus* sp. nov., holotype male, 48.5 mm, Philippines; c, *M. andamanicus*, 65 mm, male, Tungsha Tao; d, *M. mozambicus*, paratype ovigerous female, 47.5 mm, Madagascar.



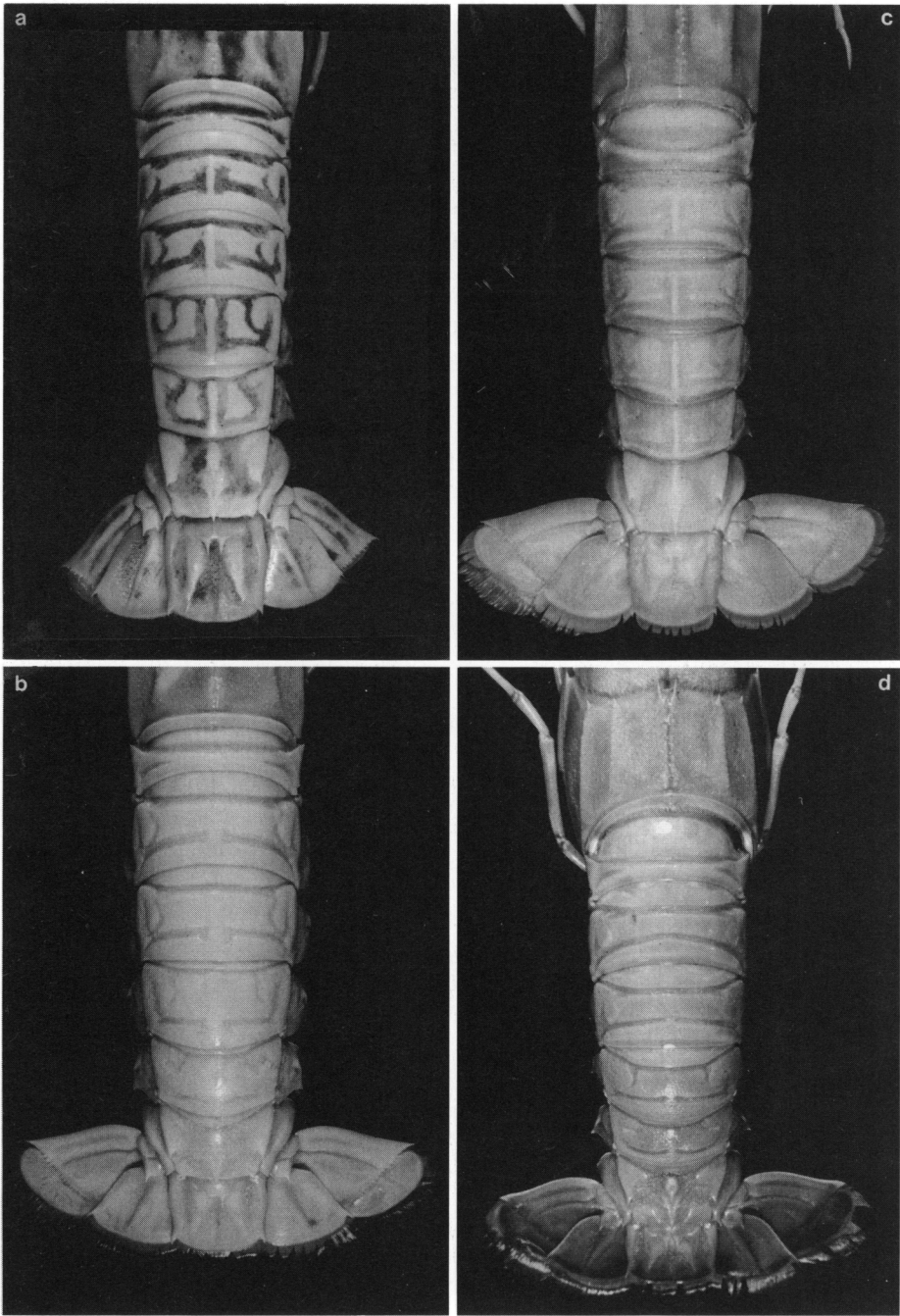
Pl. 3. Dorsal view of anterior carapace and large chelipeds. a, *Metanephrops japonicus*, 44.5 mm, female, Japan; b, *M. armatus* sp. nov., paratype male, 48 mm, Tai-Shi, Taiwan; c, *M. formosanus*, 37 mm, male, Taiwan; d, *M. sagamiensis*, 60 mm, male, Japan.



