

Biodiversity and fish resources management of the north Central Java sea

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Abstract

Central Java is a province in Indonesia located in the central part of Java Island and is surrounded by the north and south coasts. The bottom of the north coast is not deep compared to the south coast, and the waves are not as fierce as the south sea, so there are many passenger and fishing ports on the north coast. The south coast is steep, and the waves are fierce, so it is rarely used for harbours and only for tours. Geological conditions, geographic conditions, hydrodynamic conditions, and marine biodiversity in the Central Java region have economic aspects. The socioeconomic aspect is a perspective and undeveloped value, namely the exploration of fish resources through the application of marine biotechnology. Expanding sources of marine biological materials will make Central Java more developed in the future. The sources of marine biological materials are abundant because of their geographical location and specific ecosystem, so the Indonesian sea area, especially Central Java, has promising prospects for the future. Biodiversity and Utilization of Fish Resources on the North Coast of Central Java can potentially be a valuable source of exploration material in the bio-industry sector.

Keywords: Biotechnology, Bioindustry, biodiversity, Geology, Geography, hydrodynamics, Value

1. Introduction

The definition of biodiversity is biological diversity, namely the diversity of living organisms from all sources, including terrestrial, marine and aquatic ecosystems and their environment and substrates, including the diversity of species between species and their ecosystems. Utilization of fish resources means meeting human needs without compromising the ability of future generations to meet their own needs. Marine biodiversity is the diversity of flora, fauna and microorganisms that are different from the genes contained in them and the ecosystems formed so that they are used as a source of marine biological materials, namely sources of marine materials (Pringgenies, 2019). The sea is for human needs, which is available in Indonesia.

Fishery resources on the north coast of Central Java, such as Demak, Tegal, Batang, and Brebes, are generally bottom or demersal fisheries. Most of the north coast of Central Java is a sloping, shallow and murky coast (Hartoko 2010). Based on these conditions, 5 concept notes can be listened to from the north coast of Central Java based on the Java Marine Ecoregion, which can affect the existence of biodiversity in the Java Sea, namely geological conditions, geographic conditions, hydrodynamic conditions, marine biodiversity and socioeconomic aspects (Rosalina et

al., 2013; Maufikoh et al., 2014; Simanjourang et al., 2018). The concept of thought is presented in Figure 1.

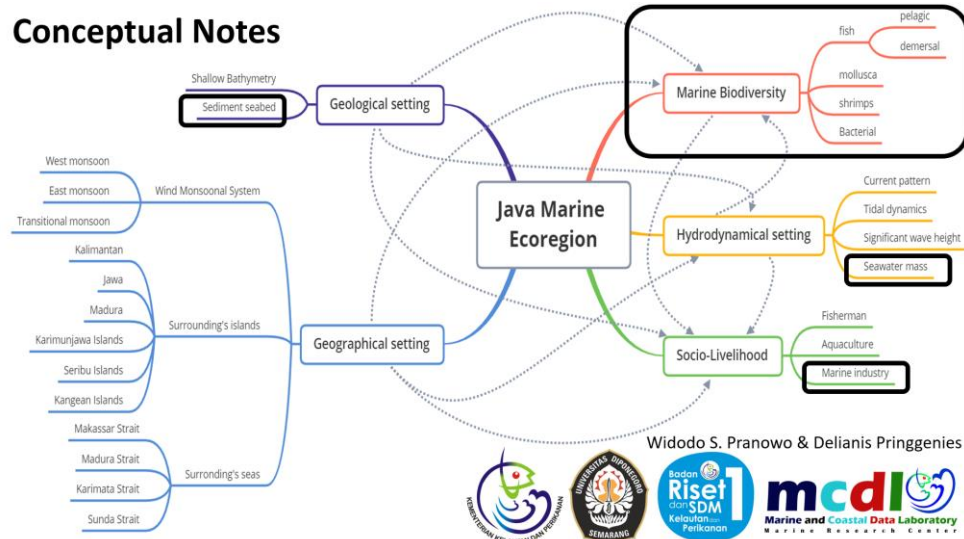


Figure 1. The concept of the Java Sea Ecoregion influences the condition of its biodiversity. The central proxy discussed is the relationship between the condition of water masses and seafloor sediments, which affect fish and shellfish as raw materials for the fishing industry.

2. Geological Conditions

Most oceans have a similar structure, created by general physical phenomena, mainly from tectonic movements and sediments from various sources. The structure of the oceans, starting with the continents, usually begins with the continental shelf and continues down the continental slope - steep descents into the sea, until it reaches the abyssal plains - the topographical plains, the beginning of the seafloor and its main areas. The boundary between the continental slope and the abyssal plain usually undergoes a more gradual decrease, called continental uplift, caused by sediment flowing down the continental slope.

