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Short Communication: Seawater Mollusca (bivalve) diversity at Dullah Laut Beach, Tual City, Southeast Moluccas, Indonesia

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Abstract. *Roshitafandi DA, Sartika HW, Dewi AK, Nashrurrokhman M, Ratman N, Trijoko. 2018. Short Communication: Seawater Mollusca (bivalve) diversity at Dullah Laut Beach, Tual City, Southeast Moluccas, Indonesia. Ocean Life 2: 21-26.* Indonesia is a country that has high-level of biodiversity supported by diverse types of beaches. Dullah Laut Village is located on one of the small islands in Southeast Moluccas. Dullah Laut Beach is a natural white sandy beach with algae, seagrass, and rocky substrate. Bivalve is part of the Mollusca found mostly on the Dullah Laut Beach. The purpose of this research is to know the diversity of Bivalve class in the intertidal zone of Dullah Laut Beach, Southeast Molucca related with the environmental parameters. This research was conducted in July and August 2017. The environmental parameters recorded at the time of the study were 27°C for temperature, 0,01 mg/L for nitrite, and 0,5 mg/L for ammonia. The method used in this study is purposive sampling method. After data collection was completed, the next steps were documentation, preservation, and identification conducted in the Faculty of Biology, Universitas Gadjah Mada, Indonesia. Based on this research, we found 4 genera of the class Bivalve in Dullah Laut Beach namely *Atactodea*, *Macrocallista*, *Mactra*, and *Hippopus.*

Keywords: Diversity, Dullah Laut, Mollusca, Southeast Moluccas

INTRODUCTION

Indonesia is a country with high levels of biodiversity supported by its location in the tropics (Supriatna 2008). In addition to megadiversity countries, Indonesia is a maritime country that has abundant marine wealth. Various types of beaches that exist in Indonesia support various kinds of marine life. Various marine commodities can be cultivated today such as fish, crustaceans, molluscs, echinoderms, and seaweed. One of the most live animals includes well-exploited molluscs such as meat oysters, pearl oysters, green shells, blood clams, abalone, and kima (Sudradjat 2015). One of the abundant marine biotas in Indonesia is Mollusca. Molluscs are suitable to live in sandy beach environments and coral fragments (Romimohtarto and Suhardjono 1999). Molluscs are covered with an exoskeleton. Eastern Indonesia is one part of Indonesia that has various types of beaches that are still natural. The beach consists of various substrates such as algae, seagrass, sand, and rocks suitable for Mollusca habitat. Dullah Laut Village is a small island in Southeast Moluccas that has beaches with various substrate. The island is located at the coordinate point -5.533990 LS / 748941 BT and obscured by other small islands. These sandy and rocky beach characteristics are very suitable for habitat for Molluscs, especially bivalves. In accordance with the origin of the word (bi = two, valve = kaleal kalkareus), bivalves are a type of Mollusca that has a shell (Holley 2015). The sedentary live bivalves are filter-feeders. The sleek bushes secrete strong threads that attach them to the substrate of rocks, docks, ships, other animal shells, and so on. Yet there are also bivalves such as clams that can live with interesting the self-enters the sand or mud using its muscle legs as an anchor. Then there are also bivalves such as mussels that move fast along the seafloor by flapping their shells (Campbell et al. 2008). In this study, bivalves took based on different substrate types will be analyzed. In addition, with the existence of bivalves that are still awake there, data collection is needed to assess the potential in the village of Dullah Laut. The state of the village beach Dullah an unspoiled sea and become an archipelago becomes an exciting reason for proper research. This results in Mollusca being a good environmental indicator. This study was conducted to determine the diversity of bivalves in the coastal village Dullah Laut. The expected outcome of this research could be a database for conservation and science concerning Mollusca for the wider community.

MATERIALS AND METHODS

Study area

The study was located at Dullah Laut Beach, Duroa Island, Tual City, Southeast Moluccas, Indonesia (coordinate -5.533990LS/132.748941BT) (Figure 1). Sampling was conducted in intertidal zone of Dullah Laut Beach. These sites have varied types of substrate. Substrate types were classified as sandy substrate, seagrass substrate, and rocky substrate (low tide near subtidal zone).

