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FIRST RECORD OF *DIOPATRA CLAPAREDII* GRUBE, 1878 (ONUPHIDAE, POLYCHAETA) FROM INDONESIAN WATERS, WITH SOME NOTES ON ITS ECONOMIC IMPORTANCE

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ABSTRACT

Diopatra claparedii Grube, 1878, is a common polychaete species that occurs in Southeast Asian countries, including Malaysia, Singapore, Thailand, and the Philippines. However, the occurrence of this species in Indonesia has never been recorded. In the present study, we identified the presence of *D. claparedii* in the eastern part of the Segara Anakan Lagoon in Cilacap, Central Java Province. The species is characterized as having distinct pectinate chaetae with funnel-like combs. The worms, like in some other Asian countries, are commercially exploited for use as fishing bait. The distributional map of this species is provided in this article.

Key words: Annelida, species description, tubicolous worms

INTRODUCTION

The genus *Diopatra* was erected by Audouin & Milne Edwards (1833) based on the species *Diopatra amboinensis* collected from Ambon, Maluku Province, Indonesia. The genus, to date, has 67 species that have been described worldwide (WoRMS Editorial Board, 2022). *Diopatra* is the only genus of the family Onuphidae whose members possess spiral branchiae (the other genera have either single or pectinate branchiae). The other two distinct characters of this genus include the presence of sensory papillae covering styles of both antennae and palps, and serrated limbate chaetae (Budaeva & Fauchald, 2011). These tubicolous worms occur in temperate and tropical coastal ecosystems, typically inhabiting protected intertidal and subtidal areas with soft sediment (Berke, 2022).

Diopatra claparedii Grube, 1878, was originally described from the type material collected from Manila, the Philippines. The species was later reported to occur in some neighboring countries such as Peninsular Malaysia, Singapore and Thailand; the worms are commercially exploited to be used as fishing bait (Paxton, 2002; Idris & Arshad, 2013). Despite the distribution of *D. claparedii* in several Southeast Asian countries, the occurrence of this species in Indonesian waters has never been reported. There are only two *Diopatra* species that have been identified from Indonesia, i.e., *D. amboinensis* and *D. uncinifera* Quatrefages, 1866; in total, seven onuphid species have been identified from the country (Pamungkas & Glasby, 2019). In the present work, we documented the occurrence of *D. claparedii* in the eastern part of the Segara Anakan Lagoon in Cilacap, Central Java Province.

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MATERIALS AND METHODS

Diopatra worms were obtained from two locations, i.e., the intertidal mangrove area of Jeruklegi Village and the subtidal area of Donan Creek in Karangtalun Village on June 4, 2021 and November 6, 2022, respectively. Both villages belong to Cilacap Regency, Central Java Province. The studied sites are part of the Segara Anakan Lagoon, i.e., a semi-closed estuary situated between Nusakambangan and Java Island. In Jeruklegi, the worms were collected from the intertidal area during a low tide using a hand shovel (the presence of these animals can be observed by looking at the tip of the animals' tube showing up on the muddy sediment surface). In Karangtalun, the worms were collected from the bottom of Donan Creek. Using one foot, the tip of the animal's tube was palpated; the tube containing the animal was then taken out of the sediment using bare hands. The animals were fixed using formalin 4% for about 24 hours, then rinsed using tap water and transferred into a jar with alcohol 70%. The specimens were identified in the laboratory under a stereo microscope OLYMPUS SZ11 and a compound microscope OLYMPUS CKX53 (an OLYMPUS EP50 camera was mounted to the latter microscope) using the identification keys of Fauchald (1977) and Budaeva & Fauchald (2011). All the specimens of the present work are deposited at the Museum Zoologicum Bogoriense (MZB) in Cibinong, Bogor, West Java Province, and are the first *Diopatra* collection of the museum. The distributional map of the species (Fig. 1) was created using *SimpleMappr* (www.simplemappr.net) and *Google Maps*.