Sediment is a solid material derived from rocks that have undergone a weathering process; disintegration; transport by water, wind and gravity; as well as deposition or accumulation by natural processes or agents to form layers on the earth's surface that are solid or unconsolidated (Bates and Jackson, 1987). Sediment on the seafloor varies in origin, from eroded soil material carried out to sea by rivers or wind currents, to the waste and decay of marine animals and to the deposition of chemicals in the seawater itself, including some from outer space. Boggs (1986) mentions that surface sediments on the seafloor are generally composed of: biogenic material originating from organisms; authigenic materials resulting from marine chemical processes (such as glauconite, salt, phosphorus); residual materials; material left over from previous deposition; and detritus material as a result of erosion from land (such as gravel, sand, silt and clay).

Seafloor sediments are known to have four types, namely: Terrigenous, describing sediments originating from material eroded by rain, rivers, and glaciers and those carried by wind to the sea, such as volcanic ash; Biogenous material is sediment which is a complex part of marine animals that accumulates on the ocean floor; hydrogen sediments are dissolved materials that settle in the oceans when ocean

conditions change; cosmogenic sediments come from extraterrestrial sources. These components comprise the seabed under their genetic classification (Hartoko, 2010; Webb, 2019).

The north coast of Central Java is known as shallow waters caused by geological conditions such as the impact of sedimentation. The research results by Solihuddin et al. (2020) stated that the Pantura Java landscape is surrounded by alluvial sedimentary beaches consisting of gravel, sand and silt, which have a low resistance to erosion. Fluvial processes dominate coastal processes through active rivers, which carry sediment loads so that a deltaic morphology and tidal mud flats form around the coast. While the characteristics of a rocky beach experience an abrasion process due to the rock material's relatively resistant (resistant) nature to the erosion process, the beach process tends to be stable, or there is no significant change in the landscape. Sediments at the bottom of the Java Sea are the result of supplies from rivers that flow into the Java Sea (Siregar et al., 2017).

2.a. Geographical Conditions

The north coast of Central Java is a coast that is not deep, and the coasts of East Java and West Java and the south coast of Kalimantan flank its geographical location. Furthermore, many rivers flow to the north coast of Central Java, resulting in shallow waters. On the other hand, some land formations experience erosion, abrasion, and sedimentation, so they change the coastline's shape (Sunarto, 1999).

The shoreline changes were 771.424 hectares of abrasion and 177.931 hectares of accretion. The abrasion coastline changes occurred due to ocean currents and sea waves continuously hitting the shoreline and the relatively flat beach meanwhile, While changes in the coastline towards the open sea on the coast are caused by the accumulation of sediment originating from the mainland and deposited on the coast, primarily through river estuaries (Satyanta Parman, 2010).

Geographical processes in the North Coast region of Central Java, especially between Semarang and Demak, are very dynamic, including abrasion processes, transportation processes and sedimentation processes. The abrasion process in several places has reached 0.5 km from the coastline, causing the loss of ponds and several settlements. There has been a reasonably heavy sedimentation process in other places, especially near river mouths. The sedimentation process in the coastal area causes a change in the coastline, which tends to be towards the sea (retrogradation. Usually, the emergence of new land in this area will become a place of value for residents (Satyanta Parman, 2010).

2.b. Hydrodynamic Conditions

The hydrodynamic conditions of the Java Sea are influenced by the west, east and transition monsoon systems (Siregar et al., 2017; Heryati et al., 2018) and are also influenced by mixed tides, which tend to be diurnal and diurnal (Wyrski, 1961; Widiantosa et al., 2016; Saputra et al., 2016; Kusuma et al., 2018; Amalina et al., 2019). Wind gusts will collaborate with the dynamics of the water level due to tides to produce a sea level that varies spatially and temporally, and then currents represent water flowing from high sea level to low sea level (Simanjorang et al., 2018)). Surface currents in the Java Sea during the westerly monsoon generally move to the east, whereas during the east monsoon, the surface currents move westward (see Figure 2), while for the transitional

