Identification of *Harmfull algae blooms* (HABs) species from Demak marine waters

M Zainuri ¹ *, H P Kusumaningrum², D Nugroho Sugianto¹, H Endrawati ¹, I Mishbach¹

¹ Marine laboratory. Faculty of Faculty of Fisheries and Marine Science, Diponegoro University
² Department of Biology, Faculty of Science and Mathematics, Diponegoro University
E-mail: Muhammad.zainuri@yahoo.co.id

Abstract. The *Harmfull algae blooms*, or HABs, are a major environmental problem existing in the aquatic environment. Blue-green algae and cyanobacteria are examples of Harmfull algae bloom being able to impact on human health and aquatic ecosystems. *Harmfull algae blooms* occurred when colonies of algae, living in the sea and freshwater, have grown out of control and produced toxic or harmful effects on people, aquatic environment and birds. The objective of the study is identifying HABs microalgae using an appearance on microscope followed by toxicity measurement. The method that we used in this research is observation through data collection and objects recording. The research found that some of HABs microalgae in Demak waters are from genus *Melosira, Thalassiotrix, Navicula, Climacodium, Protoperidinium, Trichodesmium, Halosphaera*. The existence of waters phytoplankton has physical and chemical factors such as nitrate, phosphate, current and organic matters. The HABs plankton is going to exist in the waters when the nitrate and phosphate concentration rise to upper levels. It is presumed that the Demak waters have been being supported by environmental factors due to the limited HABs algae.

1. Introduction

Kendal and Demak waters have many estuaries, bordered with mangrove and some of its territories have been converted by an industrial area. It caused the ecological function of the coastal area as protection from land degradation resulting in erosion and abrasion; even some parts experienced sea level rise or rob. It leads to an increase in a coastal organic matter brought from the mainland through rivers and to estuaries. The organic matter causes the nutrient loading of water to the presence of Nitrogen (N), Sulfur (S) and Phosphate (P) elements to increase dynamics in line with the season and weather, as well as the dynamics of activities in the land area. Excess supply of Nitrogen (N), Sulfur (S) and Phosphate (P) elements in water will lead to eutrophication or enrichment phenomena which will result in decreasing aquatic resources.

Eutrophication phenomena are enriched elements Nitrogen (N), Sulfur (S) and phosphate (P) on water resulting in a negative impact on the environment and causing a decrease in aquatic resources/death. Eutrophication is as a result of increased levels of unsharp in water which is the limiting factor. Nutrient element phosphorus (P) and Nitrogen (N) is the limiting factor with the respective content of 0.7% and 0.09% of the wet weight. (P) Limit the eutrophication levels if (N) is more than eight times the levels of (P) and N() limit the eutrophication process if applied for less than eight times the levels of (P) [5]. Eutrophication occurred as a result of the high rates of sedimentation,
degradation of mangrove forests, changes in land use, governance and waste waters of impurities in the form of organic matter with excessive nutrient content of the element Nitrogen (N), and phosphate (P). Organic material as the impact of human activities that are disposed through the river basin are brought to mura, and coastal waters [24].

However, the process may also indicate the emergence of productive phytoplankton types in biological processes through the process of photosynthesis, which at the same time produces toxic materials as a conversion of the availability of Nitrogen (N), and Phosphate (P) elements exceeding the threshold [1]. Types of phytoplankton being capable of producing toxic or toxic substances are recognized as Harmful Algae Blooms (HABs) as a result of the excess supply of Nitrogen (N), and Phosphate (P) elements in aquatic and can cause anoxic conditions. For example, decreased and even oxygen depletion in water bodies, mass mortality of fish / biota and resulting in biomagnification processes that negatively impact the food chain and become harmful [4]. Types of phytoplankton in certain water can generate toxic materials and are classified as Harmful algae blooms [6][9][19]. Nutrients is a substance that is needed and affect the growth of aquatic organisms such as phytoplankton, especially nutrient N and p. According to TC. Jennerjahn, et al. (2009) b high low content of N and P in a chloro -ila-a may effect waters contained in phytoplankton and subsequent effect on its abundance [32]. Harvey (1926) and Redfield (1934) in Basmi (1999) States that a reserve of N and P have been exhausted more or less at the same time as a result of the growth of phytoplankton [3]. The rate of growth of phytoplankton never ceased at all even when the concentration of nutrients is very low. So the rate of nutrient supply (compound) in the surface waters to determine the fertility of an area. If the process occurred, then a waters, estuary or lagoon, will become a disaster area, and cause a decrease in carrying capacity for the surrounding ecosystems.