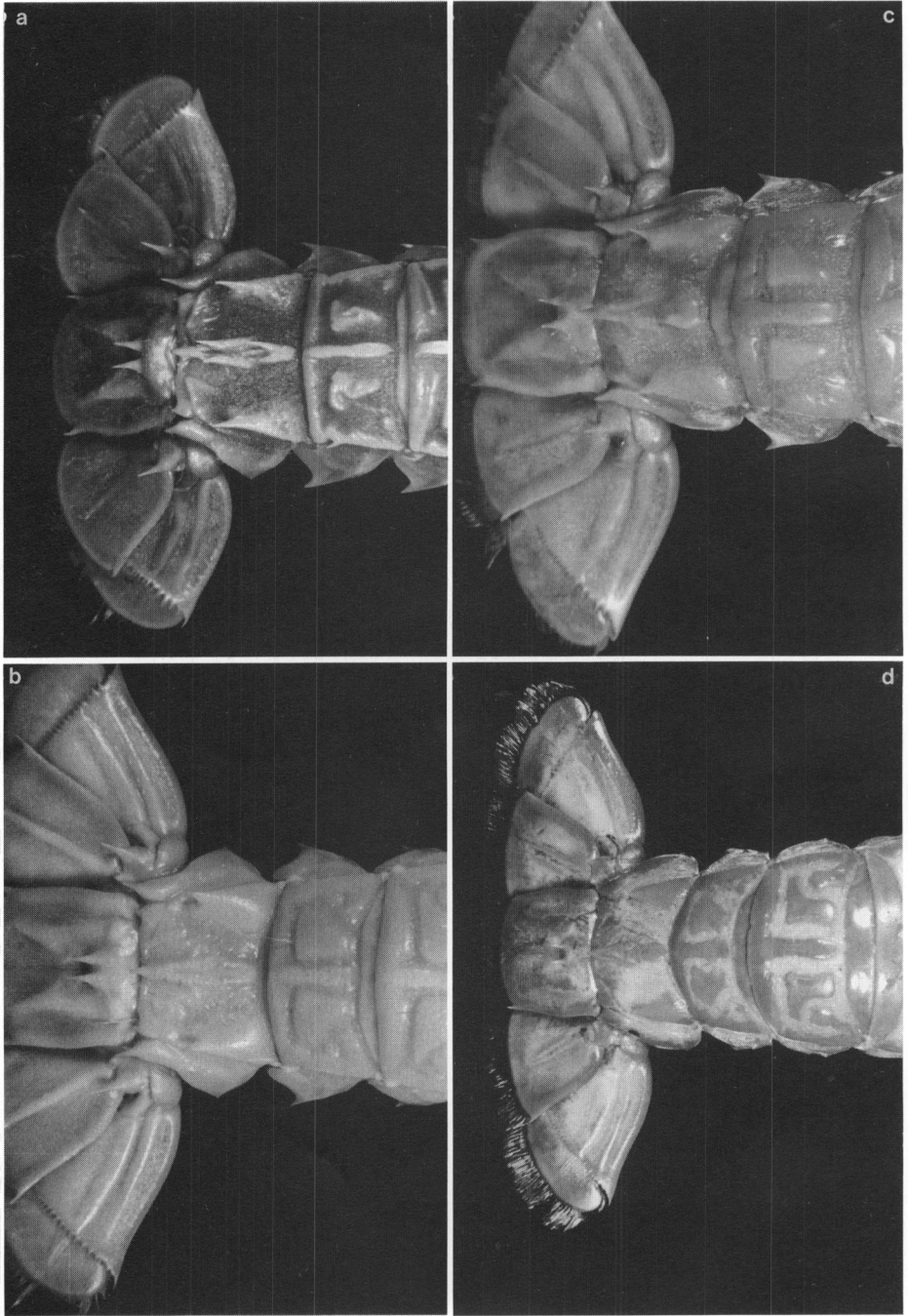
Pl. 4. Dorsal view of anterior carapace and large chelipeds. a, *Metanephrops andamanicus*, 64 mm (cl. including rostrum), male, Andaman Sea; b, *M. velutinus* sp. nov., holotype male, 48.5 mm, Philippines; c, *M. andamanicus*, 59 mm, male, Tungsha Tao; d, *M. mozambicus*, paratype ovigerous female, 47.5 mm, Madagascar.



