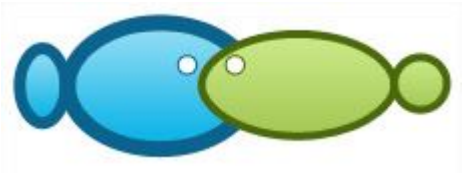

Lobster diversity of Palabuhanratu Bay, South Java, Indonesia with new distribution record of *Panulirus ornatus*, *P. polyphagus* and *Parribacus antarcticus*

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Abstract. This work presents the diversity of lobsters collected from a survey in Palabuhanratu Bay, South of Java, Indonesia during July 2015 – December 2016. The survey was conducted monthly in a fish harbour. Information on the occurrence of previous survey was also included. A total of thirty one lobster specimens were collected from fishermen. Twelve species of three families were recorded from the survey, i.e. family Palinuridae [*Panulirus ornatus* (Fabricius 1798), *P. versicolor* (Lareille 1804), *P. penicillatus* (Olivier 1791), *P. homarus* (Linnaeus 1758), *P. longipes longipes* (A. Milne Edwards 1868), *P. polyphagus* (Herbst, 1793), *Linuparus somniosus* Berry & George 1972, *Palinustus waguensis* Kubo 1963, *Puerulus mesodontus* Chan, Ma, & Chu, 2013], family Scyllaridae [*Parribacus antarcticus* (Lund 1793), *Thenus indicus* Leach, 1815], and family Nephropidae [*Metanephrops andamanicus* (Wood-Mason, 1891)]. The habitus photographs are presented and biological information of the lobsters are described. Among the twelve species, the occurrence of *Panulirus ornatus, P. polyphagus,* and *Parribacus antarcticus,* is reported as new distribution record in south of Java, Indonesia. Brief notes on the fishery point of view and the importance of diversity research for sustainable life are discussed.
Key Words: Crustacea, fishery, new record, Palinuroidea, Nephropoidea, Scyllaridae.

Introduction. Lobsters are commercial crustaceans in fishery market of the world (Chan 1998). Certain species can even be considered as prestigious commodity due to the high price in the market. To date taxonomy and catalog of marine lobsters in the world was made available by Holthuis (1991) and Chan (1998). Chan (2010) reported an updated list of all considered valid species of living marine lobsters known in the world up to 2010. In those years, lobster of infraorder Astacidea, Glypheidea, Achelata, and Polychelida comprised 248 valid species (with four valid subspecies) of marine lobsters in 6 families and 55 genera. In recent studies, there have been many new discoveries in the last decade, for example 2 species from genus *Thauma* (Chang et al 2014), 1 species from genus *Thymops* (Ahyong et al 2012), 1 species from genus *Linuparus* (Tsoi et al 2011), 5 species from genus *Puerulus* (Chan et al 2013), 1 species from genus *Chelarctus* (Yang & Chan 2012), 1 species from genus *Galearctus* (Yang et al 2011), and 1 species from genus *Stereomastis* (Artüz et al 2014). Research on marine and freshwater crustaceans of Indonesia has been increasing in the last decade, and most of them focused on the biology of valuable crustaceans, e.g. habitation and behavior (Sarong & Wardiatno 2013; Wardiatno et al 2014; Wardiatno et al 2016a), morphometric and allometric relationships (Wardiatno & Mashar 2013; Mashar & Wardiatno 2013a, b; Muzammil et al 2015; Pramithasari et al 2017), dynamics of abundance and population

(Wardiatno & Mashar 2011; Mashar et al 2014; Hamid & Wardiatno 2015), biological reproduction aspects (Wardiatno & Mashar 2010; Zairion et al 2014; Hamid et al 2015a, b; 2016a; Zairion et al 2015a, b; Edritanti et al 2016), distribution pattern of ovigerous female (Hamid et al 2016b), biochemical composition (Wardiatno et al 2012; Santoso et al 2015), and bioinvasion (Patoka et al 2016). Beside that some of the crustacean studies in Indonesia were related to biodiversity, e.g. Mashar et al (2014, 2015), Ardika et al (2015), Wardiatno et al (2015, 2016b, c, d), Wahyudin et al (2016), etc.

Palabuhanratu Bay is one of fisheries centres located in southern coast of Java facing the Indian Ocean. Beside finfish fisheries, there is also the lobster fishery with high potential value in the bay. The existence of lobster in the bay is supported by diverse habitat such as coral reefs and sand-rocky substrates in shallow part and muddy to sandy substrates in deeper part. Spiny lobsters are usually captured by hand directly in shallow sand-rocky substrates or coral reefs, while deep sea lobster is a by-catch of net fishing gear. As in other countries, lobster in Pelabuhanratu Bay is sold for export as well as for local consumption.

This work presents the diversity of lobster from fish harbour in Palabuhanratu Bay. There are all together 12 species of lobsters, i.e. *Panulirus ornatus* (Fabricius 1798), *P. versicolor* (Lareille 1804), *P. penicillatus* (Olivier 1791), *P. homarus* (Linnaeus 1758), *P. longipes longipes* (A. Milne Edwards 1868), *P. polyphagus* (Herbst, 1793), *Linuparus somniosus* Berry & George 1972, *Palinustus waguensis* Kubo 1963, *Puerulus mesodontus* Chan, Ma, & Chu, 2013, *Parribacus antarcticus* (Lund 1793), *Thenus indicus* Leach, 1815, and *Metanephrops andamanicus* (Wood-Mason, 1891). Three of the 12 species, i.e. *Panulirus ornatus, P. polyphagus,* and *Parribacus antarcticus,* is reported as new distribution record from south of Java, Indonesia in this report.

Material and Method. The lobster diversity survey was conducted from July 2015 until December 2016 in a fish harbour in Palabuhanratu Bay, West Java - Indonesia (Figure 1). The specimens were preserved in 96% alcohol, transported to the laboratory for assessment of morphological characters and identification. The specimens were lodged in the collection of the Department of Aquatic Resources Management, Bogor Agricultural University, Indonesia. All lobsters were identified based on the morphological characteristics using the taxonomic keys from Holthuis (1991), Chan & Yu (1995), Chan (1998), Burton & Davie (2007), and Chan et al (2013), and the characters are presented. Results of the previous survey were also included in this paper.

