Observations on *Metanephrops neptunus* (Bruce, 1965) (Crustacea: Astacidea: Nephropidae) from the Pratas Islands, South China Sea

Ming-Chih Huang, Tadashi Kawai

**Abstract.**— The Neptune lobster, *Metanephrops neptunus* (Bruce, 1965), is reported from 300–600 m depths off the Pratas Islands southwest of Taiwan in the South China Sea. Seven males and three ovigerous females were captured in July 2019. Key morphological features and internal structures are described, with particular attention to the chelae, mandibles, gills, cephalothoracic and abdominal sculpturing, and gastric mills. The red-and-white coloration is described and illustrated from fresh specimens. The geographic range, depth of occurrence, stomach contents, and fecundity of the species are also noted.

**Key words:** distribution, gastric mill, gill, morphology, red-headed lobster, stomach contents

**Introduction**

In July 2019, we were able to obtain several deep-sea lobsters of a species that has been attracting the attention of fishermen in Keelung, northern Taiwan. These lobsters, bought at a fish market in Keelung, belong to the little-known species *Metanephrops neptunus* (Bruce, 1965), also called the “Neptune lobster” or, in Australia, “Neptune’s scampi”. Its Taiwanese vernacular name is “jinsigao” and its Mandarin name translates as “red-headed lobster”.

The original description of *M. neptunus* was based on two specimens whose state of maturity was unknown, and morphological information on adult individuals of the species is still needed (Bruce, 1965). Biological information of any sort concerning *M. neptunus* is scarce despite its possible importance for fisheries.

The new material, comprising ovigerous females and similarly sized, presumably adult, males, is from deep water in the Pratas Islands (Dongsha Islands in Mandarin). These islands consist of one emergent and two submerged atolls in the northern South China Sea. They are under the control of the Republic of China (Taiwan) and in part comprise the Dongsha Marine National Park (Dai, 2004). The present specimens were taken from waters outside the protected area. Based on these specimens, we provide an illustrated description of systematically important parts of the external and internal morphology of *M. neptunus*, including the mandibles, gills, and gastric mill, as well as color photographs. The stomach contents, which can provide significant clues as to diet and feeding habits, were also recorded, along with fecundity and egg size.

**Materials and Methods**

Ten specimens of *Metanephrops neptunus* were bought at the Zhengbin Fishing Harbor in Keelung, Taiwan, by MCH on 17 July 2019. According to information from fishermen, coupled with the GPS record of the fishing vessel involved, these lobsters were captured in wa-
ters of the Pratas Islands about 430 km southwest of Kaohsiung, Taiwan (Fig. 1). They were preserved on ice on board the ship and then stored at ~ 20°C in the laboratory. This allowed us to observe the fresh body color.

The gastric mills, mandibles, and gills of one ovigerous female (CL = 105.4 mm) were dissected and illustrated according to Hobbs (1987, 1988) and Grown & Richardson (1990). Digital photographs of dissected body parts were taken using a stereoscopic dissecting microscope (SMZ1500, Nikon, Tokyo, Japan) equipped with a CCD system connected to a computer with imaging software (NIS element D, Nikon, Tokyo, Japan). Prints of these photographs were traced with a pen to produce hand stippling drawings (software Adobe Illustrator CC), which were then scanned and arranged into the figure plates presented here.

Measurements and abbreviations in the text are as follows: TL—total body length (from anterior tip of rostrum to posterior end of telson), AL—abdomen length, CL—cephalothorax length (from posterior margin of eye socket to posterior end of median line of carapace) (Szaniawska et al., 2005). The specimens are deposited in the National Taiwan Museum, Taipei (TMCD). The morphological terminology used in this paper was adopted from Brössing (2010) and Morgan (1986, 1997).