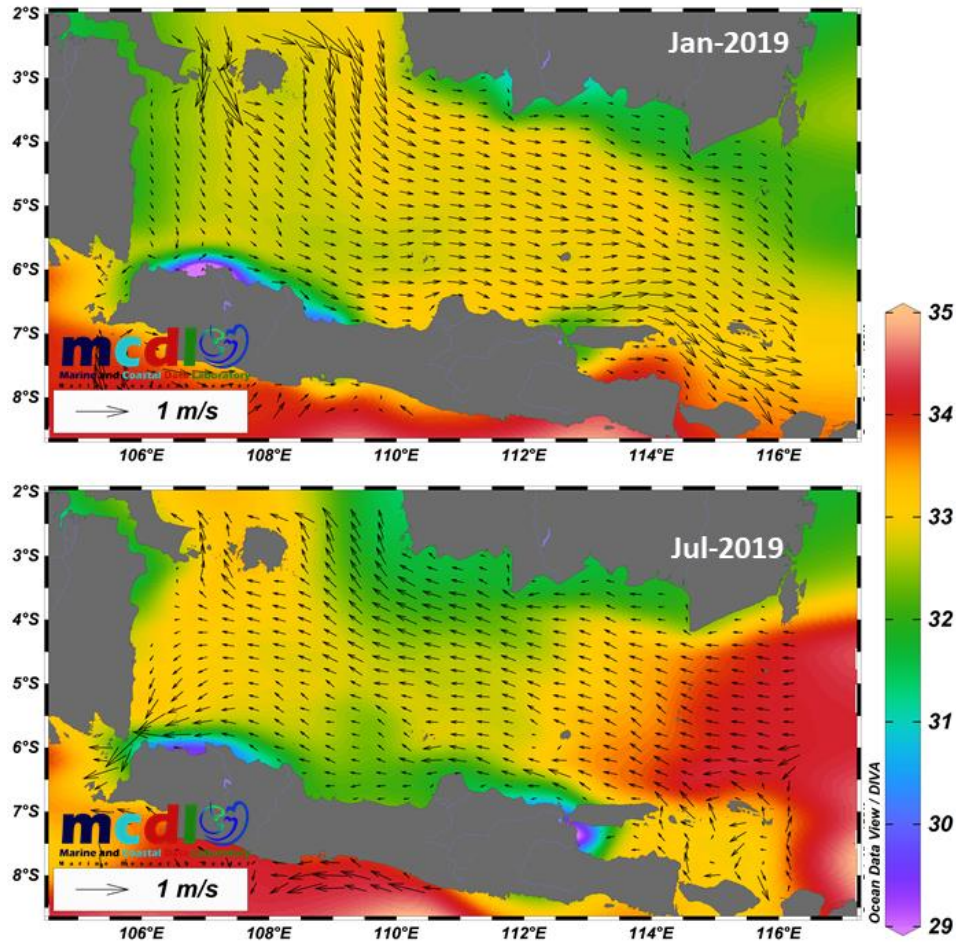


Figure 2. Current pattern (arrow vector) and water mass (salinity) in the Java Sea during the west monsoon (Jan-2019) and east monsoon (July-2019).

The tidal conditions in the Java Sea are unique (Wyrтки, 1961; Maufikoh et al., 2014). It generally has a mixed tidal type character that tends to be diurnal, but certain areas have a diurnal type character that covers the area around the Central Java peninsula. (Jepara, Rembang, Pati) to East Java (Tuban, Lamongan, Surabaya). The tidal character in the Thousand Islands is unique because sometimes it has a diurnal character, but sometimes it also has a mixed, tending to be a diurnal character (Widisantosa et al., 2016). This changing character is also found in Jepara (Pranowo et al., 2005).

The monsoon wind system, which drags the Java sea level elevation and produces surface currents, produces sea waves. Significant wave height conditions in the Java Sea vary with the distance of wave generation and monsoon wind speed (Muliati et al., 2018). According to Muliati et al. (2018), significant wave height conditions in the Java Sea under normal conditions range from 0.25 meters (November/monsoon winds transition from east to west) to 0.73 meters (August/east monsoon winds). However, in extreme conditions, significant wave heights in the Java Sea can reach more than 4 meters during the west monsoon between December and January (Muliati et al., 2018). Slightly different from

what Wicaksana et al. (2015) stated, based on the results of 9 years of modelling (2005-2013), the range of significant wave heights in the Java Sea is between 0.5 to 2.5 meters. Extreme wave height conditions in the Java Sea can occur due to the propagation of the swell wave from the North Natuna Sea through the Karimata Strait on its way to the Java Sea, as happened on December 14 2013, when Cyclone Manny occurred, where swell wave occurred within ten days. Then recorded by a tide gauge in Jepara (Muliati et al., 2018)

The water mass of the Java Sea is strongly influenced by the rivers that flow into the Karimata Strait and the Java Sea, as well as the supply of seawater masses from the Pacific Ocean, which is characterized by high salinity brought by the Indonesian Cross Flow (Arlindo) or often referred to as the Indonesian Through-Flow (ITF).), see Figure 2. The model shown by Siregar et al. (2017), shows that rivers carrying fresh water enter the Java Sea during the rainy season, which coincides with the west monsoon winds (December-February), while the water masses from The Pacific Ocean begin to enter the Java Sea from May (monsoon transition from west to east monsoon) to October/November (monsoon transition from east to west monsoon).