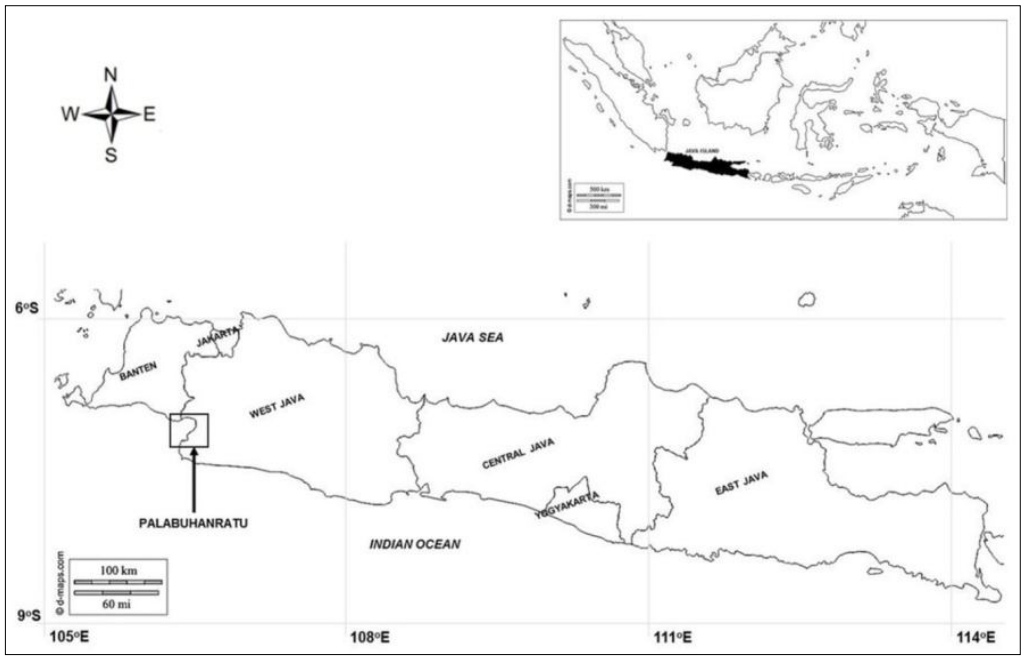

Figure 1. Map of Palabuhanratu Bay, Java Island with the insert map of Indonesia.

Results. As mentioned before, twelve species of lobsters occurred in Palabuhanratu Bay, South Java. Those species are caught both as target species and by-catch species. The descriptions are presented below.

Taxonomy
Superfamily Palinuroidea
Infraorder Achelata
Family Palinuridae Latreille 1802

Genus *Panulirus* White 1847

Panulirus ornatus (Fabricius 1798) (Figure 2a)
Palinurus sulcatus H. Milne Edwards, 1837;
Panulirus sulcatus White, 1847;
Palinurus (*Senex*) *sulcatus* Pfeffer, 1881;
Senex ornatus Lanchester, 1900

Material examined. Five specimens (POP01, POP02, POP03, POP04, POP05)

Description. Carapace rounded and spiny; rostrum absent; anterior margin bearing irregular-sized spines other than frontal horns; height of frontal horns about 2 times the eye height, without spinules in between. Antennules with flagella longer than peduncle; antennular plate at bases of antennae bearing 2 pairs of well separated principal spines (anterior pair considerably larger), sometimes also with several spinules. First 4 pairs of legs without pincers. Abdomen naked and smooth, without transverse grooves or sunken pubescent areas. Posterior half of tail fan soft and flexible.

Measurement. 3♂ 2♀; 3♂: carapace length 48.56, 48.67, and 50.52 mm; total length 135.25, 136.91, and 139.37 mm; weight 94, 96, and 107 gram. 2♀: carapace length 51.98 and 55 mm, total length 146.43 and 148.72 mm, weight 113 and 132 gram.

Remark. This paper presents a new distribution of the Ornate Spiny Lobster, *Panulirus ornatus* (Fabricius, 1798) from south of Java, Indonesia.

Ecological data. Usually occurs at depths from 1 to 10 m, but can be found to a depth of 200 m. In calm areas of coral and rocky reefs or reef slopes, sometimes also found on muddy substrate in river mouths with fairly turbid conditions (George 1968; Chan 1998). Lives solitary or in pairs; seasonal mass migrations was observed in Torres Strait populations (Chan 1998). Holthuis (1968) collected *P. ornatus* in the Red Sea, and Galil et al (1989) reported the species to actively migrate from the Red Sea to the similarities of the required environmental conditions like in the Eastern Mediterranean.

Distribution. Indo-West Pacific region from the Red Sea and East Africa (south to Natal) to southern Japan, the Solomon Islands, Papua New Guinea, Australia, New Caledonia and Fiji. Israel in the East Mediterranean (Holthuis 1991).

Panulirus versicolor (Lareille 1804) (Figure 2b)
Palinurus taeniatus Lamarck, 1818;
Panulirus taeniatus - White, 1847;
Palinurus (Panulirus) ornatus decoratus Heller, 1865;
Puer spiniger Ortmann, 1894;
Panulirus demani Borradal le, 1899;
Senex ornatus laevis Lanchester, 1901;
Puerulus spiniper - Caiman, 1909;
Panulirus ornatus laevis- De Man, 1916.

Material examined. Five specimens (POV01, POV02, POV03, POV04, POV05).

Description. Carapace rounded and spiny; rostrum absent; anterior margin bearing 4 regularly spaced large spines other than frontal horns; height of frontal horns more than 3 times the eye height, without spinules in between. Antennules with flagella longer than peduncle; antennular plate at bases of antennae armed with 2 pairs of well-separated principal spines only (anterior pair larger). First 4 pairs of legs without pincers. Abdomen more or less smooth, with broad but shallow sunken pubescent areas only present at each half of second and third segments. Posterior half of tail fan soft and flexible.

Measurement. 2♂ 3♀; 2♂: carapace length 42.09 and 43.78 mm; total length 109.63 and 121.61 mm; weight 54 and 72 gram; 3♀: carapace length 44.51, 46.33, and 48.46 mm, total length 119.78, 124.93 and 132.81 mm, weight 76, 82 and 93 gram.