**Taxonomy**

Superfamily **Nephropoidea** Dana, 1852  
Family **Nephropidae** Dana, 1852  
Genus **Metanephrops** Jenkins, 1972  
**Metanephrops neptunus** (Bruce, 1965)  
Figs. 2–5

**Nephrops neptunus** Bruce, 1965: 274, pls 13–15 (type-locality: South China Sea).  
**Metanephrops neptunus**: Jenkins, 1972: 171.–Chan and Yu, 1987: 184.–Macpherson, 1990: 299.–Holthuis, 1991: 76, figs. 148–149.

**Material examined**

Three ovigerous females (TMCD003316, 003319, and 003321), CL respectively 105.4, 104.9, and 120.8 mm, TL respectively 245.8, 249.0, and 274.8 mm, whole wet weight respectively no data, 374.4, and 410.9 g; TMCD003316 dissected to observe mandibles, gills, and gastric mill. Seven males (TMCD3317, 3318, 3320, 003322–003325), CL 88.3–126.8 mm, TL 227.8–288.3 mm, wet weight 255.5–505.7 g (Table 1). All specimens collected between North Vereker Bank and Pratas Island by bottom trawl by Keelung-based fishing vessel “Jin Ruiyi 37” in northern South China Sea.
METANEPHROPS NEPTUNUS FROM THE PRATAS ISLANDS

(20°43′00″N, 116°42′00″E), at 300–600 m depth on 27 June 2019 (purchased on 17 July 2019).

Description (TMCD003316 and TMCD003317)

Carapace and eyes: Dorsal surface of carapace spinulose (Fig. 2A, B), carapace rather uniformly spinulose, postrostral carinae each with three teeth and region between postrostral carinae densely spinulose (Fig. 2B, C). Supraorbital spine followed by strong toothed ridge extending almost to post-cervical groove. Posterior part of carapace with several longitudinal carinae. Antennal spine in most specimens followed by strong carina.

Abdomen: Surface of abdominal tergites conspicuously sculptured; raised parts of dorsal surface smooth and naked; second to fifth somites with marked dorsomedian carina flanked by pair of conspicuous longitudinal grooves (Fig. 2A, D). Distinct carinae separating abdominal tergites bilaterally from corresponding pleura. Fifth abdominal somite with no distinct spines on bilateral carinae separating tergite from pleura. Dorsomedian carina of sixth abdominal somite without submedian spines. Spine in middle of lateral margin of sixth abdominal somite short, its tip far from posterolateral margin of somite.

First pereiopods (large chelipeds): Left and right first chelipeds similar in size and shape, with palm of chela distinctly longer than wide. Chelae heavily ridged and spinulose, without large spines; no prominent basal spine on outer edge of movable finger. Inner margin of merus weakly spinulose (Fig. 2A, E).

Gastric mill: Zygocardiac teeth (Fig. 3A–C) with single lateral cusp on anterior lateral side, five corneous zygocardiac teeth on dorsal surface. Among gastric mill ossicles (Fig. 4D–F), urocardiac ossicle with two large bosses on posterior margin.

Mandibles: Sharp and corneous blade-like incisor ridge of right mandible with single large tubercle, molar ridge with two very weak processes (Fig. 3G–J).

| ID number   | Sex   | TL  | AL  | CL  | HL  | CW  | AW  | CHL | CHW | CHH | Weight |
|-------------|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| TMCD003316  | female | 245.8 | 130.4 | 105.4 | 79.8 | 52.2 | 46.3 | 98.9 | no data | no data | 316.7 |
| TMCD003317  | male  | 227.8 | 139.5 | 88.3 | 57.6 | 51.5 | 44.9 | 104 | 13.2 | 19.3 | 255.5 |
| TMCD003318  | male  | 228.5 | 128.8 | 99.7 | 70.1 | 47.5 | 38.2 | 108.2 | 13 | 17.5 | 272.4 |
| TMCD003319  | female | 249  | 144.1 | 104.9 | 67.8 | 62.5 | 55.8 | 107 | 12.1 | 19.5 | 374.4 |
| TMCD003320  | male  | 252.7 | 143.1 | 109.6 | 76.1 | 58 | 46.1 | 123.3 | 14.2 | 17.9 | 320.7 |
| TMCD003321  | female | 274.8 | 154 | 120.8 | 83.1 | 55.8 | 47.1 | 111.2 | 14.9 | 19.9 | 410.9 |
| TMCD003322  | male  | 255.5 | 143.3 | 112.2 | 79.5 | 50.8 | 44.1 | 125 | 15.5 | 20.9 | 272.4 |
| TMCD003323  | male  | 288.3 | 161.5 | 126.8 | 89.7 | 60.1 | 48.8 | 151.5 | 19 | 24.9 | 505.7 |
| TMCD003324  | male  | 263.6 | 159.2 | 104.4 | 73.5 | 56.8 | 48.9 | 95.9 | 14.1 | 19.4 | 405.8 |
| TMCD003325  | male  | 238.2 | 133.2 | 105 | 77.5 | 50.9 | 42.8 | 102.6 | 11.5 | 16.1 | 293.9 |

