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Mapping of HABs Contaminated In Green Shells (Perna viridis) in Semarang Bay

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Abstract. The existence of *Harmful Algae Blooms* (HABs) can adversely affect the water like a mass death of fish and oxygen depletion. Some types of HABs can be contaminated with seafood and contain biotoxins that are detrimental to the health of humans who consume them. Green mussels *(Perna viridis)* has the properties of *filter feeders* so vulnerable to contamination HABs. This research was conducted to produce spatially thematic maps contaminated HABs in *P. viridis* so providing information about risk prediction *P. viridis* when consumed by humans. Sampling was done *purposively* in three (3) stations that represent the Bay Semarang namely western boundary waters (Kendal), middle (Semarang) and the eastern boundary (Demak). Sampling done two (2) times, namely East season (June -July) and the second transitional season (September) 2016. Analysis of HABs done either in water or body tissues *of P. viridis* through the analysis of *food habit.* The results shows that *P. viridis* genus positive contaminated HABs phytoplankton Tricodesmium and Ceratium. Spatial distribution and abundance of Tricodesmium genus Fitoplankton is wider and taller than the HABs Phytoplankton genus Ceratium. Group HABs are found in the tissues *of P. viridis* no potential as biotoxin that does not cause adverse health risks.

Keywords: Green Shells, HABs, Semarang's Bay

1. Introduction

Semarang's Bay is a water that stretched from Delta Bodri Kendal to Delta Wulan Demak. It's under increasing pressure as long as development of settlement areas, agriculture, aquaculture, ports and industries along the Gulf coast Semarang [1] The used of land in the coastal area impacts on the water quality conditions in Semarang Bay and potentially be pollution [2]. The mechanism of distributing the impact from upstream toward downstream areas Semarang Bay can through the mechanism of precipitation, infiltration and runoff . There are five main watersheds that lead to Semarang Bay and within the DAS are many large and small rivers that flow into Semarang Bay [3], so many pollutants from various sources will accumulate in Semarang Bay and can affect aquatic organisms such as Green Mussels. In 2015 Semarang Bay's water showed mesotrofik until to eutrofik status that have nutrient enrichment, so potentially be make a pollution [4].

Green Mussels as a filter feeder organisms have a high vulnerability to absorb harmful contaminants, but has a privilege that adaptability or the ability to survive in a high ecological pressures without interference, metabolically Green Mussels are not disrupted by the presence of contaminants. *P. viridis* exposed with harmful contaminants, are not able to be detected by naked eyes without laboratory analysis and further analysis [5]. The threat of contaminants it will endanger the *trophic level* organisms or humans who consume *P. viridis.* Information on the effects of pollution on biota Green mussels still very low so we need studies that examine this particular risk prediction *(Risk Assessment)* of *P. viridis.* There are two (2) contaminants that could potentially get into the body tissues *of P. viridis,* namely inorganic contaminants such as heavy metals and organic contaminants such as phytoplankton. Phytoplankton is an autotrophic organism that plays an important role in the food chain in waters, phytoplankton is a good source of food for Green Shells. However, the increase in the population of some species of phytoplankton due to nutrient enrichment waste from domestic activities, agriculture and fisheries could lead to a population explosion of phytoplankton containing toxins or better known as *Harmful Algae Blooms* (HABs) can have a negative impact. An increase in the population of toxic phytoplankton in the waters will produce toxins that can be transferred through the food chain *(food web)* or the environment. The content of toxins contained in these phytoplankton can affect the growth and even kill the organisms that consumed [6].

This study aims to determine risk prediction information based on the analysis of HABs on Green Shells spatially in Semarang Bay. This research is useful to provide information to the public about information on Green Shell Risk Prediction so as to give consideration and choice to the community to consume Green Shell caught in Semarang Bay safely.

2. Materials And Methods

2.1. Sampling Methods

The research location is in the Semarang Bay, sampling was done *purposively* in three (3) representing the Semarang Bay stations are: Station I, the waters of the western boundary of Semarang Bay (Kendal); Station II, is the central waters of Semarang Bay (Semarang); And Station III, is the eastern boundary of Semarang Bay (Demak). Sampling time is 2 (two) times in East (June-July) and transitional period II (September) in 2016. Data taken are sea water sample data: plankton to identify and study HABs concentration and water quality data Supporters. Sampling was done by *purposive P. viridis* with consideration for the uniform samples (obtained both in terms of size or age) and have same of absorption, metabolism and response to HABs. At each point of observation in station, sample's 30 shells *P. viridis* taken with a total weight of shell @ ± 5-10 grams, in order to obtain the minimum weight for the analysis of *P. viridis* HABs on the network without a shell 25 grams.