2. Materials and methods

2.1 Location and Time Study

This research use approach spacious – temporal with time observation monthly. Primary data observed at the time of the highest tide and lowest low tide. Analysis of the quality of the waters is carried out in the laboratory of marine and Oceanography, Department of Oceanography, Fisheries and Marine Science Faculty, Diponegoro University. Analysis of the composition and abundance of phytoplankton is carried out in-situ on the Eastern season between the months of June-August 2018 for three months. Note the statement of Nontji (2008), that the Meteorological and oceanographic data, Indonesia waters influenced by the wind season (monsoon) [20].

In-situ data capture as many as 9 points each point is made three times of repetition with a difference in spatial ecological characteristic in the lower rows of Demak marine waters. It is aimed at evaluating the differences influence ecologically (response) against the existence of natural factors impact the existence of anthropogenic activities influence the society surrounding it. More characteristic approaches in spatial research presented at (Figure 1; Table 1).

2.2 Design Research

Research is using the method of observation, according to Irawan (2002) in the Dewi (2018) this method is a collection of data that is based on direct observation and recording of systematically against objects that are examined [8][12]. Sampling techniques in the measurement of Eutrophication using the method of purposive sampling, a random sampling technique is done based on the characteristics or particular characteristics [10].
3.2 Method of sampling and data collection

3.2.1 Sampling and analysis of phytoplankton

Sampling phytoplankton in the area of the Laguna Segara Saplings was done vertically. The distribution of phytoplankton will be affected by physical and chemical factors of waters [30]. It will determine the sampling method to be used. Sampling phytoplankton done vertically using a plankton-net no. 25 with filter 100 litres of water on each observation station, the next sampling results fit on a sample-sized containers of 100 ml, and given the sign (label).

2.3.2 Preservation of Samples and Identification of Harmful algae blooms (HABs)

Preserving samples using up to 4% formalin (Nontji, 2006), as many as 10 drops. As for the mechanism of identification is done using a light microscope with a magnification of binocular 40 times, according to the statement (Nontji, 2006), that the magnification of 40 to 100 times have been sufficient for the analysis of the phytoplankton, which assisted Opti tool to laboratory document [20]. Phytoplankton samples which will be observed under the microscope melted on the surface of the object (glass object), then covered with a cover glass: identification and calculation repetition 3 x as
much done with 20 fields of view. Furthermore, the results of the identification of the distinguished types of phytoplankton and the productive use of the book HABs classified identification: *Identifying Marine Phytoplankton*, Tomas, Carmelo R (1997); *Planktonologi*, Sahlan (1982) and *Marine Plankton*, a practical guide, Newel and Newel (1993). Next to the classification of types of phytoplankton and Praseno reference Sugestiningsih HABs (2000); Sidharta (2005) and Sidabutar (2016).

3. Result and Discussion

3.1 Sampling and the phenomenon of eutrophication

Sampling is done along the lower reaches of the estuary waters of the adjacent rows of Demak with the area of mangrove forests, according to Ridd et al., (1990) that the waters around the mangrove forests hold the key role important in nutrient cycles, because the turnover is quite fertile nutrients, as well as the area, is known for its lush organic producers characteristic [23]. Added Laybon and Parry (1992) that the mangrove ecosystem has the potential as a prolific producer of organic matter through litter leaves that accumulated in the waters as well as in nature. After going through the process of decomposition bacteria and protozoa, on the next cycle of the process stages produced the macronutrient (N and P), which is the key to the fertility of the waters. The macronutrient content of a low level of high waters can affect the abundance of chlorophyll-a and phytoplankton [2] Vaddruci, et al., (2013).