Procedures

Collection of molluscs was done by purposive sampling method in various substrates within the intertidal zone. If the substrate was sandy, the collection of molluscs was done by digging. Sampling was conducted four times in two months on 13, 21 June, and 14, 26 July at 04.45 pm until 18.00 pm WIT. All bivalve specimens found alive were collected and placed into a plastic container. The collection of mollusc samples mollusc was assisted by local residents. Samples were preserved by washing, boiling, then cleaning the contents. The samples of mollusc were documented on mm block paper and were brought to the Faculty of Biology, Universitas Gadjah Mada, Indonesia for identification. Preserved samples of mollusc were identified with the help of FAO, Worms, EOL, and other literature. The environmental parameters like water temperature was tested four times in two months with a thermometer. Test of nitrite and ammonia was done by LIPI (Lembaga Ilmu Penelitian Indonesia) using KIT ammonia and nitrate.

RESULTS AND DISCUSSION

Results

The list of species is presented in Table 1, as well as Figure 2-5. The samples of mollusc (bivalve) were identified belonging to genus *Atactodea, Hippopus, Macrocallista, Mactra,* and *Tridana*.

The substrate of Dullah Laut Beach in the intertidal zone was sandy, seagrass, then rocky substrate. Atactodea was found on sandy substrate by digging. *Macrocallista* and *Mactra* were found on substrate that was overgrown with seagrass. *Hippopus* was found on sandy bottoms of rock substrate.

The sample of water from Dullah Laut Beach was brought to LIPI to test the nitrate and ammonia content using KIT nitrate and ammonia. The result of nitrite content is 0.01 mg/L and ammonia is 0.5 mg/L. The value of nitrite contained when it compared with water quality standards from government decisions (KMLH No 51 2004) it is not more than the standard value which means the water was still safe for the cultivation or life of marine animal, while the value of ammonia exceeded the standard value which means the water is not good enough for cultivation.

Table 1. Type of substrate for each genus of mollusc in Dullah Laut Beach, Moluccas, Indonesia

Genus	Kind of substrate
Atactodea	Sandy substrate
Hippopus	On sandy bottoms of rock substrate
Macrocallista	Seagrass
Mactra	Seagrass