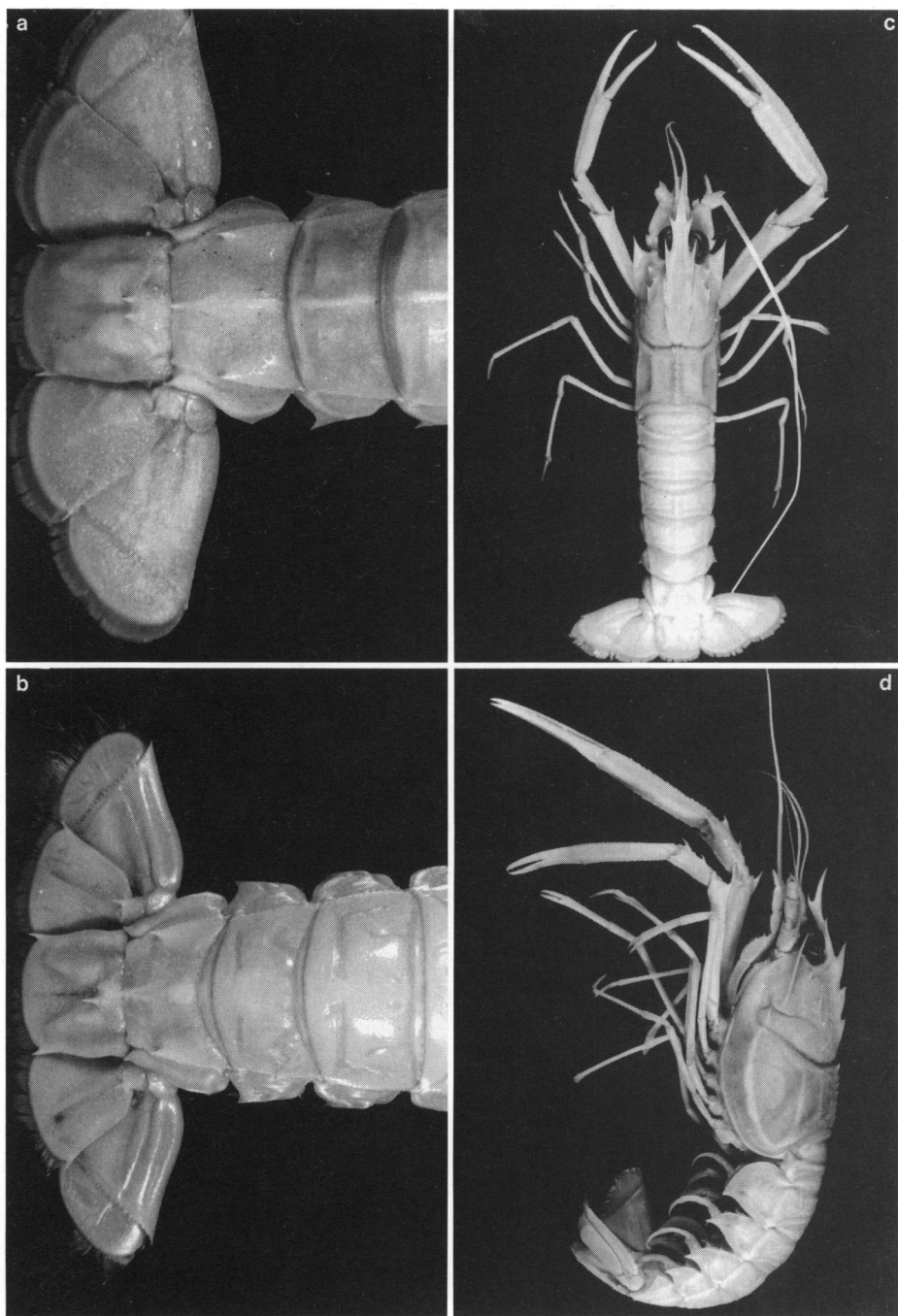
Pl. 5. Dorsal view of abdomen. a, *Metanephrops japonicus*, 44.5 mm, female, Japan; b, *M. armatus* sp. nov., holotype male, 57 mm, Su-Ao, Taiwan; c, *M. sagamiensis*, 60 mm male, Japan; d, *M. armatus* sp. nov., paratype ovigerous female, 40 mm, Tai-Shi, Taiwan.