RESULTS

In total, 22 individuals of *Diopatra* were examined. The lower number of individuals examined from Jeruklegi (2) was because most of the individuals collected from this village had been used in the study by Wibowo et al. (2022). We found that all of these solitary tubeworms were identical to *D. claparedii* Grube, 1878. Our finding thus extends the distribution of the species in Southeast Asia. The detailed photographs of the preserved species, as well as the photomicrographs of the animals' chaetae, complement the previous species descriptions by Grube (1878), Paxton (2002), and Idris & Arshad (2013) – the first two studies used line drawings whereas the third one mostly used SEM micrographs to describe the species. Additionally, we provided the photograph of the animal's tube which was not provided in the previous studies.

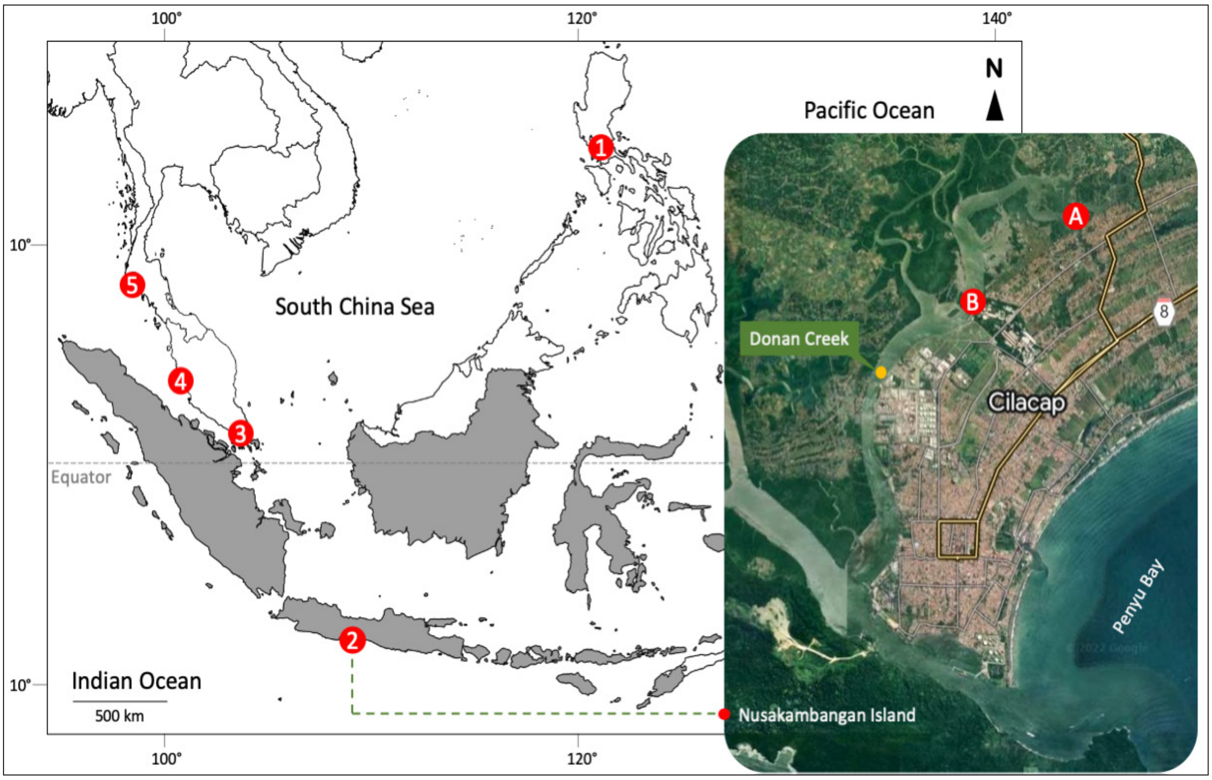

Figure 1. Distributional map of *Diopatra claparedii*. Red circles indicate geographic areas in which the species was reported to occur. Symbols: 1, Manila, the Philippines (the type locality); 2, Central Java, Indonesia (present study); 3, Sungei Buloh, Singapore; 4, Peninsular Malaysia; 5, Nam Bor Bay and Phang-nga Bay, Thailand; A, Jeruklegi Village; B, Karangtalun Village.