Comparisons. The characteristic colour pattern distinguishes this species immediately from all other spiny lobsters (Holthuis 1968).

Ecological data. Found in shallow water, reef areas at depths of usually less than 16 m (mostly between 4 and 12 m) in clear or sometimes turbid water with strong currents, often on seaward edges of the reef plateau. Nocturnal and not gregarious; hides in crevices during the daytime with white antennae often sticking out (Holthuis 1991; Chan 1998). In the western Pacific females appear to reproduce all year (Chan 1998). In the Galapagos number of egg ranges from 200,000 to 600,000 per year, and the length of maturity in femalewere 25-30 cm (Hearn & Toral-Granda 2007). In the Phillippines this species possibly willproduceup to five broods per year (Freitas et al 2007). Natural mortality (M) in the Marshall Islands was estimated 0.42 per year (Ebert & Ford 1986).

Distribution. Indo-West Pacific region: entire Red Sea and east coast of Africa (south to Natal), to southern Japan, Micronesia, Melanesia, northern Australia and Polynesia (Holthuis 1991). This species also occurs in the coastal waters of Georgia (United States), both the coastal waters of the continental USA and in the Atlantic Ocean.

Panulirus penicillatus (Olivier 1791) (Figure 2c)
Palinurus gigas Lamarck, 1801;
Palinurus penicillatus Olivier, 1811;
Palinurus ehrenbergi Heiter, 1861;
Palinurus (Panulirus) ehrenbergi Heller, 1865;
Palinurus (Senex) penicillatus Pfeffer, 1881;
Cancer theresae Curtiss, 1938.

Material examined. Two specimens (PPP01, PPP02).

Description. Carapace rounded and spiny, with branchiostegal areas slightly inflated; rostrum absent; anterior margin armed with 4 large and regularly spaced large spines other than frontal horns; height of frontal horns about 2 times the eye height; median area behind frontal horns with a longitudinal row of spinules. Antennules with flagella longer than peduncle; antennular plate at bases of antennae armed with 4 close-set principal spines (posterior pair larger). First 4 pairs of legs without pincers. Abdominal segments with a transverse groove, not continuous with pleural groove; anterior margins of pleura spinous. Posterior half of tail fan soft and flexible.

Measurement. 2♂: carapace length 53.12 and 55.33 mm; total length 141.35 and 144.37 mm; weight 105 and 116 gram.

Comparisons. *Panulirus penicillatus* shows a rather great variability in the colour pattern of its legs and in its pubescence (Holthuis 1968).

Ecological data. Found in shallow waters, usually at depths from 1 to 4 m (maximum depth 16 m) at seaward edges of reefs, in clear waters not influenced by rivers.

Nocturnal and usually not gregarious, but sometimes occurs in a “harem” of mixed sexes; often found in deep caves during the daytime and strongly clinging to rocks at surf zones or areas with strong currents such as surge channels (Chan 1998).

Distribution. It occurs in the Indo-West Pacific and East Pacific regions (Holthuis 1991), south from the Red Sea to South and East Africa, Madagascar and surrounding islands; through the Indian Ocean and South China Sea to Japan, the Phillippines, Indonesia, Hawaii, Samoa and the Tuamotu Archipelago; northern and eastern Australia; and as far east as the islands of the west coast of the US (the Galapagos and Revillagigedo Archipelagos, and Cocos and Clipperton Islands), and Mexico (Sinaloa, Nayarit and Guerrero). According to Cockcroft et al (2011) this species occurs in many countries as follow: American Samoa (American Samoa, Swains Islands); Australia (New South Wales, Northern Territory, Queensland, Western Australia); Cambodia; China (Fujian, Guangdong, Guangxi, Hunan); Christmas Island; Comoros; Cook Islands (Cook Island, Manihiki Island); Djibouti; Ecuador (Galápagos); Egypt (Egypt (African part, Sinai); Eritrea; Fiji; French Polynesia (Marquesas, Society Islands, Tuamotu, Tubuai Islands); Guam; Hong Kong; India (Andaman Islands, Andhra Pradesh, Dadra-Nagar-Haveli, Daman, Diu, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Nicobar Islands, Orissa, Pondicherry, Tamil Nadu); Indonesia (Bali, Jawa, Kalimantan, Lesser Sunda Island, Maluku, Papua, Sulawesi, Sumatera); Iran; Japan (Kazanretto, Marcus Island, Nansei-shoto, Ogasawara-shoto); Kenya; Kiribati (Gilbert Islands, Kiribati Line Is., Phoenix Islands); Macao; Madagascar; Marshall Islands; Mauritius (Mauritius (main island), Rodrigues); Mayotte; Mexico (Guerrero, Nayarit, Revillagigedo Islands, Sinaloa); Micronesia, Federated States of Mozambique; Myanmar (Coco Islands, Myanmar (mainland)); Nauru; New Caledonia; Niue; Norfolk Island; Northern Mariana Islands; Oman; Pakistan; Palau; Papua New Guinea (Bismarck Archipelago, North Solomons, Papua New Guinea (main island group)); Philippines; Pitcairn; Réunion; Samoa; Saudi Arabia; Seychelles (Aldabra, Seychelles (main island group)); Solomon Islands (Santa Cruz Islands, South Solomons); Somalia; South Africa (KwaZulu-Natal); Sudan; Taiwan, Province of China (Kin-Men, Matsu-Pai-chuan, Taiwan, Province of China (main island)); Tanzania; Thailand; Tokelau; Tonga; Tuvalu; United States (Hawaiian Islands); United States Minor Outlying Islands (Howland-Baker Islands, Johnston Island, Midway Islands, US Line Islands, Wake Islands); Vanuatu; Viet Nam; Wallis and Futuna; Yemen (North Yemen, Socotra, South Yemen).

Panulirus homarus (Linnaeus 1758) (Figure 2d)
Astacus homarus Fabricius, 1775;
Palinurus homarus Fabricius, 1798
Palinurus dasypus H. Milne Edwards, 1837
Palinurus spinosus H. Milne Edwards, 1837
Palinurus burgeri De Haan, 1841;
Palinurus (Senex) buergeri Pfeffer, 1881;
Senex dasypus Ortmann, 1891;
Panulirus dasypus Henderson, 1893;
Panulirus buergeri Ortmann, 1897;
Panulirus burgeri megasculpta Pesta, 1915;
Panulirus homarus rubellus Berrry, 1974.