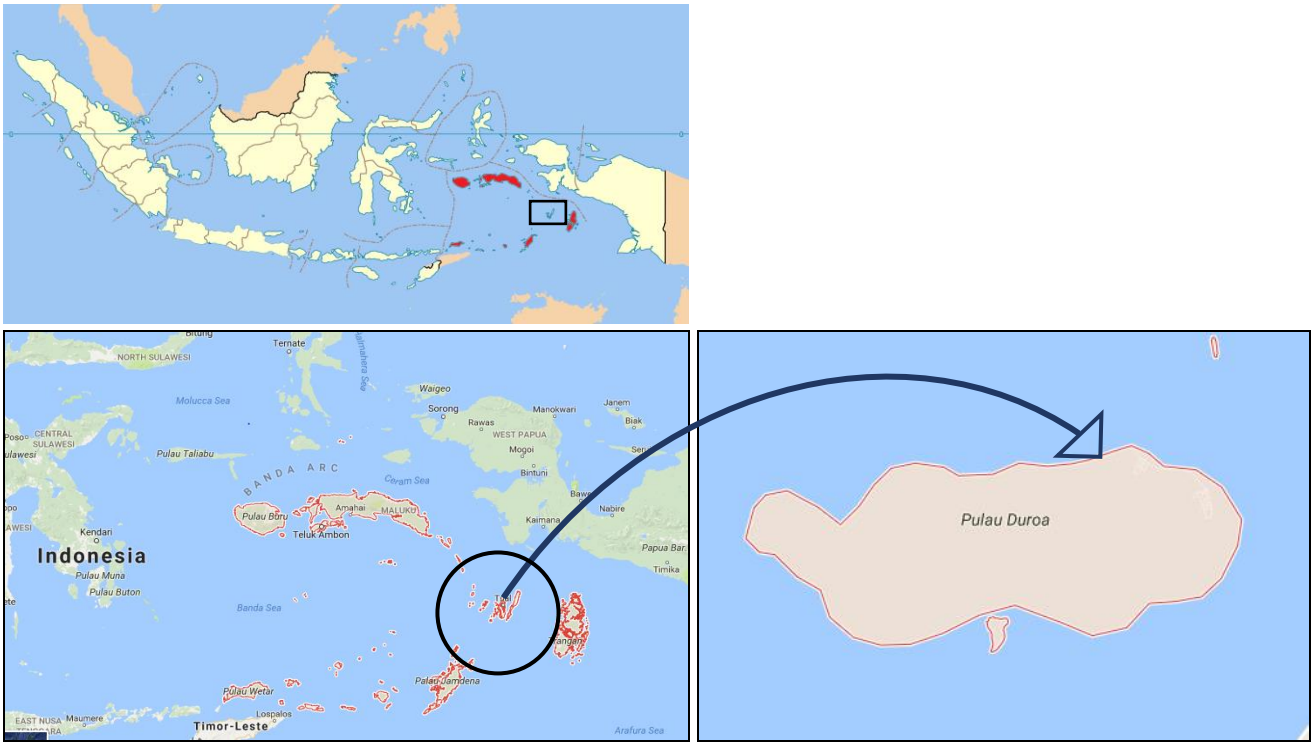

Figure 1. Location of Dullah Laut Beach, Maluku, Indonesia

Table 2. Test results of nitrite and ammonia samples

Test Results of nitrite samples			
Location	Cons	Unit (mg/L)	Evidence
In front of Dullah Laut Junior High School	-	0.01	Still safe for the cultivation or life of marine life, based on (KMNLH 2004 No.51)
Test result of ammonia sample			
Location	Cons	Unit (mg/L)	Evidence
In front of Dullah Laut Elementary School	-	0.5	Not good enough for cultivation because it does not match with the value of water quality standards
Comparison with water quality standards			
The value of water quality standards in accordance with government decisions (KMNLH No 51 2004)	Nitrite : its value is not more than 0.1 mg/L Ammonia : its value is not more than 0.3 mg/L'		

Discussion

Generally, Bivalvia is an aquatic organism which lives on the bottom of the sea and buries itself in sand or corals (Nontji 1987). This organism is well distributed on mud and soft sediment due to its feeding characteristic, which is filter feeder and burrower (Woodin 1976). The size of sediment grain would influence the distribution of bivalves. A coarse sediment has lower nutrition for bivalves because organic substances could not settle (Wood 1987). Based on Regulation of Environmental Ministry number 51 (2004), the interval pH for marine organism between 7-8.5 mg / L. The result of Nitrite contain on the seawater could be nutrition for bivalve because the value is still within limits while the result of Ammonia found in this study could be toxic for bivalves. The value of ammonia exceeds the standard value probably because the waters have been contaminated with either organic or inorganic waste.

Atactodea is an edible dioecious cosmopolitan clam which its very abundant on tropical region (Baron 1992; McLachlan and Brown 2006; Boxshal et al. 2013). These clams live on fine sand and bury itself in it to find food, reproduce, and avoid predators (Heryanto and Radjab 2013). The morphological characteristic of *Atactodea* is small, small, equivalve and relatively robust. Internal ligament, a poorly-defined umbo, relatively pronounced lateral teeth and grooves and sculptured concentric ridges. The species is opisthogyrate, whereby the umbones curve toward the posterior rather than the anterior margin of the valve, thereby reversing the usual mode of identification for left and right valves (Chan 2010; Lamprell and Whitehead 1992). This bivalve is a true filter feeder on sandy substrates at intertidal zone (Baron 1992; Paulay 2000).

Mactra includes to family Mactridae Lamarck. The common name of its species is wedge through shell with the size up to 40 mm and distributed on Indo-Pacific to Durband (Nel et al. 2012). This species belongs to Kingdom Animalia, Phylum Mollusca, Class Bivalvia, Order Eulamellibranchiata, Family Mactridae, Genus *Mactra* (Venkatesan et al. 2010). Mactridae was known as "surf clams" family which consist of 180 species (Huber 2010).