SYSTEMATICS

Order Eunicida
Family Onuphidae Kinberg, 1865
Genus *Diopatra* Audouin & Milne Edwards, 1833
Diopatra claparedii Grube, 1878
(Figs 2–4)

Material examined. 2 (MZB. Pol. 00237), intertidal mangrove habitat of Jeruklegi, Cilacap, Central Java, 7°39’53.5”S, 109°02’01.9”E, coll. Eko S. Wibowo, June 4, 2021. 20 (MZB. Pol. 00238), Donan Creek near Karangtalun Village, Cilacap, Central Java, 7°40’47.6”S, 109°00’40.5”E, coll. Muji, November 6, 2022.

Diagnosis. Tube conical and elongated, tapering posteriorly, ranging from 30 to 60 cm long. Anterior part of tube tough, thick and leathery, reinforced with fibers and bits of mangrove leaves, and sometimes plastic; posterior part thin and papery. A few larger mangrove leaves usually present near tube opening (Fig. 2).

All specimens incomplete (anterior part) with 32–158 chaetigers, 4.5–13 cm long and 0.7–1 cm wide. Living specimens dark reddish brown, yet a few days after preservation prostomium, peristomium and chaetigers 1–7 turning purplish with longitudinal striations. Purplish color extends to both antennophores and palpophores, as well as basal part of first few parapodia. Other parts of body generally pale yellow, except branchiae moss green (Fig. 3).

Prostomium anteriorly rounded with two paired subulate frontal lips. Ceratophores of both antennae and palps with around 9 proximal rings and 1 longer distal ring; styles gradually tapering with relatively pointed tips. Three antennae more or less equal in length, reaching chaetiger 10. Two paired palps reaching chaetiger 2 (Fig. 3). One pair of well-developed nuchal organs presents, forming 3/4 circular grooves, mostly hidden under peristomium probably due to fixation. Maxillae sclerotized with following formula: Maxilla I = 0–1 + 0–1, Maxilla II = 0–8 + 0–8, Maxilla III = 0–8 + 0, Maxilla IV = 0–8 + 0–8, Maxilla V = 0–1 + 0–1 (some specimens do not possess maxillae). Mandibles with shafts and high cutting plates; shafts comprising dark and whitish regions.

Peristomium with one pair of subulate peristomial cirri, inserted subdistally on anterior part of peristomium, almost lateral to antennae, about 1–1.5 times as long as peristomium. Peristomium and chaetigers 1–5 about twice as long as following ones (Figs. 3A, B, & D).

Anterior parapodia with lip-like prechaetal lobes and subulate postchaetal lobes. Prechaetal lobes best developed on chaetigers 1–4, reduced from chaetigers 5–7, and absent from chaetiger 8 posteriorwards. Postchaetal lobes gradually reduced posteriorwards from chaetiger 6, but still present as small lobes to around end of branchiate region.

Dorsal cirri subulate, becoming very slender posteriorly, present from first to last chaetigers. Ventral cirri subulate, much smaller than dorsal cirri, gradually shorter posteriorwards, present on chaetigers 1–5 only. Spiralled branchiae starting from chaetiger 4, best developed on chaetigers 6–10 with 10–18 whorls, reaching to chaetiger 1 when anteriorly extended. Branchial whorls closely spaced, individual filaments thin, becoming shorter towards tip of branchia, giving bush-like appearance (Fig. 4A).

Modified parapodia (chaetigers 1–4) with 1–2 slender simple chaetae on upper side and falcate and bidentate hooks with short hoods on lower side (Figs. 4B & C). From chaetiger 5 posteriorwards limbate chaetae replacing hooks (Fig. 4D). Pectinate chaetae with funnel-like combs present from anterior chaetigers posteriorwards (Fig. 4E).

Remarks. The specimens examined in the present study agree well with the original description of *D. claparedii* by Grube (1878), as well as the redescriptions of the species by Paxton (2002) and Idris & Arshad (2013). While spiraled branchiae (Fig. 4A) confirm the identity of the genus, *D. claparedii* can be distinguished from all other *Diopatra* species by the presence of distinct pectinate chaetae with funnel-like combs (Fig. 4E).