Material examined. Five specimens (PHP01, PHP02, PHP03, PHP04, PHP05).

Description. Carapace rounded and spiny, sometimes with branchiostegal areas slightly inflated; rostrum absent; anterior margin armed with 4 regularly spaced large spines other than frontal horns; height of frontal horns about 2 times the eye height, without spinules in between. Antennules with flagella longer than peduncle, antennular plate at bases of antennae bearing 2 pairs of well-separated principal spines (anterior pair slightly larger) and some spinules. First 4 pairs of legs without pincers. Abdominal segments with

a slightly crenate transverse groove, sometimes interrupted at the middle. Posterior half of tail fan soft and flexible.

Measurement. 1♂ 4♀; 1♂: carapace length 50.41 mm; total length 116.95 mm; weight 60 gram. 4♀: carapace length 43.36, 46.59, 46.70, and 50.41 mm, total length 121.2, 126.55, 127.48, and 133.73 mm, weight 73, 81, 82, and 96 gram.

Comparisons. The crenulated grooves of the third, fourth and fifth abdominal somites are interrupted in the midway (Meyyappan & Kathirvel 1978).

Remark. *Panulirus homarus* is a spiny lobster that has the greatest abundance in Palabuhanratu Bay.

Ecological data. In reef areas with sand in the surf zone and sometimes also in turbid waters at depths from 1 to 5 m, but can be found down to a depth of 90 m. Gregarious and nocturnal (Chan 1998).

Distribution: Indo-West Pacific region: East Africa to Japan, Indonesia, Australia, New Caledonia and probably the Marquesas Archipelago (Holthuis 1991).

Panulirus polyphagus (Herbst, 1793) (Figure 2e)
Palinurus fasciatus Fabricius, 1798;
Palinurus polyphagus Bosec 1802;
Panulirus orientalis Dofleln, 1900.

Material examined. Two specimens (PYP01, PYP02).

Description. Carapace rounded and spiny; rostrum absent; anterior margin with irregular-sized pines other than frontal horns; height of frontal horns less than 2 times the eye height, without spinules in between. Antennules with flagella longer than peduncle; antennular plate at bases of antennae armed with 1 pair of well-separated principal spines only. Abdomen naked and smooth; without transverse grooves or sunken pubescent areas. Posterior half of tail fan soft and flexible.

Measurement. 2♀: carapace length 56 and 61 mm; total length 99 and 102 mm; weight 120 and 147 gram.

Remark. This species was present as first record from Palabuhanratu Bay, southern Java, Indonesia.

Ecological data. *P. polyphagus*is most commonly found in coastal waters on muddy and rocky substrates to a depth of 40 m, although its habitat ranges from 3 to 90 m depth (Morgan 1980; Holthuis 1991) and live mainly at the river influenced shelf where the water is shallow, turbid and heavy moderate run-off (George 1997). In Johor coastal waters of Malaysia the species could attain sexual maturity at 6.02 cm CL (carapace length) for male and 6.59 cm CL for female (Ikhwanuddin et al 2014).

Distribution: Indo-West Pacific from Pakistan to India, Thailand, Viet Nam, Taiwan Province of China, the Philippines, Indonesia, Papua New Guinea, and northern Australia (Chan 1998).

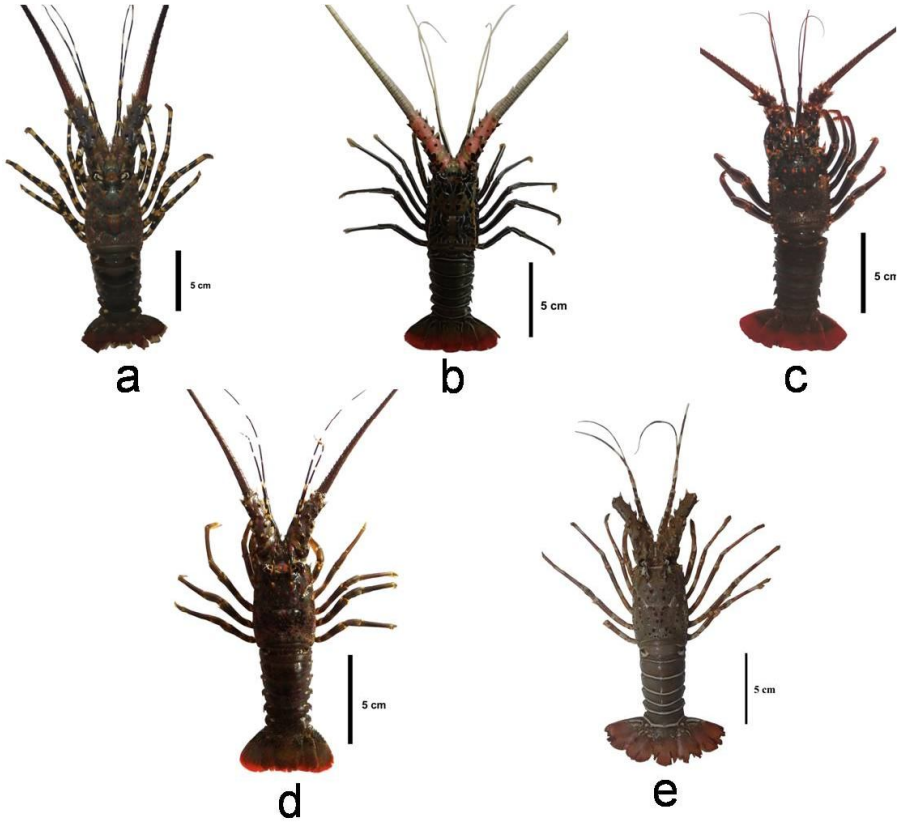

Figure 2. A specimen of **a.** *Panulirus ornatus* (male) **b.** *Panulirus versicolor* (male) **c.** *Panulirus penicillatus* (male) **d.** *Panulirus homarus* (female) **e.** *Panulirus polyphagus* (female).

Panulirus longipes longipes (A. Milne Edwards 1868) (Figure 3a)
Palinurus femoristriga Von Martens, 1872;
Palinurus longitarsus Lenz & Richters, 1881
Senex femoristriga Ortmann, 1891;
Panulirus bispinosus Borradaile, 1899;
Panulirus japonicus longipes - De Man, 1916.