2.2. *Biotoxin analysis*

Biotoxin analysis of HABs was detected through the analysis of the Food Habit *P.viridis.* The shells are prepared in advance by blending and then diluted with aquadest before being analyzed. Phytoplankton identification in the network based on the book identification *P.viridis* Yamaji essay, M, Sachlan by using a checklist.

2.3. *Spatial analysis*

Spatial analysis using ARGIS software with IDW interpolation method. All parameters that have been interpolated overlay done then reclass method, weighting or scoring quantitatively on each indicator both Biotoxin and Bioakumulasi. The end result of these processes is the risk prediction maps obtained spatially *P. viridis.*

3. Results And Discussion

3.1. Location Description

Semarang Bay is one of the coastal areas susceptible to environmental degradation such as coastal erosion, sedimentation and rob floods. Industries located in the vicinity of Semarang Bay like Terboyo Industrial Area, LIK Genuk, PT. Indonesia Power, Port of Tanjung Emas Semarang, Kendal Port, PT

Pokphan Sayung, PT KLI Kendal, and several other industries provide threats of pollution in Semarang Bay, so the study of potential contaminants both organic and non-organic that could harm biota and the environment It is important to do it as a preventive measure as well as management in coastal areas.

3.2. Phytoplankton Analysis of HABs in Waters

Identification of HABs in the waters is done for comparison and supporter of the data within the network HABs *P. viridis*. Based on the list of HABs phytoplankton groups (Wiadnyana, 1996) and GEOHAB (2001), there are 2 (two) genera including HABs in Semarang Gulf waters, namely Tricodesmium *(Tricodesmium erythreaum)* and Ceratium *(Ceratium fusus)* (Figure 1). Although the percentage of phytoplankton HABs abundance is low (<15%) compared with Non-HABs Phytoplankton found in waters, the presence of HABs Phytoplankton still needs to be wary because accroding Nontji [7], HABs produce toxins in the body which can then be diverted to shellfish or fish through the food chain *(food chain)*. The presence of toxic in the body of the shell may not cause death to the shell, but when eaten by humans it can cause health problems and even death.

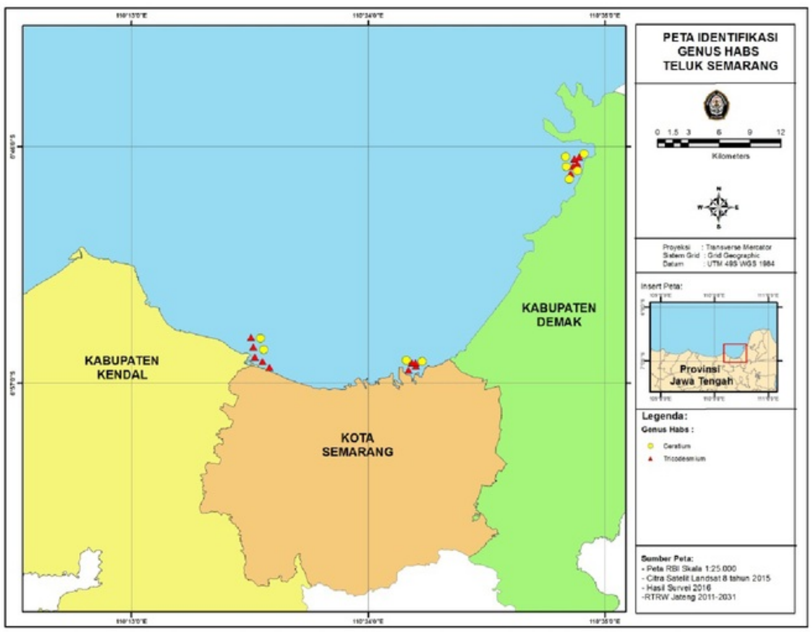

Figure 1. Map of Identification of Genus HABs in Teluk Semarang Waters

3.3. Phytoplankton Analysis of Contaminated HABs in the viridical Perna Network

Analysis of HABs contaminated phytoplankton in Green Shell tissue was analyzed by looking at the habit of eating the biota The. While the large percentage of Phytoplankton HABs approach *of Prefoderance Index (%)* as presented in Table 1, 2 and 3.