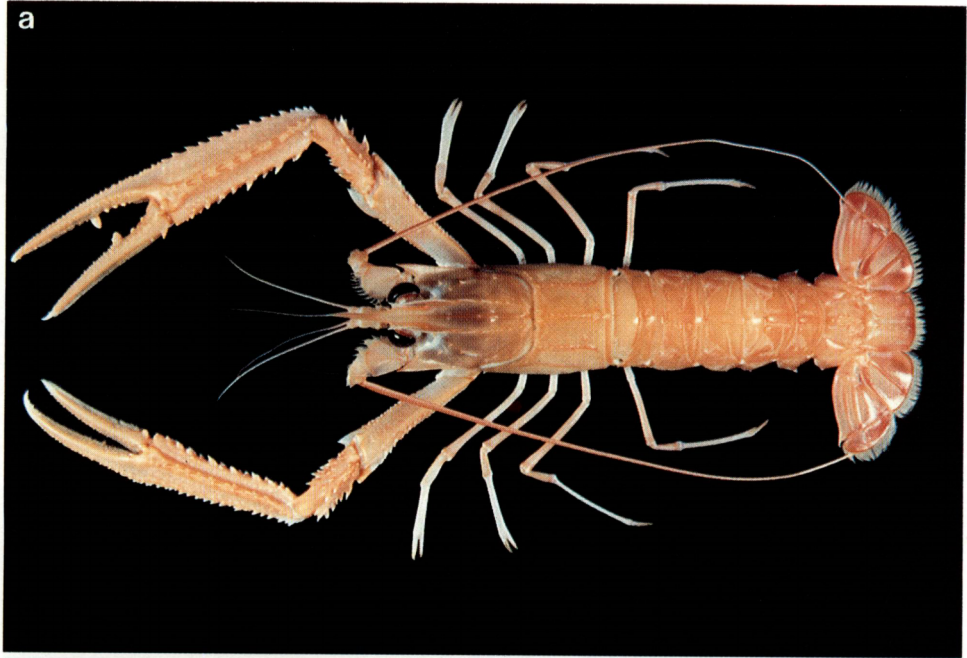
Pl. 6. Dorsal view of abdomen. a, *Metanephrops andamanicus*, 64 mm (cl. including rostrum) male, Andaman Sea; b, *M. mozambicus*, paratype ovigerous female, 47.5 mm, Madagascar; c, *M. velutinus* sp. nov., holotype male, 48.5 mm, Philippines; d, *M. formosanus*, 37 mm, male, Taiwan.



Pl. 7. Dorsal view of posterior abdomen and tail-fan. a, *Metanephrops japonicus*, 44.5 mm, female, Japan; b, *M. armatus* sp. nov., paratype male, 48.5 mm, Tai-Shi, Taiwan; c, *M. sagamiensis*, 60 mm, male, Japan; d, *M. andamanicus*, 61 mm, male, Kenya.



Pl. 8. a, b, dorsal view of posterior abdomen and tail-fan. a, *Metanephrops velutinus* sp. nov., holotype male, 48.5 mm, Philippines; b, *M. mozambicus*, paratype ovigerous female, 47.5 mm, Madagascar. c, d, *Metanephrops velutinus* sp. nov., holotype male, 48.5 mm, Philippines. c, dorsal view; d, lateral view.



Pl. 9. *Metanephrops armatus* sp. nov., holotype male 57 mm, Su-Ao, Taiwan. a, dorsal view; b, lateral view.