TL: total body length, AL: abdomen length, CL: cephalothorax length, HL: cephalothorax length form the tip of the rostrum to cervical groove, CW: cephalothorax width, AW: abdomen width, CHL: chela length, CHW: chela width, CHH: chela height (Szaniawska et al., 2005).
Fig. 2. *Metanephrops neptunus* (female, TMCD003316, CL = 105.4 mm). A, dorsal view of entire body; B, dorsal view of carapace; C, lateral view of carapace; D, dorsal view of abdomen; E, dorsal view of cheliped (first pereiopod). Scale bars: 5 cm.
Fig. 3. Gastric mill and mandible of female *Metanephrops neptunus* (female, TMCD003316, CL = 105.4 mm). A, lateral view of zygocardiac ossicle; B, dorsal view of zygocardiac ossicle; C, mesial view of zygocardiac ossicle; D, caudal view of urocardiac ossicle; E, ventral view of urocardiac ossicle; F, lateral view of urocardiac ossicle; G–H, ventral views of mandibles; I–J, proximal views of mandibles. An: anterior; In: incisor ridge; LC: lateral cusp; Mr: molar ridge; scale bars: 2 mm.
Gills: Podobranchs (Fig. 4A, B) consisting of flat, blade-like lamella with no filaments and shaft covered with fine filaments on its lateral side. Lateral sides of arthrobranchs (Fig. 4C–F) and pleurobranchs (Fig. 4G, H) covered with longitudinal rows of short, solid filaments of similar length.

**Identification**

The number of recognized species (including fossil species) of *Metanephrops* has increased from 14 to 18 since the erection of the genus in 1972. According to the World Register of Marine Species (WoRMS, 2020), the superfamily Nephropoidea currently includes 17 genera. Among these, *Metanephrops* currently contains *M. andamanicus* (Wood-Mason, 1892), *M. arafurensis* (De Man, 1905), *M. armatus* Chan & Yu, 1991, *M. australiensis* (Bruce, 1966), *M. binghami* (Boone, 1927), *M. boschmai* (Holthuis, 1964), *M. challengeri* (Balss, 1914), *M. formosanus* Chan & Yu, 1987, *M. japonicus* (Tapapare-Canevri, 1873), *M. mozambicus* Macpherson, 1990, *M. rubellus* (Moreira, 1903), *M. sagamiensis* (Parisi, 1917), *M. siboga* (de Man, 1916), *M. sinensis* (Bruce, 1966), *M. taimanicus* (Hu, 1983), *M. thomsoni* (Bate, 1888), *M. velutinus* Chan & Yu, 1991, and *M. neptunus*. Members of this genus are conventionally divided into four species-groups, viz., the *arafurensis*, *atlanticus*, *binghami*, and *japonicus* groups (De Man, 1916; Yaldwyn, 1954; Jenkins, 1972; Chan & Yu, 1987; Holthuis, 1991; Tshudy et al., 2007). *Metanephrops neptunus* belongs to the *arafurensis*-group together with *M. arafurensis* and *M. australiensis*. All three species share a spiny carapace; weakly carinate, finely granulose, spiny chelipeds with an angulate outer margin; one or two deep transverse furrows on the dorsal surface of the pleonal terga; and uropods with a spinulose dorsal surface. According to Holthuis (1991), a rather uniformly spinulose carapace and a heavily spinulose region between the postrostral carinae are the key characters that distinguish *M. neptunus* from these two congeners. The present specimens display these features and are therefore identified as *M. neptunus*.