Distribution. *Diopatra claparedii* has been reported to occur in several Southeast Asian countries including Malaysia, Singapore, Thailand, the Philippines, and Indonesia (present study).

Habitat. *Diopatra claparedii* inhabits both intertidal and subtidal estuarine habitats.

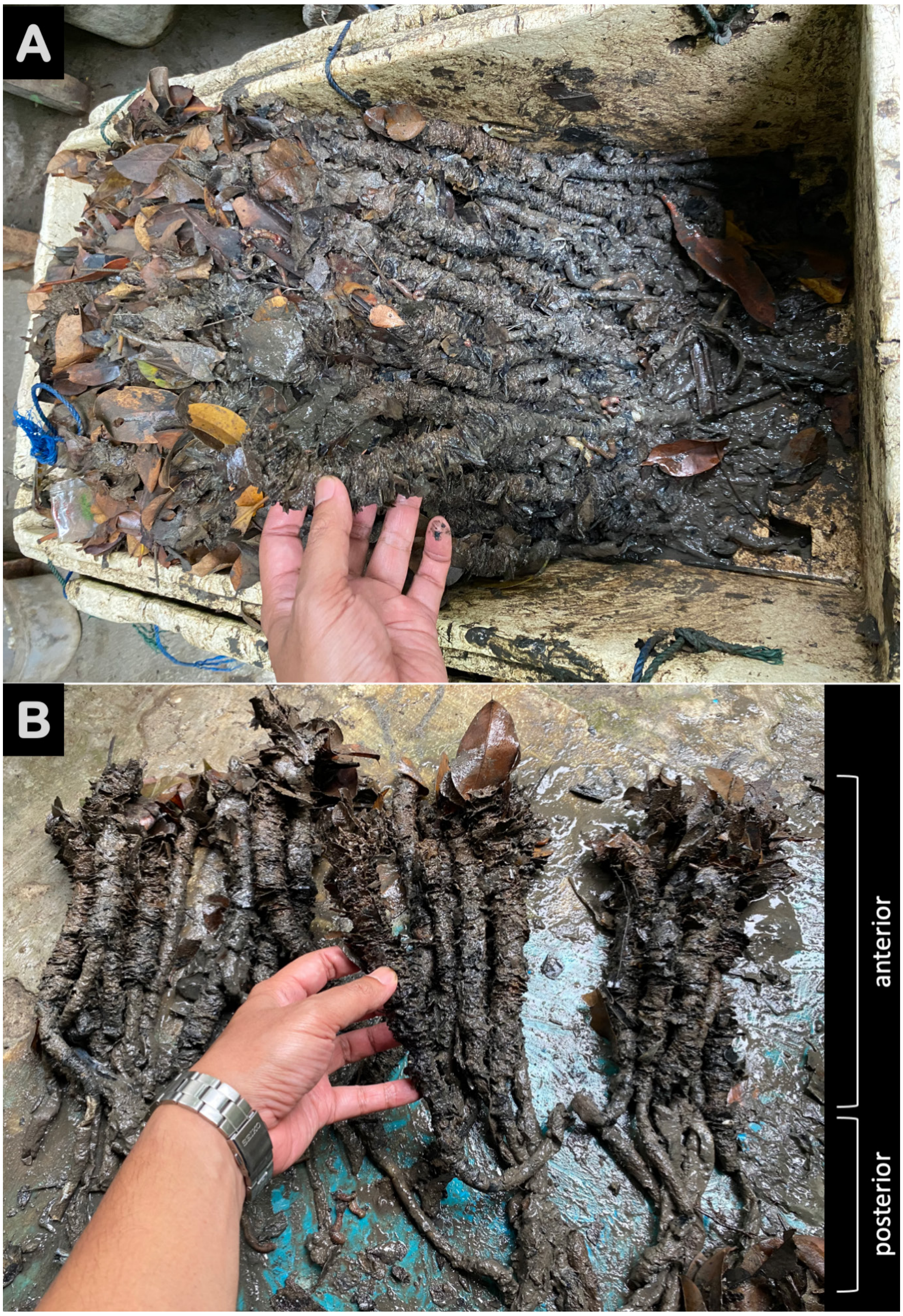

Figure 2. *Diopatra claparedii* in their tubes collected from Karangtalun Village, Cilacap: (A) Freshly caught worms in a styrofoam box; (B) Preparation of worm packing for sale (one plastic pack contains 5-7 worms depending on the size).