The characteristic of *Mactra* and *Atactodea* as a member of Mactridae are having shell equivalve, ovate or trigonal to transversely elongated, closed to somewhat gaping posteriorly. Umbones prosogyrate, more or less prominent. Outer surface smooth or mostly concentrically sculptured, often with an obvious periostracum. External ligament short and not prominent, just behind the umbones; internal ligament well developed, set in each valve in a deep trigonal pit of the hinge plate and pointing towards the umbo. Hinge characteristic, each valve with two cardinal teeth and smooth or striated, more or less developed, lateral teeth; cardinal teeth of the left valve forming an inverted V-shaped process; delicate additional cardinal lamellae often present in either valve. Interior of shell porcelaneous. Two, often subequal, adductor muscle scars. Pallial line with a well-developed sinus (Carpenter and Niem 1998).

Atactodea known as active burrower in sandy or muddy substrate with feeding type is filter feeding in the soft bottom ecosystem (Poutiers 1998; Lamprell and Whitehead 1992). Meanwhile, it also had a role as filtering water clarity, phytoplankton, and suspended solids on estuary (Gerritsen et al. 1994). *Mactra* also could be found in mangroves and seagrass beds (Masagca et al. 2010; Mudjiono et al. 1992). Having female and male reproductive organs in separates individual, it is a dioecious animal with free swimming in the larval stage. Generally, these species are considered edible bivalves (Carpenter and Niem 1998). On outer valves of this Bivalvia, there is a calcified layer. Vaughn and Hakenkamp (2001) explain that algae and other invertebrates could attach on bivalve shells.

The shells of *Mactra* and *Atactodea* are mostly solid, equivalve or subequivalve, obliquely rounded, or ovate to subtrigonal in outline and usually not gaping; inequilateral, with generally prominent, prosogyrate umbones, at or in front of the midline of shell. Lunule and/or escutcheon are usually present. The sculpture is only concentric, or with a radial component. The periostracum is typically inconspicuous. The external ligament, located behind the umbones, is often inserted in a deep groove. The hinge has 3 usually radially disposed of cardinal teeth in each valve (1 or more of which may be grooved or bifid), anterior

lateral teeth are sometimes present. The interior of the shell is porcelaneous. Two more or less equal adductor muscle scars, the posterior is sometimes slightly larger. Pallial sinus is usually present. Internal margins are smooth to denticulate. Gills of eulamellibranchiate type, with folded branchial sheets; outer demibranch are smaller than the inner, expanded and almost flat above the axis. The foot is large and rather short, hatchet-shaped, and rarely byssate in the adult. The mantle broadly opens ventrally. Siphons are short to long, naked, fused or separate, with simple tentacles on tips and inside the inhalent opening to strain out large particles (Carpenter and Niem 1998).

Macrocallista is a bivalve belonging to the family Veneridae (Sartori et al. 2015). The shell of *Macrocallista* is mostly solid and transversely elongate-oval with a more or less smooth surface. The interior of the shell is porcelaneous and the pallial sinus is deep with two typically equal adductor muscle scars. Lunule and/or escutcheon at the dorsal view are usually present. The external ligament, behind the umbones, is often inserted in a deep groove with three hinges that usually radially disposed of cardinal teeth in each valve (one or more of which may be grooved or bifid), and anterior lateral teeth are sometimes present. The mantle broadly opens ventrally. Such as *Mactra* and *Atactodea*, *Macrocallista* are also active borrowers in various soft bottoms among marine growths like seagrass. *Macrocallista* are common in low intertidal to shallow subtidal depths (Carpenter and Niem 1998; Etheridge and Jack 1892).

Hippopus is genera that belongs to the family Cardiidae, subfamily Tridacninae (ter Poorten et al. 2014; ter Poorten 2014). Cardiidae is an important and conspicuous mollusc family found throughout the Red Sea and Indo-Pacific, from East Africa to the Eastern Pacific biogeographic region (Rosewater 1965; Othman et al. 2010). *Hippopus* is generally known as giant clam or kima. The shell of family Cardiidae is equivalve, thick, heavy and often very large, with strongly scalloped free margins, inequilateral. The body and shell in adults of Tridacnidae appear to be reverse to other bivalves because of their highly specialized mode of life. The valve margins are in dorsal position and the umbones, ligament, and hinge are situated ventrally. The outer surface of the shell has strong radial folds. The externak ligament is set in a groove of the anteroventral margin. A hinge with a single ridge-like cardinal tooth is present in each valve; two lateral teeth in the right valve and one lamellar lateral tooth in the left valve. The interior is porcelaneous, has a pallial line without a sinus and internal margins are often more or less crenulated (Carpenter and Niem 1998).