Table 1. Plankton on Green Shells at Station 1. Demak

No	Genus	*Index of Prefoderance (%)*	
		St 1 (East Season)	St 2 (Transitional Season II)
1	Coscinodiscus	58.24	30.07
2	Thalasiotrix	14.29	2.20
3	Synedra	12.31	-
4	*Tricodesmium erythreaum* *	5.41	14.95
5	Guinardia	2.64	3.34
6	Thalasionema	0.26	-
7	Nitzschia	3.74	11.74
8	Bacteriastrum	0.92	2.66
9	Pyrocitis	0.79	-
10	Rhizosolenia	1.32	24.79
11	Minidiscus	0.04	4.89
12	Pleurosigma	0.04	2.63
13	Tintinnopsis	-	0.16
14	Protoperidium	-	1.82
15	Leptocylindrus	-	0.45
16	*Ceratium fusus* *	-	1.07

Description (-): unidentified, (*) Phytoplankton HABs

Analysis of the food habits of *P. viridis* at the station I (the territorial waters of Demak) has found 12 genera of phytoplankton in East season, while in the transition season II 13 genera. Plankton found on Green Shell's gastric at Station 1. Demak is relatively small compared to other stations, it is presumably because the size found at Demak station is smaller than other stations, so the absorption capacity or filter feeder capability is not as big as the shells found. Differences in the size of Shell between stations are caused by slightly different planting times (charts) on each station. Phytoplankton types of HABs found in East season just *Tricodesmium erythreaum* while in the transition season, HABs found Phytoplankton is *Tricodesmium erythreaum* and *Ceratium fusus*. The present of *Ceratium fusus* same as research in a coastal region of Sagami Bay, Japan that seasonal abundance of the dominant dinoflagellate, *Ceratium fusus*, was investigated from January 2000 to December 2003. In Sagami Bay, *C. fusus* increased significantly from April to September, and decreased from November to February, though it was found at all times through out the observation period. Rapid growth was observed over a salinity range of 24 to 30 that *C. fusus* has the ability to grow under wide ranges of water temperatures (14–28°C), salinities (20–34), and photon irradiance (50–800 μmol $m^{-2}s^{-1}$); it is also able to grow at low nutrient concentrations [8].

Table 2. Plankton on Green Shells at Station 2. Semarang

No	Genus	*Index of Prefoderance (%)*	
		St 1 (East Season)	St 2 (Transitional Season II)
1	Thalasiotrix	20.43	-
2	*Tricodesmium erythreaum* *	17.15	1.24
3	Coscinodiscus	29.78	60.02
4	Miniduscus	2.52	4.17
5	Guinardia	2.35	1.79
6	Triceratium	0.07	-
7	Rhizosolenia	1.74	12.28
8	Synedra	17.08	-
9	Navicula	0.18	-
10	Thalasiosira	0.72	-

Table 2

No	Genus	*Index of Prefoderance (%)*	
		St 1 (East Season)	St 2 (Transitional Season II)
11	Thalasionema	2.89	-
12	Pyrocytis	1.14	-
13	Bacteriastrum	0.11	-
14	Skeletonema	0.80	-
15	Nitzschia	3.66	6.34
16	Pleurosigma	0.33	4.68
17	Leptocylindrus	0.25	3.89
18	Isthmia	0.07	-
19	Chaetoceros	0.15	0.63
20	Biddulphia	0.07	-
21	Favella	0.22	-
22	Surirella	0.02	-
23	Detonule	0.02	-
24	Microstella	0.01	-
25	Stephanopyxis	-	1.63
26	Protoperidinium	-	0.67
27	Prorocentrum	-	2.66

Description (-): unidentified, (*) Phytoplankton HABs

Analysis of the food habits of *P. viridis* in station II (Semarang territorial waters) has found 24 genera of phytolankton on East season, while in the transition season II 12 genera. HABs Phytoplankton are found in both East and Transition II season is kind *Tricodesmium erythreaum.*