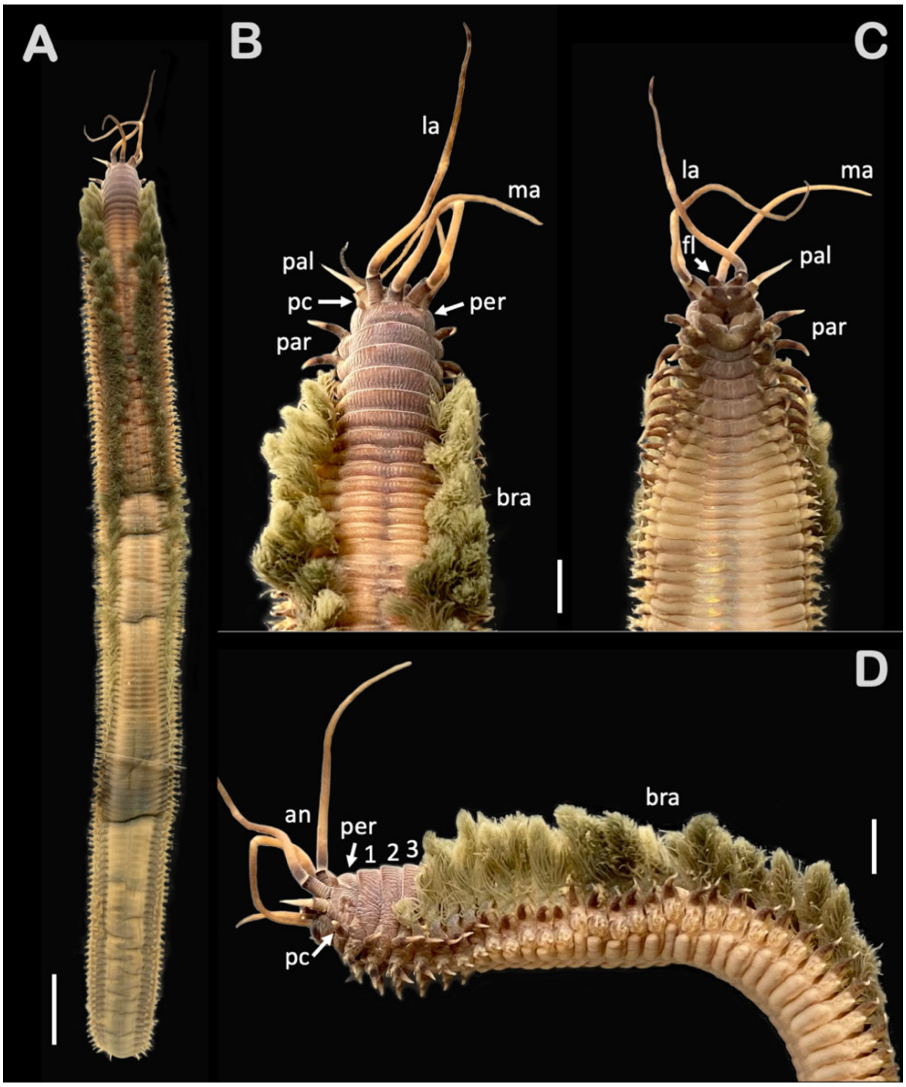

Figure 3. *Diopatra claparedii*: (A) anterior part; (B) anterior dorsal view; (C) anterior ventral view; (D) anterior lateral view. Abbreviations: an, antennae; bra, branchiae; fl, frontal lip; la, lateral antenna; ma, median antenna; pal, palp; par, parapodia; pc, peristomial cirrus; per, peristomium; numbers 1–3, chaetigers 1–3. Scale bars: A, 1 cm; B–D, 0.25 cm.