**Remarks**

Sahlmann et al. (2011) examined the mouth-
parts of *Puerulus angulatus* (Bate, 1888) and *M. formosanus* Chan and Yu, 1987 by scanning electron microscopy. Both were similar, but both mandibles of *M. armatus* and *M. formosanus* had two differently sized and weak molar processes. The present study confirmed the presence of two weak molar process in *M. neptunus* as well (Fig. 3I–J). Also, *Nephrops norvegicus* (L.) have similar mandible (Farmer, 1974).

**Coloration**

Fresh specimens of both males and females displayed almost the same body coloration, with a basically red cephalothorax and milky–white abdomen (Fig. 5). The eyes were black. The proximal third of the fingers as well as the palm of the chela were milky–white in the otherwise red first chelipeds–just as in a female Indonesian (Kai Islands) specimen of this species studied by Chan (1997)–and the second and third chelipeds and posterior two pairs of walking legs are red. In a previous study, Chan (1997) showed that the dorsal red coloration of the body is variable in *M. neptunus*. The chela coloration in *M. neptunus* is different from that of the all-red first chelae of *M. arafurensis* (Chan, 1997).

**Geographic range**

Like the present specimens, the Holotype specimen of *M. neptunus* was collected in the South China Sea close to Pratas Island (19°25.5'N114°07.5'E to 19°22.0'N114°11.0'E; 7 January 1964) (Bruce, 1965). Thereafter it has been recorded from several localities in the
South China Sea and Western Australia (Holthuis, 1991) as well as from Philippine waters in the Sulu Sea and from Indonesia’s Tanimbar and Kai Islands and Makassar Strait (Chan, 1997).

**Habitat depth**

The present material were collected from the seabed at 300–600 m depth. Bruce (1965) description the temperature was 5.13°C at a depth of 812 m. Holthuis (1991) type series of *Metanephrops neptunus* was captured at depths of 300–800 m, where the water temperature was approximately 5–11.9°C. The known depth range of *M. neptunus* is 300–940 m, but it is most commonly found at depths of 500–800 m (Chan, 1997).

**Stomach contents**

The stomach contents of the dissected specimen of *M. neptunus* were dominated by inorganic sediment and detritus, with a few remains of benthic polychaetes, nematodes, and crustaceans. The gut contents of *M. formosanus* and *M. armatus*, as reported by Sahlmann et al. (2011), were similar each other and consisted of animal tissue (crustaceans, fish, and bivalves) and a large amount of inorganic sediment. The stomach contents of *M. neptunus* are, therefore, similar to those of *M. formosanus* and *M. armatus*.

**Fecundity**

The numbers and size of the eggs carried by the three ovigerous females were similar. The one examined in detail (TMCD003316, TL = 245.8 mm) was carrying 24 dark green, non-eyed, spherical eggs of 2.3–3.8 mm in diameter (mean ± SD = 3.23 ± 0.23 mm).

**Acknowledgements**

This study was funded in part by grants from the National University of Tainan, Taiwan, ROC. The authors thank Ms. Fang Yi Lee and Mr. Chao Hsin Wu, National University of Tainan, for their technical support, and also Drs. Tin-Yam Chan and Mark J. Grygier, National Taiwan Ocean University, and Dr. Yukio Hanamura of Crustacean Society of Japan for providing invaluable scientific advice and English revision after reading drafts of the manuscript. MCH also thanks the owners of the seafood shop Shi Shang Xian for allowing him to inspect their wares.

**Literature Cited**

Balss, H., 1914. Ostasiatische Decapoden. Die Natantia und Reptantia. In: F. Doflein, Beiträge zur Naturgeschichte Ostasiens. Abhandlungen Bayerischen Akademie der Wissenschaften, Supplement 2(10): 1–101, figs. 1–50, pl. 1.