2.c. Marine biodiversity

Indonesia's marine biodiversity, or marine biodiversity, is known to have a high prospecting value because of Indonesia's geographical location, which is in the middle of the equator and thousands of large and small islands in Indonesia, such as on the north coast of Central Java. However, understanding the meaning of biodiversity will be more prospective for intelligent citizens to study how rich the marine resources of the Indonesian nation are. The wealth of Indonesia's marine biodiversity contributes to national development in all fields. This can be proven by seeing that most of Indonesia's population lives and makes a living in coastal areas (Lubis et al., 2016) as seen on the north coast of Central Java

Ariana et al. (2017) said that biodiversity is a layered concept. Biodiversity observation can be defined at the Gene, Species, and habitat/Ecosystem Levels. Furthermore, marine biodiversity emphasizes aspects of marine species, genes and gene products, and the coastal and open ocean habitats in which they live. This activity is related to the ability to identify where these biotas live, what if the product is produced in more significant quantities, how many species currently exist, and how diverse they are

Observation of marine biodiversity is fundamental because marine diversity can be used to indicate the impact of various external stressors. However, some things are rarely informed about the value of Indonesia's marine biodiversity related to marine biotechnology related to bacterial and genetic bioprospecting, and the upstream will go to the bioindustry.

3. Socioeconomic Aspects

3.a. Fishermen and Farmers

Fishermen and cultivators have an essential role and are a mainstay in supporting national food sovereignty. Indonesia, which consists of thousands of islands and is surrounded by oceans, makes Indonesia rich in food that comes from the sea. Based on Indonesia's geographic location, it can be predicted that fishery products account for more than 50% of all animal protein consumed by the public. This

condition provides an opportunity to contribute to job creation. The number of fishery business actors capturing fisheries and cultivators in Indonesia is enormous. Nevertheless, all of this must be synergized between the community and the government to create management that is orderly, consistent, responsible, committed, virtuous, noble, and responsive to advances in biotechnology

3.b. Marine industry

The success of the marine industry is based on the supply and demand of goods worldwide. These include traditional maritime activities such as designing, building, manufacturing, supplying, maintaining ships or spare parts, operating and managing shipping lines, or crewing ships. However, in the marine industry, inland and marine fisheries management are all efforts, including integrated processes in information gathering, analysis, planning, consultation, decision-making, allocation of fish resources, and implementation and law enforcement of laws and regulations field of fisheries. The abovementioned things have been running even though there are always evaluations and developments for the community's welfare

Some things are exciting and potentially useful and have high value in the marine industry, namely the application of biotechnology, which continues to grow occasionally. Fishery technology aims to accelerate the fishery production process, increase the volume of fishery production, and perfect fishery production with the lowest production price but big profits. Biotechnology includes basic sciences, including physics, chemistry, biology and microbiology (Pringgenies, 2019). Developing fisheries biotechnology applications seems to be not optimal, especially those related to fisheries, especially fish. There are exciting things that can be used as bioprospecting value, namely the use of prospecting bacteria in the biotechnology field, such as the potential of their active compounds as antibacterial, antifungal and their benefits for health and also in the fisheries sector

Based on direct observations, the realization that there are 106 bacteria/ml seawater (or ca. 5 x 106/teaspoon) creates a revolution in marine microbial ecology (Proctor. L.M and D. M. Karl. 2007). Bacteria can change nature by making fish smell bad (pathogenic bacteria) that interfere with health. However, some bacteria can kill bacteria, namely the potential for producing marine resources beneficial to health. Until now, it is known that many natural products have been utilized, and in fact, these products are from microorganisms that live in invertebrate animals ((Ocky, 2013). Bacteria that live in the digestion of fish are thought to have great potential as health prospects because bacteria in the digestive system break down nutrients, such as sugar—complex, into a form that the body can use. Non-pathogenic bacteria also help prevent disease by occupying places that pathogenic or disease-causing bacteria want to occupy, so it is predicted that some bacteria protect humans from disease by attacking pathogenic bacteria. On the other hand, marine bacteria are used for microbial bioprospection, namely secondary metabolites, with an emphasis on the marine environment, such as being useful in aquaculture techniques or potential in feed nutrition (Lozada M and H.M. Dionisi, 2015).

