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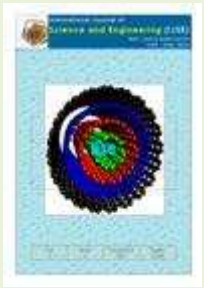

Assessment of Water Quality Using Macrobenthos as Bioindicator and Its Application on Abundance-Biomass Comparison (ABC) Curves

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Abstract *- Activities of aquaculture and industry which is directly adjacent to an aquatic environment will result in increasing organic matter and causes a decreasing quality of water in it. The use of bioindicators of macrobenthos will detect environmental disturbances occur in the aquatic environment. This study aims to determine the level of pollution in aquatic environments using macrobenthos as bioindicators and their application in the abundance and biomass curves. Locations of this study is polyculture ponds and coastal of PT. Kayu Lapis Indonesian located in Mororejo Village, Central Java. Based on the abundance of macrobenthos results shows that in coastal area of PT. Kayu Lapis Indonesia is dominated by Cirratulidae (60%) from Polychaeta while in polyculture ponds is dominated by Potamididae (58%). Based on the abundance and biomass comparison (ABC) curves, the polyculture ponds were categorized as unpolluted area, whereas the coastal area of PT. Kayu Lapis Indonesia was categorized as moderately polluted. Based on the research results of macrobenthic community, the ABC curve is considered effective to demonstrate the environmental disturbance occurs in aquatic environments.*

Keywords :*macrobenthos; bioindicator; water quality; ABC curve;polychaeta*

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I. INTRODUCTION

Structure of macrobenthos community has been used to determine various environmental disturbances both in farming (Sapto, 2007; Gonzalez and Jerez, 2011; Yokoyama et al, 2007) and industrial activities (Wijayanti, 2007; Mooraki, 2009; Amin et al, 2012). Macrobenthos are organisms that live in the mud, sand, gravel, stone or organic waste either on the basis of the aquatic environment which is capable to settle and stick to the bottom of aquatic environment (Lind, 1979). Therefore macrobenthos is an organism which is difficult to escape from environmental disturbance.

Macrobenthos animals have a variety of roles including as part of the food web of aquatic ecosystems and improve the structure of the sediment through the activity of digging, drilling, bioturbation and excretion. Through their roles macrobenthos can determine the quality of the waters between space and time to look at the structure or dominance of a taxa (Sapto, 2014). Macrobenthos can respond quickly to changes in the environment occured through the structure and abundance changes.

The coastal area of Central Java especially Kendal Regency is an area that relies its livelihoods through aquaculture efforts both in monoculture and polyculture. In addition, the presence of the PT. Kayu Lapis Indonesia indirectly contributes to the surrounding environment. This study aims to determine the level of pollution in aquatic environments using macrobenthos as bioindicators and their application in the Abundance-Biomass Curves

II. MATERIALS AND METHODS

1. The Study Sites
   The sampling sites located at Mororejo Village, Central Java. First location was in polyculture ponds and the second location in coastal area of PT. Kayu Lapis Indonesian located ± 200 m from the first location.Sampling was conducted in two times, which was on September 2013 and February 2014.
2. Sampling Procedures
   The base sediments taken from two locations using Eckman Grabthen the sample was introduced into a plastic bottle containing 4% of formalin solution. Samples of animal macrobenthos were treated by rinsing, sorting and preservation in 70% of ethanol solution. Biomass is calculated by obtaining the dry weight of each sample of macrobenthos animals.
3. Identification
   Identification is performed using identification books of Day (1967), Rouse and Pleijel (2001) after that calculation

of the amount of types, tabulation and calculation of biomass was conducted.

4. Data Analyses

The diversity of the macrobenthic assemblages was analysed using *Shanon-Wiener* index (H'). *Evenness* (*e*) index was used to express similarity (Krebs, 1985). Dominance of macrobenthic assemblages was analysed using *Simpson* index (C) (Odum, 1993). Graphical method of Abundance Biomass Comparison was used to determine the extent of changing patterns of macrobenthic structure based on biomass and abundance of each sampling station in space and time.

H' value normally will not be more than 5 (five). In general, the greater number of species in the community, then the value of the index H' will be higher as well.

a. *Shannon-Wiener* diversity index

$$H' = \sum_{i=1}^{s} (p_i)(\log_2 p_i) \quad \text{..... (1)}$$

Specification:

S = number of species

Pi = proportion of the total sample of i-th species = ni / N

n*i* = number of individuals of i-th species

N = total number of individuals of all species

b. *Evenness* Similarity index

$$e = \frac{H'}{\ln S} \quad \text{.....(2)}$$

Specification:

H' = index of species diversity (species) *Shanon-Wiener*

Ln = exponential logarithm

S = number of species (types).