Material examined. Two specimens (PLP01, PLP02).

Description. Carapace rounded and spiny; rostrum absent; anterior margin armed with irregular-sized spines; height of frontal horns about 2.5 times the eye height; median area behind frontal horns always bearing some additional spinules other than the regular longitudinal row of 3 spines; cervical groove about as wide as posterior marginal groove. Antennules with flagella longer than peduncle; antennular plate at bases of antennae bearing 1 pair of well separated principal spines and some scattered spinules; ventral surfaces of distal 2 antennal segments each with 1 large spine, often flanked by some scattered spinules. First 4 pairs of legs without pincers. Thoracic sternum without strong submedian protrusions. Abdominal segments with a complete transverse groove joining the pleural groove; abdominal pleura only with that of second segment sometimes bearing spinules. Posterior half of tail fan soft and flexible.

Measurement. 1♂ 1♀; 1♂: carapace length 60.92 mm; total length 174 mm; weight 178 gram. 1♀: carapace length 40.83 mm, total length 122.86 mm, weight 84 gram.

Ecological data. Found in shallow coral or rocky reefs (but can be found down to a depth of 130 m), usually in clear waters with moderate currents, sometimes in slightly turbid waters. Nocturnal and not gregarious (Chan 1998).

Distribution. The western form occurring from East Africa to Thailand, Taiwan, the Philippines and Indonesia (Holthuis 1991; Chan 1998).

Genus *Linuparus* White 1847

Linuparus somniosus Berry & George 1972 (Figure 3b)

Material examined. One specimen (LSP1).

Description. The postcervical region between the median and lateral ridges are covered with scattered sharp tubercles, with no rows or distinct pattern(s) discernible (vs. with a well defined row of sharp tubercles surface). The dorsal surface of the distal antennal segment has two prominent sharp spines. The chitinous margin on the penile process of the fifth pereiopod coxa is mostly entire or distinctly toothed.

Measurement. 1♀: carapace length 94 mm, total length 251 mm, weight 340 gram.

Remark: This species was presented as the first record from Palabuhanratu Bay, southern Java, Indonesia (Wowor 1999).

Ecological data. L. somniosus live on rough substrate with sand and mud (Holtuis 1991). This species was obtained from depth variation in different locations, in the western Indian Ocean from 216 to 375 m deep (Berry & George 1972; Holthuis 1991), at the Straits of Malacca from 155 to 177 m deep (Ng 1992), and in Indonesia from 20 to 25 m (Wowor 1999).

Distribution. Off the east coast of Africa from Kenya to Natal, South Africa (Berry & George 1972; Holthuis 1991), Straits of Malacca, near southwestern Thailand (Ng 1992), and South of Java (Wowor 1999).

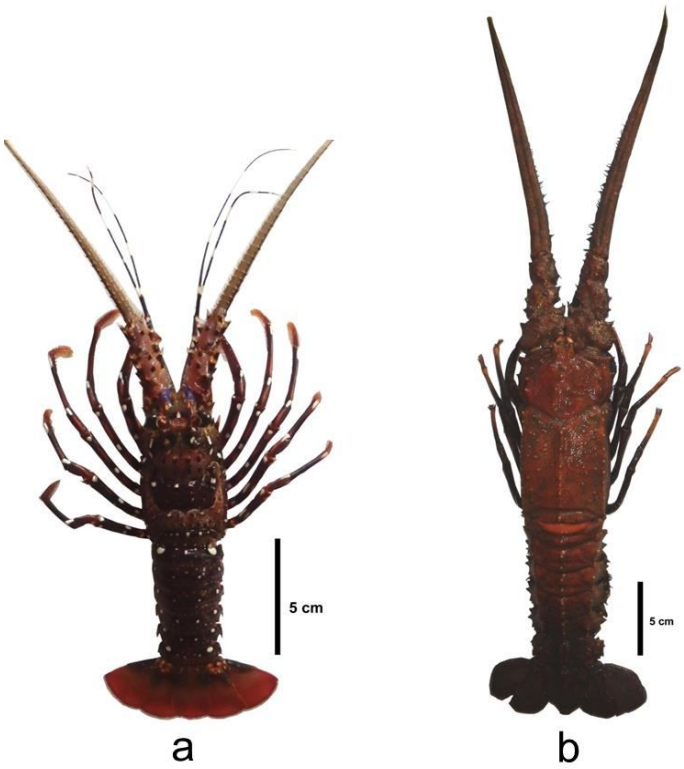

Figure 3. A specimen of **a.** *Linuparus somniosus* (female) and **b.** *Panulirus longipes longipes* (male).

Genus *Palinustus* A. Milne-Edwards, 1880

Palinustus waguensis Kubo 1963 (Figure 4a)

Material examined. Two specimens (PWP01, PWP02).

Description. Body heavily pubescent with spines well developed. Anterior margin of carapace between supraorbital horns bearing 0-8 spines; inner margin of supraorbital horn armed with 0-5 spines. Antennal and branchiostegals pines more or less as long as widest diameter of eye but postorbital spine short and about half as long as antennal spine. Distal antennal segment with dorsomesial surface armed with 1 or 2 spines and distomesial tooth distinctly longer than half of segment length. Epistome with central region evenly tuberculate, anterolateral corers not developed as strong tooth and lateral regions with only median parts tuberculate. Thoracic sternum with lateral margins distinctly serrated; posterior margin with median region generally bearing 1 pair of short submedian spines, lateral regions unarmed or occasionally having 1 or 2 sharp tubercles. Distal fourth segment of maxilliped III armed with 3-9 fixed spines along ventral margin, while carpus of pereiopod I having 1 or 2 fixed spines along dorsal margin. Dactyli of pereiopods relatively short, those of pereiopod I about 4.7 times as long as broad. Abdominal tergites distinctly pubescent, with lateral oblique furrows well defined. Posterior margin of abdominal tergite VI distinctly serrated. Abdominal sternite I heavily spinulose along entire margin, with submedian pair of spines largest; sternites II-V each generally bearing outer pair of larger and inner pair of smaller spines, with that of II often having some additional spinules on lateral parts; sternite VI armed with strong median tooth and 8-12 other teeth.