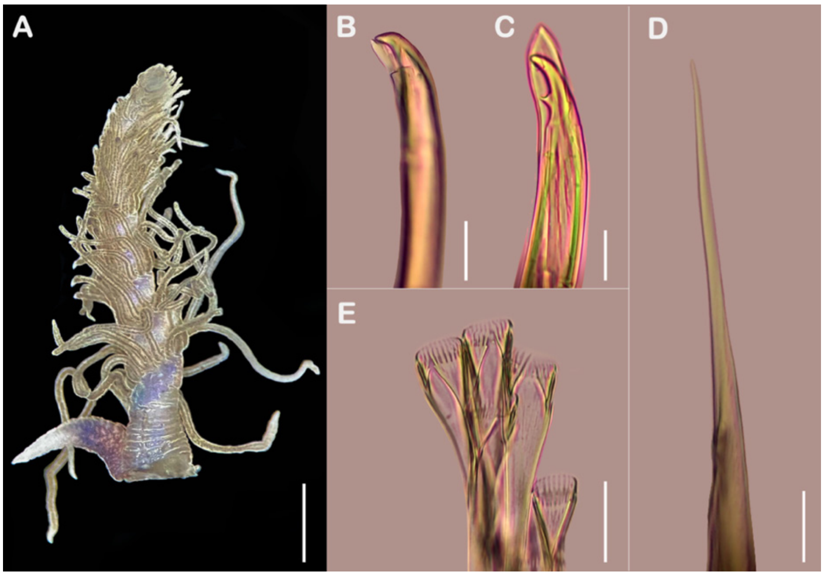

Figure 4. Body parts of *Diopatra claparedii*: (A) anterior branchia; (B) simple falcate hook from chaetiger 3; (C) pseudocompound bidentate hook from the same chaetiger; (D) limbate chaeta from a middle parapodium; (E) pectinate chaetae from the same parapodium. Scale bars: A, 1 mm; B, D, E, 50 µm; C, 25 µm.

DISCUSSION

Members of the genus *Diopatra* are generally considered difficult to identify as the worms look almost identical and lack clear diagnostic features. The animals can only be distinguished by combinations of several morphological characters showing various degrees of overlap and variability (Paxton, 2002). Many of *Diopatra* species, including *D. claparedii*, were consequently mistakenly identified as another species, mostly the well-known European species *D. neapolitana* Delle Chiaje, 1841 (e.g., Paxton, 2002; Idris & Arshad, 2013; Berke, 2022), leading to the incorrect conclusion that *D. neapolitana* is cosmopolitan.

Although *Diopatra* species are generally well represented in warmer waters and can be expected to be common in the Indo-Pacific region (Paxton, 2002), only two species have been described from Indonesia, i.e., *D. amboinensis* and *D. uncinifera*. Unfortunately, none of the type materials of both species has been deposited in the country, which results in the difficulty for local researchers to use them as comparative materials in identifying *Diopatra* species. Records of *Diopatra* and other Indonesian polychaete species in general are limited as most biodiversity studies conducted by local researchers have focussed more on ecological aspects; the specimens yielded from these studies were mostly identified to either family or genus level only (Pamungkas & Glasby, 2019).

Besides becoming the first record from the country, *D. claparedii* obtained in our study was interestingly also a new record from mangrove habitats of the Segara Anakan Lagoon despite a number of benthic studies conducted around the estuary (e.g., Indarjo et al., 2005; Nordhaus et al., 2009; Pamungkas, 2013). It was initially postulated that the local species prefer to inhabit mangrove habitats relatively far away from the industrial area of the lagoon (Wibowo et al., 2022) as the area, i.e., the water, the sediment, and the macrobenthic invertebrates, was reported to be contaminated mostly by polycyclic aromatic compounds (Dsikowitzky et al., 2011). However, the fact that *D. claparedii* was also found in Donan Creek near Karangtalun Village, which is situated around the industrial area, suggested that the species may be resistant to contaminants. The contaminants, nonetheless, may have caused abnormalities in *D. claparedii* morphology as we found individuals with incomplete and even without maxillae.