The higher the value of e, the higher similarity degree between several types of communities compared will be.

c. *Simpson* dominance index

$$C = \sum Pi^2 \quad \text{.....(3)}$$

Specification:

Pi = proportion of the total sample of the i-th species = ni / N

Furthermore, the total abundance and biomass were compared using abundance and biomass curves to determine the level of interference or contamination occurs.

III. RESULTS AND DISCUSSIONS

Based on the macrobenthos identification results at both locations as much as 2 phyla, 3 classes and 8 families were obtained. At the first location, macrobenthos group dominated by three main families, i.e 58% of Potamididae, 20% of Mytilidae and 17% ofBatillariidae. While at second location was dominated by 60% of Cirratulidae, 12% of Spionidae and 12% of Batillariidae. Proportion of macrobenthos abundance for the first location indicated in Figure 1. and for the second location shown in Figure 2.

From the results of the study, family Potamididae was a family of Gastropoda class with quite high distribution found in both sites. This is due to the environmental conditions in accordance with its life.

Hutchinson (1993) stated that Gastropod is animal that is able to breed and live well on various types of substrates that are rich in food materials as well as chemical and physical factors that support its life. At the coastal location of PT. KLI macrobenthos group dominated by Cirratulidae and Spionidae of Polychaeta. Both of these families belong to the class of opportunistic taxa. Opportunistic taxa is taxa that exploits disturbed condition due to environmental stress by increasing their reproduction so that the population is increasing compared to other organisms which cannot survive (Putro, 2014).

At the first location in the second sampling time showed the position of biomass curve was above the abundance curve. Based Clarcke and Gorley (2006), the shape of the curve as the picture above showed that the first location was categorized as undisturbed area. Conditions at the first location allowed macrobenthos animals to proliferate and survive normally so there is no change in the structure of macrobenthos animals. (Figure 3).The curve at the second location on the first sampling times showed a different position than the first location. In Figure 4 (left) shows the position of the abundance curve that intersects with the biomass curve. The position of this curve shows that the second location of the first sampling was categorized as moderately disturbed.In Figure 2 is shown that species that dominate this location consists of Polychaeta class where this species is an opportunistic species. In disturbed condition Polychaeta groups survive by reproducing more quickly but with a smaller biomass.

The second location was a coastal area of PT. KLI which is an adjacent area to the location of Ngebum beach tourism. This condition allows the second location to enrich organics, both derived from industrial waste as well as tourism waste. Value of W on the curve indicates the disruption of a study site. Getting closer to the negative, the higher of environmental disturbance in an area.