Measurement. 2♀: carapace length 42 and 48 mm, total length 117 and 131 mm, weight 70 and 100 gram.

Comparisons. Postorbital spine distinctly shorter than antennal and branchiostegal spines, different with other species (Chan & Yu 1995).

Remark. According to Holthuis (1991), almost all the material previously identified as *P. mossambicus* caused of some confusion in the taxonomy. *P. waguensis* has large variations in morphological characteristics, namely 0-8 spines (average 4.4) on the anterior margin of the carapace between the supraorbital horns (Chan & Yu 1995).

Ecological data. At depths inhabits the outer parts of coral and rocky reef slopes (Holthuis 1991) at depths from 72 to 118 m (Chan & Yu 1995).

Distribution. Indo-West-Pacific from Japan to Taiwan, the Philippines, Indonesia, Thailand, India, and Madagascar (Holthuis 1991; Chan & Yu 1995).

Genus *Puerulus* Ortmann 1897

Puerulus mesodontus Chan, Ma & Chu, 2013 (Figure 4b)

Material examined. Three specimens (PMP01, PMP02, PMP03).

Description. Body moderately pubescent. Carapace similar in length to abdominal somites I-V; surfaces mostly covered with spinules and sharp granules. Supraorbital horn just overreaching the eye and extending to a position approximating the basal one-third of the antennular plate; dorsal margin almost straight, and smooth; followed by a row of three regularly spaced teeth decreasing sharply in size posteriorly; third tooth always prominent. Eye longer than broader. Postorbital spinules well-developed. Two rows of cervical spines converging anteriorly into a well-developed median spine. Three gastric teeth; the first tooth generally smaller or the third tooth generally larger; sometimes all

gastric teeth similar in size or occasionally the first tooth larger; the base of the third tooth less than 1.5-fold wider than the base of the first tooth; the third tooth distinctly distant from the two anterior teeth. Pereiopod V not chelate in males, but chelate in females. The merus of maxilliped III with an anterodorsal spine. The abdomen with a raised granular-to-lobular surface, but the granules not forming distinct rows.

Measurement. 1♂ 2♀; 1♂: carapace length 55.07 mm, total length 153.95 mm, weight 56 gram. 2♀: carapace length 65.66 and 81.91 mm, total length 182 and 226 mm, weight 111 and 246 gram.

Comparisons. *P. mesodontus* is unique amongst those species that possess three teeth behind the supraorbital horn because of the position and size of the third tooth, and because the cervical spines converge anteriorly into a well-developed median spine. The third tooth behind the supraorbital horn is always distinct and never minute, of similar spacing and in the same row as the anterior two teeth (Chan et al 2013).

Remark. This species was present first record from Palabuhanratu Bay, southern Java and also first record of the species in Indonesia (Wardiatno et al 2016b).

Ecological data. Genus *Puerulus* lives at depths of 200-700 m in seas of the Indo-West Pacific region facing the Indian Ocean (Holthuis 1991; Chan 1998). *P. mesodontus* lives at depths of 219-736 m (Chan et al 2013).

Distribution. The western Pacific as Japan, Taiwan, the Philippines, Papua New Guinea, the Solomon Islands, Vanuatu, New Caledonia, Fiji (Chan et al 2013), and Indonesia (Wardiatno et al 2016b).

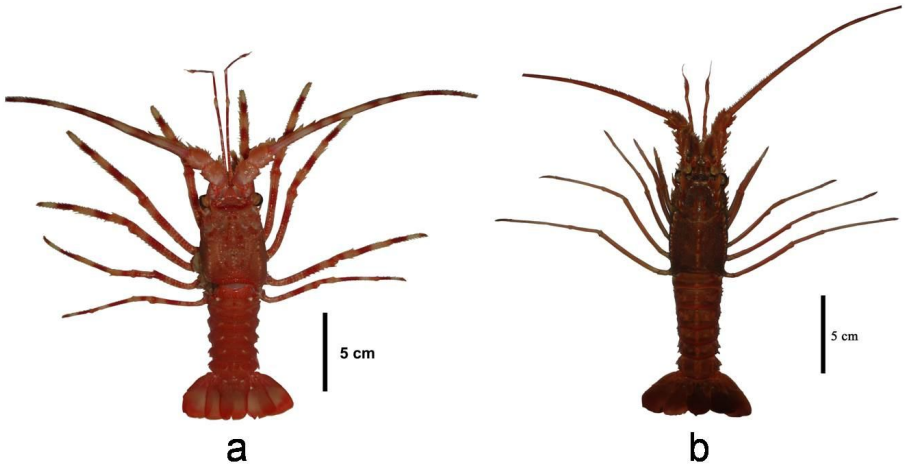

Figure 4. A specimen of **a.** *Palinustus waguensis* (male) and **b.** *Puerulus mesodontus* (female) (Picture b was taken from Wardiatno et al 2016a).

Family Scyllaridae
Subfamily Ibacinae

Genus *Parribacus*

Parribacus antarcticus (Lund 1793) (Figure 5a)
Cancer (Astacus) ursus major Flerbst, 1793;
Scyllarus carinatus Gulldlng, 1825;
Ibacus ciliatus Gulldlng, 1825;
Ibacus parrae H. Milne Edwards, 1837;
Ibacus antarcticus FI. Milne Edwards, 1837;
Parribacus parrae Dana, 1852;
Scyllarus (Ibacus) parrae Flerklots, 1861;

Parribacus antarcticus carinatus Pfeffer, 1881;
Parribacus papyraceus Rathbun, 1906;
Parribacus ursus major De Man, 1916;
Cancer barffi Curtiss, 1938.

Material examined. One specimen (TIP01).

Description. Body extremely flattened, with dorsal surface uniformly covered with scale-like tubercles and short hairs. Carapace with distinct rostral tooth; without branchial ridge but with deep cervical incisions; lateral margin cut into large teeth. Eyes small and subspherical; orbits not closed and situated on anterior margin of carapace. Antennae broad, flattened and plate-like; fourth segment armed with 6 large outer teeth. All legs without pincers and similar in size. Abdomen with median carina on second and third segments markedly elevated; transverse grooves separating articulated and non-articulated parts of each segment are wide and almost naked; fifth segment without posteromedian spine; pleura directed laterally. Posterior half of tail fan soft and flexible.