Table 3. Plankton on Green Shell's at Station 3. Kendal

No	Genus	*Index of Prefoderance (%)*	
		St 1 (East Season)	St 2 (Transitional Season II)
1	Thalasiotrix	15.31	5.18
2	*Tricodesmium erythreaum* *	4.61	8.34
3	Coscinodiscus	44,78	30.60
4	Miniduscus	6.03	0.97
5	Guinardia	0.39	-
6	Triceratium	0.25	-
7	Rhizosolenia	2.90	29.47
8	Synedra	12.56	-
9	Thalasiosira	0.53	-
10	Thalasionema	1.74	-
11	Pyrocytis	0.06	-
12	Bacteriastrum	0.17	-
13	Skeletonema	0.10	-
14	Nitzschia	7.97	1.40
15	Guinardia	0.79	-
16	Pleurosigma	1.31	3.84
17	Leptocylindrus	0.21	1.97
18	Skeletonema	0.26	0.08
19	Chaetoceros	0.26	9.74
20	Biddulphia	0.04	-

Table 3.

No	Genus	Index of Prefoderance (%)	
		St 1 (East Season)	St 2 (Transitional Season II)
21	Detonule	0.08	-
22	Stephanopysis	0.43	3.81
23	Dictyoca	0.13	-
24	*Ceratium fusus* *	1.43	2.06
25	Thalasiotrix	15.31	-
26	Tintinnopsis	-	0.40
27	Asterionella	-	0.51
28	Melosira	-	0.08
29	Protoperidinium	-	1.02

Description (-): unidentified,, (*) Phytoplankton HABs

Analysis of the food habits of *P. viridis* in station III (Kendal territorial waters) showed on East season found 25 genera were found, while in the transition season 16 genera. Species HABs Phytoplankton *Tricodesmium erythreaum* and *Ceratium fusus* found on east season and transition season. Comparison of Phytoplankton type composition in each station is presented in Figure 2.

Based on the analysis of food habits, phytoplankton HABs Tricodesmium contaminants in water was found also in the stomach tissue *of P. viridis,* while the genus Ceratium only found in *P. viridis* in Kendal waters and Demak in the transition season (Figure 2). Factors thought to cause these differences and at least Ceratium found on *P. viridis* are:

- The low abundance of Ceratium in the waters
- Ceratium eaten not only by *P. viridis* but other consumer level I like the fish of planktonic
- Suitability Ceratium size with openings and uptake *P. viridis,* if Ceratium size larger than *P. viridis,* it will most likely not be absorbed and filtered out in the network *P. viridis.*

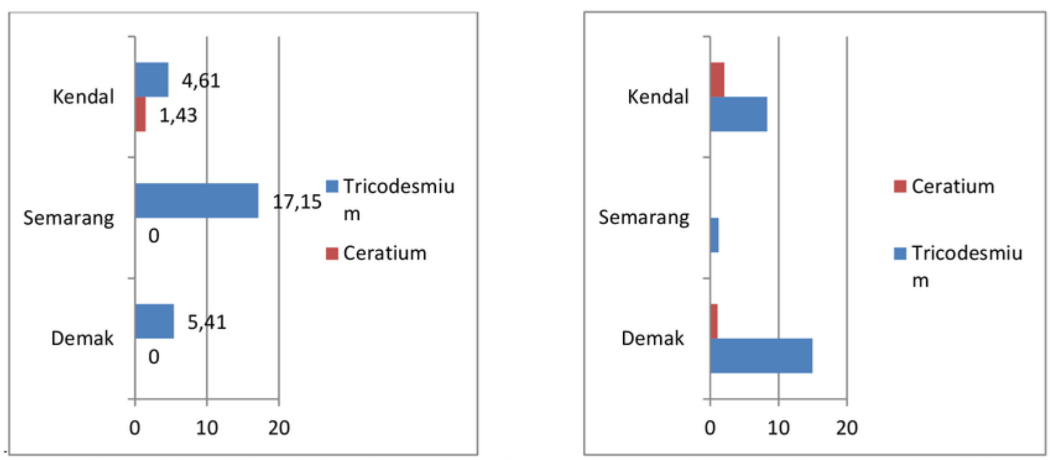

Figure 2. Composition of Phytoplankton Contaminated HABs on the Network *P. viridis* East season (A) and the Transition season (B)

HABs dominant genus of phytoplankton found in both aquatic and *P. viridis* is Tricodesmium. Which belongs to the Cyanophyceae class. Two (2) types of Tricodesmium genus that cause HABs are

Tricodesmium thiebautii and *Tricodesmium erythareum.* Sediadi *in* Anggita *et al.,* [9], this type of shaped colonies Tricodesmium important role in the biogeochemical processes in marine waters. Tricodesmium type distribution. Found in subtropical marine waters to tropical marine waters. *Tricodesmium* sp. in high densities in these waters need special attention, because of the impact of *blue-green algae bloom* can cause oxygen depletion. Another characteristic *Tricodesmium* spp. to watch out for is when overflow *(blooms)* in tropical waters, which can cause a lack of oxygen resulting in the decay process that eventually can lead to the death of marine life, such as fish [10].