We noticed that *D. claparedii* is more likely to occur in water areas with higher salinity, i.e., the eastern part of the Segara Anakan Lagoon – a recent study by Wibowo et al. (2022) reported that the species inhabited areas with salinity levels between 25 and 32 ppt. This partly explains why Indarjo et al. (2005) did not find the species in Klaces, i.e., a village in the western part of the lagoon, and neither did Pamungkas (2013). That is because the water salinity in the western part of the lagoon is relatively low throughout the year due to the presence of two big rivers that empty into the lagoon, i.e., Cibeureum and Citanduy. In a rainy season, for example, the salinity levels in the area ranged from 2.8 to 10.2 ppt (Pamungkas, 2013), which is much lower below the tolerable range for *Diopatra* species, i.e., between 15 and 40 ppt (Hakkim, 1975). Both lower and higher salinity levels, i.e., 21 and 42 ppt, respectively, were reported to result in a lower regenerative capacity of *D. neapolitana* (Freitas et al., 2015; Pires et al., 2015), which may also apply to *D. claparedii*. In addition, ecological sampling devices such as core and grab samplers are apparently not effective in sampling these relatively big tube worms (the instruments are designed to sample smaller benthic animals) that previous benthic studies in the Segara Anakan Lagoon did not yield the species.

Furthermore, while Java has been the island where *D. claparedii* was first documented to occur within the country, we suspect that the animals also dwell along the northern coast of Sumatera, across the Peninsular Malaysia and Singapore, where the worms were reported to occur (Paxton, 2002; Idris & Arshad, 2013). This is because, geographically, the coast is relatively protected with quite large mangrove habitats ideal for the species to live. Further taxonomic studies are required to prove this, as Sumatera is among the islands with poorly studied polychaete diversity (Pamungkas & Glasby, 2019).

Diopatra claparedii is popular among local anglers as the worms are used as fishing bait, just like *D. neapolitana* in Europe (e.g., Cunha et al., 2005). *Diopatra claparedii* is called '*lur umah*' in the local language, which means 'marine worm with housing', and is sold at a price of IDR 1000 per individual (the animals are traded in the worm diggers' house, not in traditional markets). Despite their economic importance, the population of *D. claparedii* in Cilacap may be threatened as an experienced worm digger may obtain about a 300–400 individuals within a few hours of digging. This digging activity is generally considered unsustainable for the environment as it may lead to the depletion of natural resources – data on the annual catch estimates of the worms are unfortunately not yet available. Additionally, the lagoon has been reported to be consistently shrinking over time due to sedimentation – the estuary is evolving into dry land (Yuwono et al., 2007). *Diopatra claparedii* worm farming seems to be the potential solution to utilize the worms in a more sustainable way as proposed by Wibowo et al. (2022).

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REFERENCES

Audouin, J.V. & Milne Edwards, H. 1833. Classification des Annélides et description de celles qui habitent les côtes de la France (Part 2). *Annales des sciences naturelles*, *Paris*, 1(28): 187–247.

Berke, S.K. 2022. A review of *Diopatra* ecology: Current knowledge, open questions, and future threats for an ecosystem engineering polychaete. *Biology*, 11(10): 1485.

Budaeva, N. & Fauchald, K. 2011. Phylogeny of the *Diopatra* generic complex with a revision of *Paradiopatra* Ehlres, 1887 (Polychaeta: Onuphidae). *Zoological Journal of the Linnean Society*, 163(2): 319–436.

Cunha, T., Hall, A. & Queiroga, H. 2005. Estimation of the *Diopatra neapolitana* annual harvest resulting from digging activity in Canal de Mira, Ria de Aveiro. *Fisheries Research*, 76: 56–66.

Delle Chiaje, S. 1841. *Descrizione e Notomia Degli Animali Invertebrati della Sicilia Citeriore Osservati Vivi Negli Anni 1822–1830*. Batteli & Co., Naples. Parts 1-8

Dsikowitzky, L., Nordhaus, I., Jennerjahn, T. C., Khrycheva, P., Sivatharshan, Y., Yuwono, E. & Schwarzbauer, J. 2011. Anthropogenic organic contaminants in water, sediments and benthic organisms of the mangrove-fringed Segara Anakan Lagoon, Java, Indonesia. *Marine Pollution Bulletin*, 62(4): 851–862.