Measurement. 1 ♂: carapace length (CL), 73 mm; total length, 152 cm; weight, 340 g.

Comparisons. Median carina on second and third abdominal segments of *P. antarcticus* markedly elevated; different with 5 of other species in genus *Parribacus* (Chan 1998).

Remark. This paper presents a new distribution of the Sculptured Mitten Lobster, *P. antarcticus* (Lund 1793) from south of Java, Indonesia.

Ecological data. Lives in coral and stone reefs from shallow waters with a sandy bottom to a depth of 20 m. The species is nocturnal and in the daytime hides in crevices, sometimes in small groups. Fished throughout its range but nowhere abundant (Holthuis 1991; Chan 1998).

Distribution. Indo-West Pacific region from east and southeast Africa to Hawaii and Polynesia. Western Atlantic region from the Caribbeans to Brazil (Meyyappan & Kathirvel 1978; Holthuis 1991; Chan 1998).

Subfamily Theninae

Genus *Thenus*

Thenus indicus Leach, 1815 (Figure 5b)

Material examined. One specimen (TIP01).

Description. No spotting on the pereiopods, the outer face of the propodus of the 2nd pereiopod had an uppermost longitudinal groove bearing obvious setae over at least the proximal half. Merus of the 3rd maxilliped with a small spine proximally on the inner ventral margin; the inner margin of the ischium was prominently dentate along the entire length. Abdominal segments, each with lateral margins expanded downward concealing the pleopods. No single morphometric ratio that would exclusively identify this species has been identified, but only *T. indicus* can have ratios that fall outside the following maximum and minimum values: 1st pereiopod merus width less than 0.07 carapace length and 3rd pereiopod merus length more than 0.45 carapace length.

Measurement. 1 ♂: carapace length (CL), 50.29 mm; total length, 84.06 cm; weight, 280 g.

Comparisons. Genus *Thenus* was a monotypic genus with only one species, namely *Thenus orientalis*. Then Jones (1993), and Davie & Burton (2000) resurrected one species

of the genus, *T. indicus.* In recent study, genus *Thenus* was recognized with three new species by Burton & Davie (2007).

Remark. This species was present first record from Palabuhanratu Bay, southern Java and also first record of the species in Indonesia (Wardiatno et al 2016c).

Ecological data. Thenus is the only genus of economical lobster which inhabits soft substrate in tropical region (Jones 1993). To some extent the population characteristics of this genus are similar with other lobsters, particularly tropical palinurid species (Jones 1993). *Thenus* like other slipper lobster species are bottom-dwelling and found in very shallow water to a depth of more than 484 m (Chan 1998).

Distribution. T. indicus occurred in Pakistan, India, the Gulf of Thailand, Singapore, Indonesia (west coast of Sumatra and south of Java Island), and Taiwan (Burton & Davie 2007; Wardiatno et al 2016c).

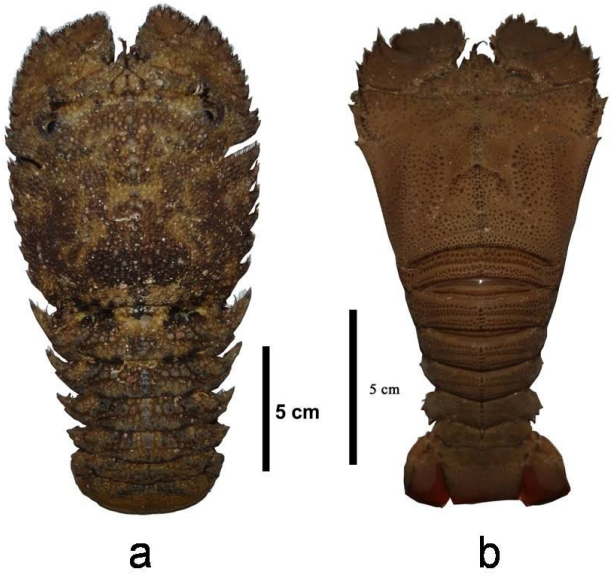

Figure 5. A specimen of **a.** *Parribacus antarcticus* (male), and **b.** *Thenus indicus* (male) (taken from Wardiatno et al 2016c).

Superfamily Nephropoidea
Family Nephropidae
Subfamily Nephropinae

Genus *Metanephrops*

Metanephrops andamanicus (Wood-Mason, 1891) (Figure 6)
Nephrops thomsoni andamanicus Alcock, 1901.

Material examined. Three specimens (MAP01, MAP02, MAP03).

Description. Carapace of *M. andamanicus* smooth between ridges and large spines. Eyes large and black, postrostral carinae with three teeth. Surface of abdominal tergites conspicuously sculptured; raised parts of dorsal surface of abdominal somites smooth and naked; second to fifth abdominal somites with marked dorsomedian carina, flanked by pair of conspicuous longitudinal grooves. Fifth abdominal somite without distinct spines on carina separating tergite from pleuron. Dorsomedian carina of sixth abdominal somite without submedian spines. Spine in middle of lateral margin of sixth abdominal somite short, tip far from posterolateral margin of somite. Chelae of first pereiopods

heavily ridged and spinulose, without large spines; no prominent basal spine on outer edge of movable finger of large chela. Inner margin of merus of first pereiopod weakly spinulose.

Measurement. 3 ♂: carapace length 51.04, 55.97, and 57.20 mm, total length 141.82, 149.34, and 154.23 mm, weight 65, 78, and 88 gram.

Comparisons. Genus *Metanephrops* traditionally can be divided into four morphologic groups, there are *arafurensis, binghami, japonicus* and *thomsoni* groups (Chan & Yu 1991; Holthuis 1991; Chan 1997). But morphology-based cladistic analysis was not supported *thomsoni* group (Tshudy et al 2007). In recent molecular analysis by Chan et al (2009), the entire genus was divided to three closely related species. Morphological of *M. andamanicus* was very similar with *M. sagamiensis, M. mozambicus* and *M. velutinus* (Holthuis 1991; Chan & Yu 1991; Chan 1997).

Remark. This species was present first record from Palabuhanratu Bay, southern Java and also first record of the species in Indonesia (Wardiatno et al 2016d).