Bate, C. S., 1888. Report on the Crustacea Macrura collected by H.M.S. “Challenger” during the years 1873–76. Challenger Reports, Zoology, 24: i-xc, 1–942, figs 1–76, pls 1–150.

Boone, L., 1927. Crustacea from tropical east American seas. Scientific results of the first oceanographic expedition of the “Pawnee”. Bulletin of the Bingham Oceanographic Collection1(2): 1–47, figs. 1–33.

Brösing, A., 2010. Recent developments on the morphology of brachyuran foregut ossicle and gastric teeth. Zoosystema, 2510: 1–44.

Bruce, A. J., 1965. On a new species of *Nephrops* (Decapoda, Reptantia) from the South China Sea. Crustaceana, 9: 274–284.

Bruce, A. J., 1966. *Nephrops australiensis* sp. nov., a new species of lobster from northern Australia (Decapoda Reptantia). Crustaceana, 10: 245–258.

Chan, T. Y., 1997. Crustacea Decapoda: Palinuridae, Scyllaridae and Nephropidae collected in Indonesia by the KARUBAR Cruise, with an identification key for the species of *Metanephrops*. In: A. Crosnier, & F. Bouchet, (eds.), Résultats des Campagnes MUSORSTOM, Vol. 16. Mémoires du Muséum national d’Histoire naturelle, Série A, Zoologie, 172: 409–431.

Chan, T. Y., & Yu, H. P., 1987. *Metanephrops for-
mosanus sp. nov., a new species of lobster (Decapoda, Nephropidae) from Taiwan. Crustaceana, 10: 245–258.

Chan, T. Y., & Yu, H. P., 1991. Studies of the Metanephrops japonicus group (Decapoda, Nephropidae), with descriptions of two new species. Crustaceana, 60(1): 18–51, figs 1–3, pls 1–8.

Dai, C. F. 2004. Dong-sha Atoll in the South China Sea: Past, present and future. In: Islands of the World VIII International Conference, Kinmen Island, Taiwan. Changing Islands–Changing Worlds. Institute of Oceanography, National Taiwan University, pp. 517–525.

Dana, J. D., 1852. Conspectus crustaceorum quae in orbis terrerum circumnavigatione, Carolo Wilkes e classe reipublicae foederatae, lexit et descriptit. Proceedings of the Academy of Natural Sciences of Philadelphia, 6: 6–28.

De Man, J. G., 1905. Diagnoses of new species of macrurous decapod Crustacea from the “Siboga Expedition”. Tijdschrift der Nederlandse Dierkundige Vereeniging, 9: 587–614.

De Man, J. G., 1916. The Decapoda of the Siboga Expedition. Part III. Families Eryonidae, Palinuridae, Scyllaridae and Nephropsidae. Siboga-Expedition, 39a: 1–222, pls. I–IV.

Farmer, A. S. 1974. The functional morphology of the mouthparts and pereiopods of Nephrops norvegicus (L.) (Decapoda: Nephropidae). Journal of Natural History, 8: 121–142.

Grown, I. O., & Richardson, A. M. M., 1990. A comparison of the gastric mill of nine species of parastacid crayfish from a range of habitats, using multivariant morphometrics (Decapoda, Astacoida). Crustaceana, 58: 33–44.

Hobbs, H. H., 1987. A review of the crayfish genus Astacoides (Decapoda: Parastacidae). Smithsonian Contributions to Zoology, 443: 1–50.

Hobbs, Jr. H. H., 1988. Crayfish distribution, adaptation, and evolution. In: D. M. Holdich & R. S. Lowery, (eds.), Freshwater Crayfish: Biology: Management and Exploitation, Croom Helm, London, UK, pp. 52–82.

Holthuis, L. B., 1964. On some species of the genus Nephrops (Crustacea, Decapoda). Zoologische Mededelingen, Leiden, 39: 71–78, fig. 1.