Fauchald, K. 1977. The polychaete worms. Definitions and keys to the orders, families and genera. *Natural History Museum of Los Angeles County*, *Science Series*, 28: 1–190.

Freitas, R., Coelho, D., Pires, A., Soares, A.M.V.M., Figueira, E. & Nunes, B. 2015. Preliminary evaluation of *Diopatra neapolitana* regenerative capacity as a biomarker for paracetamol exposure. *Environmental Science and Pollution Research*, 22(17): 13382–13392.

Grube, Adolph-Eduard. 1878. Annulata Semperiana. Beiträge zur Kenntniss der Annelidenfauna der Philippinen nach den von Herrn Prof. Semper mitgebrachten Sammlungen. *Mémoires l'Académie Impériale des Sciences de St.- Pétersbourg* (série 7), 25(8): 1–300.

Hakkim, V.M. 1975. Salinity tolerance of *Diopatra neapolitana* Delle Chiaje: Annelida-Polychaeta. *Indian Journal Marine Science*, 4(1): 99–101.

Idris, I. & Arshad, A. 2013. Checklist of polychaetous annelids in Malaysia with redescription of two commercially exploited species. *Asian Journal of Animal and Veterinary Advances*, 8: 409–436.

Indarjo, A., Widianingsih & Abdulah, A.B. 2005. Distribusi dan kelimpahan Polychaeta di kawasan hutan mangrove Klaces dan Sapuregel, Segara Anakan, Cilacap. *Ilmu Kelautan*, 10(1): 24–29.

Kinberg, J.G.H. 1865. Annulata nova. *Öfversigt af Königlich Vetenskapsakademiens förhandlingar, Stockholm*, 21(10): 559–574.

Nordhaus, I., Hadipudjana, F.A., Janssen, R. & Pamungkas, J. 2009. Spatio-temporal variation of macrobenthic communities in the mangrove-fringed Segara Anakan lagoon, Indonesia, affected by anthropogenic activities. *Regional Environmental Change*, 9(4): 291–313.

Pamungkas, J. 2013. Polychaete community composition of the Segara Anakan mangrove forest, Cilacap, Central Java, Indonesia. Thesis. University of Bremen, Bremen.

Pamungkas, J. & Glasby, C.J. 2019. Status of polychaete (Annelida) taxonomy in Indonesia, including a checklist of Indonesian species. *Raffles Bulletin of Zoology*, 67: 595–639.

Paxton, H. 2002. *Diopatra* Audouin and Milne Edwards (Polychaeta: Onuphidae) from Thailand. *Phuket Marine Biological Center Special Publication*, 24: 101–114.

Pires, A., Figueira, E., Moreira, A., Soares, A.M.V.M. & Freitas, R. 2015. The effects of water acidification, temperature and salinity on the regenerative capacity of the polychaete *Diopatra neapolitana*. *Marine Environmental Research*, 106: 30–41

Quatrefages, A. de. 1866. Histoire naturelle des Annelés marins et d'eau douce. Annélides et Géphyriens. *Librarie Encyclopédique de Roret*, *Paris*, 1: 1–588.

Wibowo, E.S., Puspitasari, I.G.A.A.R., Atang & Pamungkas, J. 2022. Biological aspects of *Diopatra* sp. (Onuphidae, Polychaeta) collected from mangrove habitats of Jeruklegi, Cilacap Regency. *Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan* 11(3): 299–305.

WoRMS Editorial Board. 2022. World Register of Marine Species. Available from https://www.marinespecies.org at VLIZ. Accessed 2022-11-06. doi:10.14284/170

Yuwono, E., Jennerjahn, T.C., Nordhaus, I., Riyanto, E.A., Sastranegara, M.H. & Pribadi, R. 2007. Ecological status of Segara Anakan, Indonesia: a mangrove-fringed lagoon affected by human activities. *Asian Journal of Water, Environment and Pollution*, 4(1): 61–70.