Ecological data. Depth range from 250 to 750 m, but mostly between 300 and 450 m. Substrate of hard mud; the species possibly lives in burrows (Holthuis 1991).

Distribution. Indo-West Pacific region: East Africa (Tanzania, Zanzibar, Kenya and Somalia), the Andaman Sea, the South China Sea (not including the Philippines), and Indonesia, and perhaps also Papua New Guinea (Holthuis 1991; Chan 1998; Tshudy et al 2007, Wardiatno et al 2016d).

Figure 6. A specimen of *Metanephrops andamanicus* (male) (taken from Wardiatno et al 2016d).

Discussion. Indonesia as a part of Indo-Australian Archipelago (IAA) region has been known as one of the hotspot for marine biodiversity (Roberts et al 2002; Hoeksema 2007; Belwood & Meyer 2009). The high biodiversity in the marine system is characterized by the high presence of coral reefs in this region (Hughes et al 2002; Hoeksama 2007). These reefs form a habitat and support many other marine organisms around. Some of these organisms also live co-exist in symbiotic relationships with coral reef ecosystem (Paulay 1997). This biodiversity has a pattern where it will decrease longitudinally and latitudinally in line with the estrangement from IAA region (Hoeksema 2007; Roberts et al 2002; Mora et al 2003; Bellwood & Hughes 2001). Many studies supported that IAA is the biodiversity centre of coral (Hoeksema 2007; Hughes et al 2002), several molluscs (Roberts et al 2002; Geiger 2000; Hoeksema 2007), and also

some crustacean groups (de Grave 2001; Ross & Newman 2002). Along with those facts, the areas also acquire high lobster biodiversity (Roberts et al 2002).

According to Chan (2010), there are 55 genera and 248 species marine lobsters in the world, and some of those species occur in Indonesia. In the present study, we describe 12 species of 5 genera of marine lobster found in Palabuhanratu Bay from thirty one specimens. Actually some species from Palabuhanratu Bay were reported previously, i.e *Puerulus mesodontus* (Wardiatno et al 2016a), *Thenus indicus* (Wardiatno et al 2016c), *Metanephrops andamanicus* (Wardiatno et al 2016d), and *Linuparus somniosus* (Wowor 1999). Beside those reported species, we also collected *Panulirus ornatus*, *P. versicolor*, *P. penicillatus, P. homarus*, *P. longipes longipes*, *Palinustus waguensis*, and *Parribacus antarcticus* from Palabuhanratu Bay, and three of them, i.e. *P. ornatus*, *P. polyphagus*, and *Parribacus antarticus* were detected to be new records from south of Java, Indonesia.

The genus *Panulirus* are widely distributed in tropical and subtropical of marine areas (between 35°N and 35°S) to maximum depths of about 100 m (George 2006; Chan 2010). Generally the species in this genus prefer coral substrate habitat with the exception of *P. polyphagus* which normally found on muddy and rocky substrates. *P. antarticus* from slipper lobster group is additionally found in reef substrat (Holthuis 1991). Another species from slipper lobster, i.e. *T. indicus* was caught from shallow sandy habitat (5-15 m depth) with small portion of silt fraction (Wardiatno et al 2016c). The last two species, i.e. *Puerulus mesodontus* and *Metanephrops andamanicus* inhabit deeper sea, where *P. mesodontus* lives at depths of 219-736 m (Chan et al 2013). *M. andamanicus* was also reported to have a preference hard mud substrate and mostly found between 300 and 450 m (Holthuis 1991). The diversity of lobster found in Palabuhanratu Bay is supported by the heterogeneity of ecosystem and substrate in this area. Moreover the benthic environment of Palabuhanratu Bay was proved to be still ecologically good (Wardiatno et al 2017).

In fishery point of view as a high value of marine commodity in the world, the market demand of lobster is increasing overtime. The value of the commodity varies according to its species, and like in most of lobster-producing centres in Indonesia *P. ornatus* has the highest value in Palabuhanratu Bay. The high price of *P. ornatus* is probably caused by its beautiful bright colours as the centrepiece of the banquet in the celebratory event. Another species, *Parribacus antarticus* has also potential specific market. In the last several years, the demand of exotic slipper lobster such as *P. antarticus* also increased. *P. polyphagus* is recognized as one of the green lobsters beside *P. versicolor. P. polyphagus* is often exported as a frozen because of its highly mortality during transportation processes. In terms of price, this species has rather low price due to its muddy taste and less attractive colour (Hart 2009).

As one of Indonesia's export marine commodities, lobster is usually exported as live or frozen product to several countries such as Hong Kong, Japan, China and Taiwan, where China is the most important market. The live lobster has the highest price, however when the market demand is higher, the production of frozen lobsters also increases as a substitute for live lobster (Hart 2009). In 2012, live lobster production for exports in Indonesia reached 2428 tons with values about US$ 28 million, while exports of frozen lobster reached 584 tons with value of US$ 5.5 million (Statistics Indonesia of the Republic Indonesia 2013).

The commitment to preserve natural resources sustainability is growing throughout the world. Marine life sustainability has also become one of the worldwide concerns. In 2015 United Nation has proclaimed and established 17 Sustainable Development Goals with 169 targets for the next 15 years agendas. The 14th goal in these agendas is very focused on marine system which the main goal is to achieve conserve and sustainably use the oceans, seas and marine resources for sustainable development. In which includes several targets such as reduce marine pollution, sustainably manage and protect marine and coastal ecosystems, regulate harvesting and end overfishing, conserve at least 10 percent of coastal and marine areas, and enhance the conservation and sustainable use of oceans and their resources, etc. To support conservation planning for the sustainability resources, research related to biodiversity

would become important foundation for understanding the ecological role of an area. The finding of lobster diversity in Palabuhanratu Bay will be very significant in determining where and how the conservation program will be performed and executed in local scale. Moreover, as the centre of marine biodiversity, complete picture of marine biodiversity is needed, so that Indonesia can play a significant role to support resources sustainability program for the next generations.

Conclusions. In fishery perspective, with 12 species lobster occurring in the waters, Palabuhanratu might be a target ecosystem for local fishermen and other area. To ensure the sustainability use of the lobsters, proper regulation and management is needed. Information about the biology and stocks of each species would be beneficial and strengthening the management in both lobster aquaculture and fishery point of views.

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