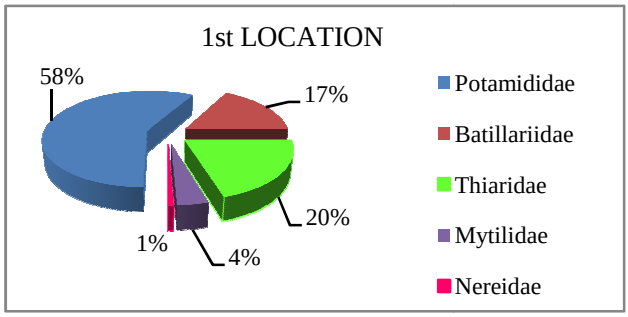

Figure 1. Proportion of macrobenthos abundance on Polyculture Ponds

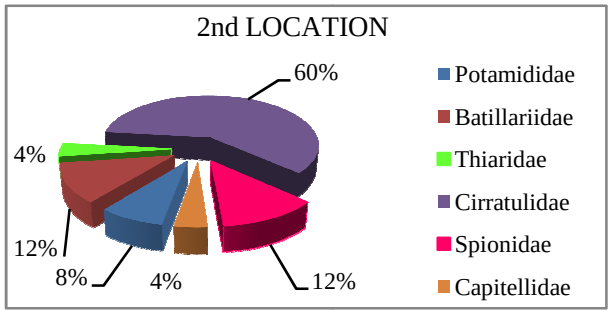

Figure 2. Proportion of macrobenthos abundance in coastal area of PT. KLI

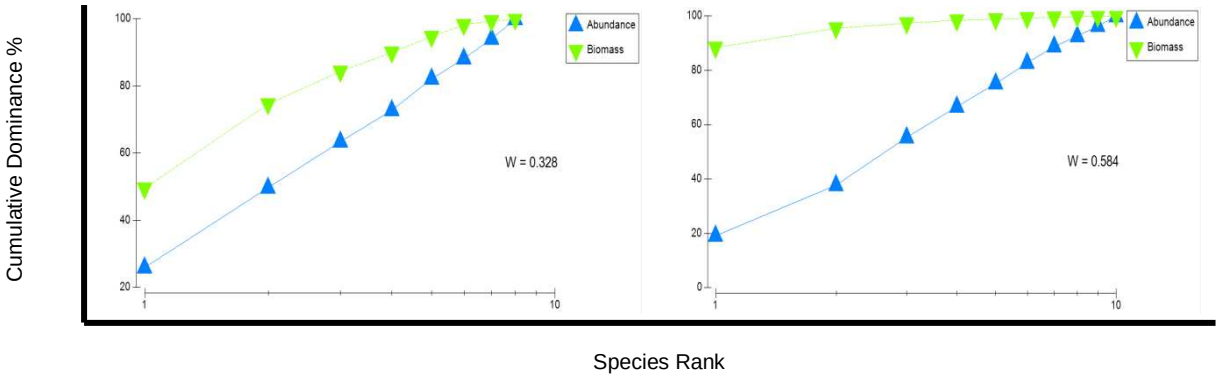

Figure 3. Abundance and Biomass curve is presented based on the transformation of Data log (X + 1) of abundance ( ) and biomass( ) makrobenthos at the first location comparing the first (A) and the second (B) sampling time

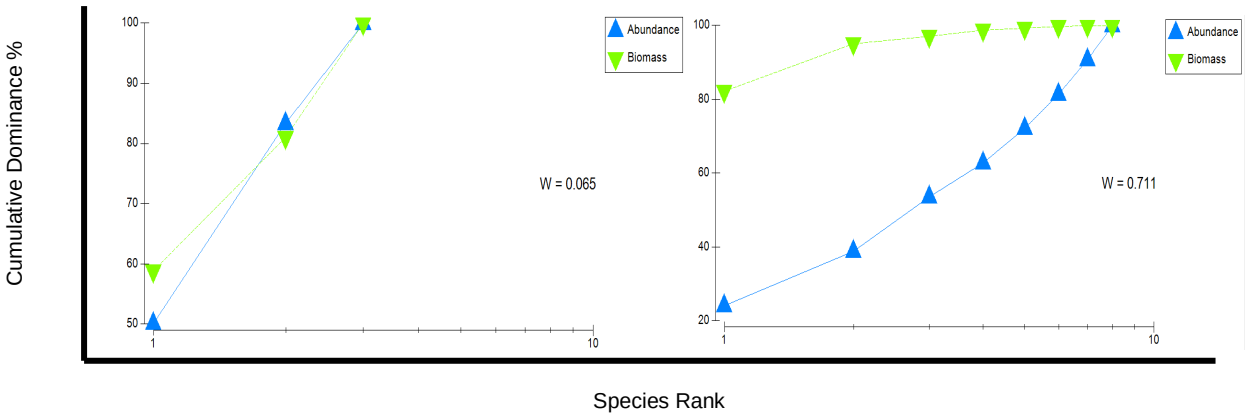

Figure 4. Abundance and Biomass curve is presented based on the transformation of Data log (X + 1) of abundance ( ) and biomass( ) makrobenthos at the second location comparing the first (A) and the second (B) sampling time

Table 1.Value of diversity

Index	1st Location	2nd Location
Shannon wiener diversity (H ')	*1.73*	*1.84*
Evenness Similarity (e)	*0.72*	*0.80*
Simpson dominance (C)	*0.22*	*0.24*

From Table of diversity index at the first location and at the second location shows figure of 1.73 and 1.84, respectively. Macrobenthos diversity index at the second location of study is low. According to Krebs (1985), the diversity is low if $0 < H' < 2.30$ the diversity is medium if $2.302 < H' < 6.907$, the diversity is high if $H' < 6.907$.

Similarity index at both locations is quite high, According to Krebs (1985), similarity is high when approaching Figure 1. The high uniformity showed no species dominate. In the calculation of dominance index at both locations showed that the figure close to 0. It means there is no species dominated at both location

IV. CONCLUSIONS

At both research locations, it was obtained dominating macrobenthos species, Potamididae in polyculture pond and Cirratulidae on coastal area of PT. Kayu Lapis Indonesia. At the second location of first sampling, the abundance and biomass curves showed that the location was in the moderately disturbed category, as shown by the intersected abundance and biomass curves. While at another location the curve showed an undisturbed condition. From this study it can be concluded that the structures of macrobenthos may indicate a disruption of an environment at the study sites.

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