Secondary metabolites are also natural products of organisms, namely organic compounds that are not directly involved in organisms' average growth, development or reproduction. These compounds are helpful for individual self-defence against predators, parasites, diseases, and competition between species and facilitate reproductive processes such as the influence on colour and smell (Pringgenies, 2019). One of the

exciting products from secondary metabolites is the discovery of bacteria from the stomach of sea cucumbers that have the potential as an antiseptic (Pringgienies et al., 2018). The research results can be used as a model for fish products because the potential of secondary metabolites from the stomach of different types of fish will get different results. After all, it has a different DNA structure and, of course, different enzymes, so the benefits are different. It is one of the riches in biodiversity and utilization of fish resources on the north coast of Central Java.

Several research results can be used to explore the bioindustry, such as the discovery of an endemic fish that emits light in Tanjung Balai Karimun, Riau Islands, Indonesia, namely the Lomek fish (*Harpadon nehereus*). Lomek fish is popular because it tastes delicious and emits light when placed in an open room when it is off..

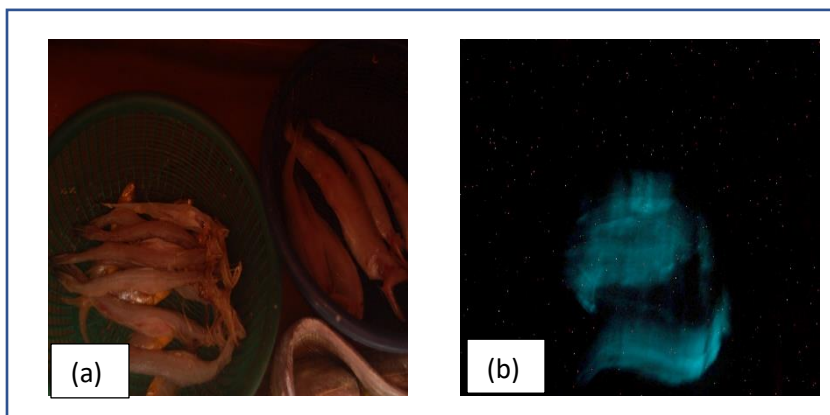


Figure 3. (a) Lomek fish without light in a luminous space (b) Lomek fish glow light in a lightless room

The bioluminescence process that occurs in Lomek fish is caused by luminescent bacteria, as seen in Figure 3 below. These fluorescent bacteria include Gram-negative bacteria, motile and capable of fermenting glucose (Dewi et al., 2019; Pringgienies et al., 2020). The potential of bioluminescent bacteria has been utilized in the medical world in America, which is very useful for detecting cancer cells (Jiang et al., 2017). Furthermore, consortium bacteria are found in mangrove litter where a location is a gathering place, looking for eat, shelter and development, and the production of marine biota such as fish in the mangrove ecosystem. The consortium bacteria are *Pseudomonas* sp., *Flavobacterium* sp., *Acinetobacter* sp., and *Bacillus subtilis* bacteria which are synergistic and have the potential as pond bioactivation products and for compost and ponds as shown in Fig. 4. (Simple patent certificate No: IDS00001704).



Figure 4. Compost with the Addition of Bioactivator Bacteria Symbion in Mangrove Litter

4. Conclusion

Five concept notes can be studied from the Biodiversity and Utilization of Fish Resources on the North Coast of Central Java based on the Java Marine Ecoregion, which affects biodiversity in the Java Sea, namely geological conditions, geographical conditions, hydrodynamic conditions, marine biodiversity and socioeconomic aspects. The socioeconomic aspect is a perspective and undeveloped value, namely the exploration of fish resources through the application of marine biotechnology.

Expanding marine biological materials sources is a prospect for the nation's future. Sources of marine biological materials in Indonesia are abundant because of their geographical location and specific ecosystems, so the Indonesian sea area, especially Central Java, has promising prospects for the future. Biodiversity and Utilization of Fish Resources on the North Coast of Central Java is a valuable source of exploration material for the bio-industry.

Conflict of interest

The contribution of the authors in this scientific article is the same. Salinity and flow data were downloaded from Hycom Archives Dataserver (<http://hycom.org>), then visualized using Ocean Data View (<http://odv.awi.de>)

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