Holthuis, L. B., 1991. Marine lobsters of the world. FAO Fisheries Synopsis, 13: 61–76.

Hu, C. H., 1983. Discovery fossil lobster from the Kuechulin Formation (Miocene), Southern Taiwan. Annals of Taiwan Museum, 26: 129–136. [in Chinese].

Jenkins, R. J. F., 1972. Metanephrops, a new genus of late Pliocene to Recent lobster (Decapoda, Nephropidae). Crustaceana, 22: 167–177.

Macpherson, E., 1990. Crustacea Decapoda: On a collection of Nephropidae from the Indian Ocean and Western Pacific. In: A. Crosnier, (ed.), Résultats des Campagnes MUSORSTOM, Vol. 6. Mémoires du Muséum national d’Histoire naturelle, Série A, Zoologie, 145: 289–328.

Moreira, C., 1903. Crustaceos. Estudos preliminares. Campanhas de pesca do haite “Annie” dos Srs. Bandeira & Bravo. Lavoura. Boletim da Sociedade Nacional de Agricultura Brazilian, 7: 60–67.

Morgan, G. J., 1986. Freshwater crayfish of the genus Euastacus Clark (Decapoda: Parastacidae) from Victoria. Memoirs of the Museum of Victoria, 47: 1–57.

Morgan, G., 1997. Freshwater crayfish of the genus Euastacus Clark (Decapoda: Parastacidae) from New South Wales, with a key to all species of the genus. Records of the Australian Museum, Supplement, 23: 1–110.

Parisi, B., 1917. I decapodi giapponesi del Museo di Milano. V. Galatheida e Reptantia. Atti della Societa Italiana di Scienze Naturali, 56: 1–24, figs 1–7.

Sahlmanna, C., Chan, T.-Y., & Chan, B. K. K., 2011. Feeding modes of deep-sea lobsters (Crustacea: Decapoda: Nephropidae and Palinuridae) in Northwest Pacific waters: Functional morphology of mouthparts, feeding behaviour and gut
content analysis. Zoologischer Anzeiger, 250: 55–66.

Szaniawska, A., Normant, M., Michalowska, M., & Kaminska, A., 2005. Morphometric characters of the freshwater American crayfish, *Orconectes limosus* Raf., from the Vistula Lagoon (Poland). Oceanological and Hydrobiological Studies, 34: 195–207.

Tapparone-Canefri, C., 1873. Intorno ad una nuova specie di *Nephrops*, genere di Crostacei decapodi Macruri. Memorie della Reale Accademia delle Scienze di Torino, 28(2): 1–7, pl. 1.

Tshudy, D., Chan, T. Y., & Sorhannus, U., 2007. Morphology based cladistic analysis of *Metanephrops*: The most diverse extant genus of clawed lobster (Nephropidae). Journal of Crustacean Biology, 27: 463–476.

WoRMS (2020). Nephropoidea Dana, 1852. Accessed at: http://www.marinespecies.org/aphia.php?p=taxdetails&id=155750 on 2020-06-05.

Wood-Mason, J., 1892. Crustacea, Part I. In: Illustrations of the zoology of H.M. Indian Marine Surveying Steamer Investigator, under the Command of Commander A. Carpenter. Calcutta. Pls. 1–5.

Yaldwyn, J. C., 1954. *Nephrops challengeri* Balss, 1914 (Crustacea, Decapoda, Reptantia), from New Zealand and Chatham Islands waters. Transactions of the Royal Society of New Zealand, 82: 721–732.

Addresses
(MCH) Department of Biological Sciences and Technology, National University of Tainan, No. 33, Sec. 2, Shu-Lin St., Tainan 70005, Taiwan, ROC.
(TK) Central Fisheries Research Institution, Hokkaido Research Organization, 238 Hamanaka, Yoichi, Hokkaido 045–8555, Japan.

E-mail addresses
(MCH)* mingchih39@mail.nutn.edu.tw
(TK) tadashikawai8@gmail.com
*Corresponding author