Rokhim et al., (2009) assumed growth of phytoplankton depends on fluctuations in nutrient elements and hydrodynamics [25]. More Ji (2008) States that at the mouth of the river strongly influenced the dynamics of ups and downs. This is supported by the statement of Chua, (1970) in Sedidi & Sutomo (1990) in Dewi, 2018) hat tropical waters phytoplankton cell division process took place rapidly and abundant in quantity towards the Mainland, due to the presence of nutrient input from the Mainland by the River, the opposite tends to decrease in the offshore area [8][26]. According to Panggabean (1994) says, in tropical areas, possible eutrophication occurred in the rainy season. Waters will experience enrichment (eutrophication) in the presence of organic material, as well as weathering the high leaching process of organic material that comes from the mouth of the river by various anthropogenic activities, which increased nutrients get into coastal waters. At the time of sampling performed on in mid-July, which enters the dry season which starts in April (BMKG, 2018), so the phytoplankton are found due to eutrophication phenomena that cause *Harmful algae blooms* is still being. On the conditions of eutrophication is just kind of certain phytoplankton can adapt well, responded quickly with the onset of blooming [21].

3.2 The role of Phytoplankton in waters

Phytoplankton play an important role in an aquatic, primary producers as well as further has the ability to respond to changes in the environment [7][21]. Dynamics of phytoplankton community structure and abundance influenced the form of adaptation against the waters of physical and chemical factors, especially the availability of nutrients and ability of phytoplankton to exploit it. Phytoplankton community controlled by dominant species, showing the strength of the species against other species. Dominant species and species that have been lost will cause significant changes towards ecologically phytoplankton communities [8]. Some species of plankton can overflow (blooming) on waters who suffered eutrophication, while species that are very sensitive to organic waste would disappear. Species composition of plankton also indicates the quality of the water mass [14]. The results of the identification of some species of phytoplankton are found that are capable of producing toxins that potentially as (HABs) *Harmful algae blooms*. So far there has not been a clear threshold regarding the quality of phytoplankton at the time of the occurrence of blooming. The condition usually characterized by the presence of domination change type, change of phytoplankton biomass, community structure [2][34]. Mulyasari et al., (2003) stated that the condition of the blooming of phytoplankton could occur when the quantity of its abundance exceeded the average phytoplankton quantity per month [17].
Figure 2. Genus Protoperidinium: (1) Protoperidinium grande KOFOID, (2) Protoperidinium depressum BAILEY and (3) Protoperidinium granii OSTENFELD.

Figure 3. Genus Trichodesmium: (1) Trichodesmium thiebautii GOMONT, (2) Trichodesmium erytraeum (EHRENBERG & GOMONT).
3.3 Types of phytoplankton which is potential as (HABs) in Demak Marine Waters

The results of phytoplankton in estuary waters downstream of Demak was identified of 7 genera (14 species) phytoplankton potentially (HABs) (Harmful Algae Blooms). One of the genus is toxic and cause human health problems included Genus Protoperidinium. There are three species mentioned as Protoperidinium grande KOFOID, Protoperidinium depressum BAILEY and Protoperidinium grani Ostenfeld (Figure 2), and one genus is toxic resulted water discoloration. It does not harm humans or biota but results in a decrease in the dissolved oxygen content in the water: there are two species of the Genus Trichodesmium there are 2 species namely Trichodesmium thiebautii GOMONT and Trichodesmium erytraeum (EHRENBERG & COMMENT) see (Figure 3), and there are 5 genera are toxic that does not harm humans but damaging the aquatic ecosystem by inhibiting the function of the gill fish, with a sharp morphology and form a chain of many, even among them resulting in lack of oxygen on waters: the Genus Melosira there are 2 species namely Melosira juergensi A. AGARDH and Melosira octogonal A. SCHMIDT; There are 3 species in the Genus Thalassiothrix there are 2 species namely Thalassiothrix frauenfeldii GRUNOW, Thalassiothrix delicatula CUPP and Thalassiothrix longissima CLEVE & GRUNOW; Genus Navicula there are 2 species of namely Navicula membranacea CLEVE and Navicula distans (W. SMITH); Genus Climacodium there are 1 species of namely Climacodium frauenfeldianum GRUNOW; and Genus Halosphaera there are 2 species namely Halosphaera viridis SCHMIDT (Figure 4). The study results in appropriate statement Hallegraeff (1995) that there are types of phytoplankton which generally raises the HABs, i.e. genus Trichodesmium. For the genus Protoperidinium belongs to the phytoplankton can produce toxin and harm the human [11].

4. Conclusion

Identification of Harmful algae blooms (HABs) species from Demak Marine Waters it has been found some potentially harmful species. The existence of HABs plankton in the Demak Marine Waters showed that the nitrate and phosphate concentration rise to the upper levels. It also showed that the other waters still support by environmental factors due to the limited present of HABs algae.

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