Hippopus is globose in shape, without a well-defined byssal orifice or very slight**.** *Hippopus* is found in sandy bottoms of rocky substrate, its foot is relatively large and non-byssate. The mantle of *Hippopus* does not indeed exceed from shells. The IUCN Red List Category and Criteria Hippopus is of least concern which means a lower risk or conservation dependent (Wells 1996).

Tridacninae mantle is much larger than that of other bivalves and it had various functions such as protecting soft organs, water transport and maintenance of the symbiotic relationship with dinoflagellates. The mantle coloration and patterns vary greatly within species. The least variation in the mantle exists in *T. gigas*, *H. hippopus*, and *H. porcellanus* (Calado et al. 2017). Their distribution is Tropical eastern Indian Ocean to western Pacific, from the Andaman Islands to eastern Melanesia; north to southern Japan and south to Queensland, restricted in the tropical western Pacific; known from the southern Philippines, Sulawesi (Celebes), Moluccas and western Irian Jaya (New Guinea) (Carpenter and Niem 1998).

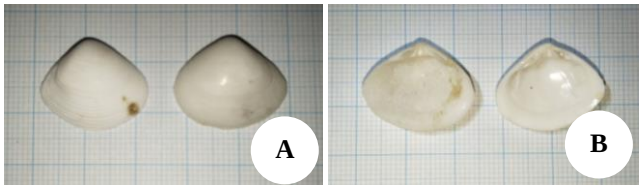

Figure 2. Shell of *Atactodea* (A) exterior view and (B) interior view

Figure 3. Shell of *Mactra* (left) interior view and (right) exterior view

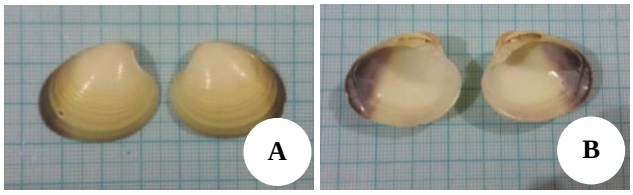

Figure 4. Shell of *Macrocallista* (A) interior view and (B) exterior view

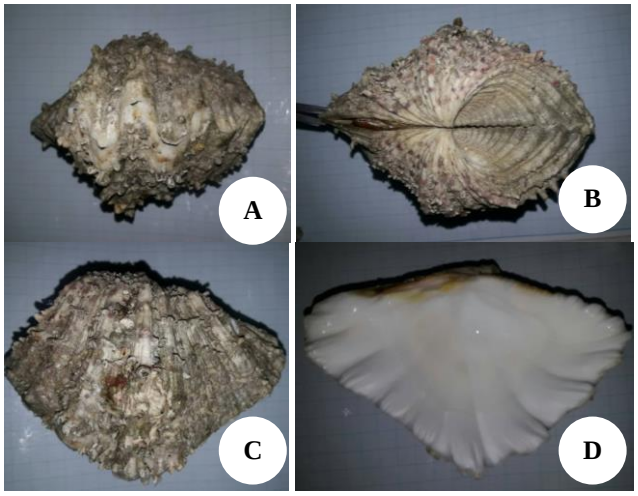

Figure 5. Shell of *Hippopus* (A) dorsal view, (B) ventral view, (C) exterior view, and (D) interior view

Tridacninae is a mixotrophic filter-feeder. The sources of organic carbon in the metabolites are supplied by symbionts and also by passively filtering live and dead organic compounds from the water column. Tridacninae is the only bivalve that can establish a symbiotic relationship with dinoflagellates. A larger mantle surface allows a larger symbiotic population that will perform photosynthesis and secrete larger amounts of organic compounds to the Tridacninae. The presence of such dinoflagellates coupled with accessory pigments can result in intense coloration of its mantle (Calado et al. 2017).

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