I. INTRODUCTION

I.1. Background of Study

The ocean makes up 76.38% of the Indonesia archipelagic country. Indonesia consists of 13.466 islands as per the research done by the National Coordinating Agency for Survey and Mapping in 2007 and 2010 (National Geographic Indonesia, 2012). Therefore, it is likely to assume that shores and aquatic ecosystems are naturally abundant. One of these is Teluk Awur, located in Jepara, a shore has been a model for mangrove forest reclamation for all around the country. And to do so, intensive knowledge of what biota is within the ecosystem are paramount for those seeking to undertake such a task (Silaen, 2013).

Teluk Awur has no shortages when it comes to rich and bountiful natural resources, such as Coral reefs, seagrass beds, and mangroves. In that vein, the beach region of Teluk Awur contains two areas which have their own attribute of ecosystems that are aquatic and terrestrial. Teluk Awur's diverse species within the ecosystems carry the possibility of becoming points of study on knowing the component resources that make up their area of living, such resources are under the branches of biotic and abiotic. Semarang City's mangrove ecosystems and products of fishery have reports of pollution and rob within the seas near its perimeter (Endri, 2012).

One of the threats to aquatic and shoreline environments originates from shipping vessels transporting goods. Their impacts upon aquatic and sea-shore environments have been categorized into three types: discharges towards water,

physical damage, and seeping emissions from the air. The discharges are made of spillage and refuse from marine litter, wastewater, non-indigenous species, and the usual suspects of cargo and oil. Damage of the physical nature can be seen by the noises made from ships, lamps and flashlights that create artificial light, colliding with the animals in the ocean, erosion of the shoreline with the resuspension of sedimentations, and grounding. Emissions from air are sulfur oxides, nitrogen oxides, small particle matter, volatile organic compounds, and ozone-shaving substances (Jagerbrand, 2019).

The practices of human society are considered to be the leading headsman on the pollution and destruction of the environment; the industrialization and urbanization of forests and lands, and the unsustainable agriculture made by short-sighted humans. And despite its good intentions, it seemed that ecotourism itself has fallen into the pit of environmental harm for its pillaging of untouched locations. The cutting down of trees and displacements of various factors in ecological systems, coupled with 'small' pollution that accumulates over time, it is no wonder many also look in concern for the future of ecotourism. The numerous amounts and sizes of motorized machines and the carving of roads in search of species unknown to the vast public have gone overboard, not to mention the depletion of grass cover which negatively affects fauna and plantation. The roads themselves become crowded by animals as they have lost most of their homes and are forced to be near high-speed mechanical hazards, which sometimes end in them and humans dead (Josphat, 2012).

The reason for using the macrobenthic lifeform community as part of an assessment of the ecosystem is that because macrobenthos have a lot of very vital roles in the system, such as an important part of the food chain within aquatic ecology whether it is the seas, the shores, lakes, or rivers. They also provide excellent sediment structure through the digging of holes, boring of the earth to upturn it, bioturbation, excretion of important substances, and many more. An organism which deviates from its normal status in accordance to the changes of water quality. Furthermore, many scientists that were not in certain specializations are knowledgeable of the many species of macrobenthos, they have a widespread home in a variety of locations, and many macrobenthic lifeforms have a consistent tolerance amongst branching species. Also, they have a long age of life, along with being slow to switch homes if there are polluting changes in their ecosystem (Sapto, 2014).

This method is led further precedence by some journals denoting bioindication with macrobenthos as its most important tool. One such paper is written by Kosari (2021) about "Macrobenthos as bioindicator of ecological status in the Yekshabe creek-estuary, Persian Gulf". Within the entries, a glaring factor is present; polychaeta is a group frequently found in the samplings, with the Spionidae family being the dominant one. The high density and diversity of macrofauna in winter are caused by low temperatures and stable environmental parameters like salinity, according to the studies done in Indian mangrove forests. The conclusion reached was also the fact that the reduction of

gametogenesis and reproduction, low quantity of dissolved oxygen and increase of hydrogen sulfide in sediments is connected to the low diversity of species in the summer.

I.2. Research Objectives

1. Assess Macrobenthic Community Structure Across Three Locations:

   a. Compare species diversity, evenness, and dominance among three sites: a relatively untouched mangrove forest near a shore, the moderately handled Marine Science Techno Park (MSTP) pier, and the heavily handled Shrimp Farm Outlet for a shrimp or prawn farm.

   b. Investigate how varying levels of human intervention affect macrobenthic communities.

2. Evaluate Macrobenthic Communities as Indicators of Ecosystem Health:

   a. Examine the roles of macrobenthic organisms in the aquatic food chain, sediment structure, and bioturbation.

   b. Utilize macrobenthic organisms as bioindicators to assess environmental quality, referencing studies which highlight their effectiveness.

3. Analyze Environmental Parameters and Their Effects on Macrobenthic Populations:

a. Correlate species diversity with environmental factors such as temperature, salinity, dissolved oxygen levels, and hydrogen sulfide concentrations.

b. Investigate seasonal variations and their impact on macrobenthic communities, drawing on empirical evidence from relevant scientific literature.

I.3.   Significance of Study

The study of macrobenthic communities is crucial for assessing biodiversity, monitoring water quality, and understanding ecosystem functions in aquatic environments. These organisms, including worms, mollusks, and crustaceans, serve as indicators of environmental health because they respond sensitively to pollution and habitat changes. Their presence helps in nutrient cycling and forms a critical part of the food web, supporting higher trophic levels like fish and birds. Additionally, studying these communities provides essential baseline data for conservation efforts and sustainable resource management. The economic relevance of some macrobenthic species also underscores their importance in commercial fishing and aquaculture, making their study vital for both ecological health and economic activities.

I.4. Research Question

For the potential of aquatic ecosystem is high, it is imperative to create a macrobenthos structure so that we can assess the elements that can and will affect the stability of the lifeforms' homes. To do so, three locations are marked for study and sampling: a mangrove forest near a shore, the MSTP pier, and the Shrimp Farm Outlet for a shrimp or prawn farm. The variables between the three of these places are the actions of human hands done to them, the mangrove forest shore being a benchmark for relatively untouched status. This escalates to the MSTP pier (Harbour) which will serve as moderately handled, to the shrimp/prawn farm Shrimp Farm Outlet as the heavily handled one. The difference in structure may perhaps lie in the anthropogenic activity done to them, should any difference be found between the three. With all these facts considered, the questions should be thus:

What are the differences between the three chosen locations using the data taken from each location and compared with numerical value of the species diversity, evenness, and dominance from each location?