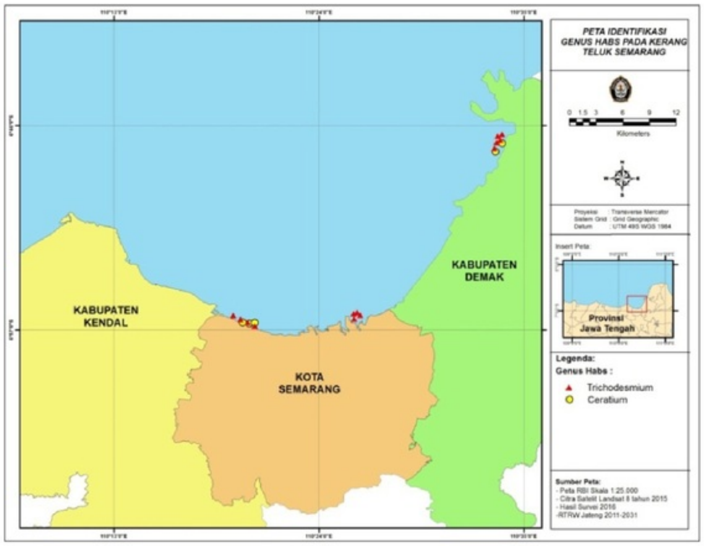

Figure 3. Mapping the identification of contaminated HABS on *P.viridis* in Semarang Bay

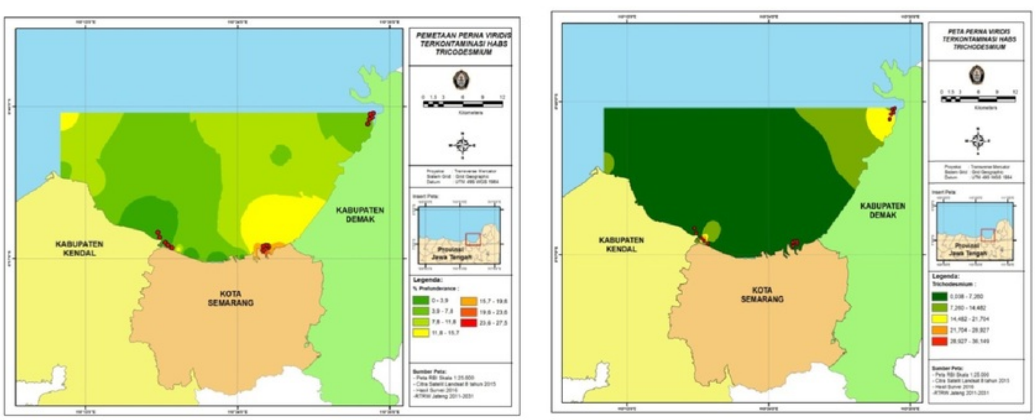

Figure 4. Mapping *P. viridis* Contaminated Tricodesmium HABs in East season (A) and Transition season (B)

Ceratium sp. is the second highest HABs phytoplankton genera were found either on the water or on *P. viridis* in the Semarang Bay. *Ceratium* s p.population explosion Can lead to mass death of marine biota due to decreased oxygen levels. According to Baek *et al*[8], a population explosion of *Ceratium* sp. can cause anoxia and sea water hypoxia, in addition there are species of this genus that can injure the gills of fish, but the mechanism can not be known. *Ceratium Furca* able to compete with other phytoplankton species, especially in the availability of nutrients, sunlight, and other environmental factors [11]. *Ceratium Furca* often found in abundance and dominate other species. Therefore, *C. Furca* more often *blooming,* resulting in the mass death of marine organisms due to oxygen depletion can occur in waters and affect other resources.

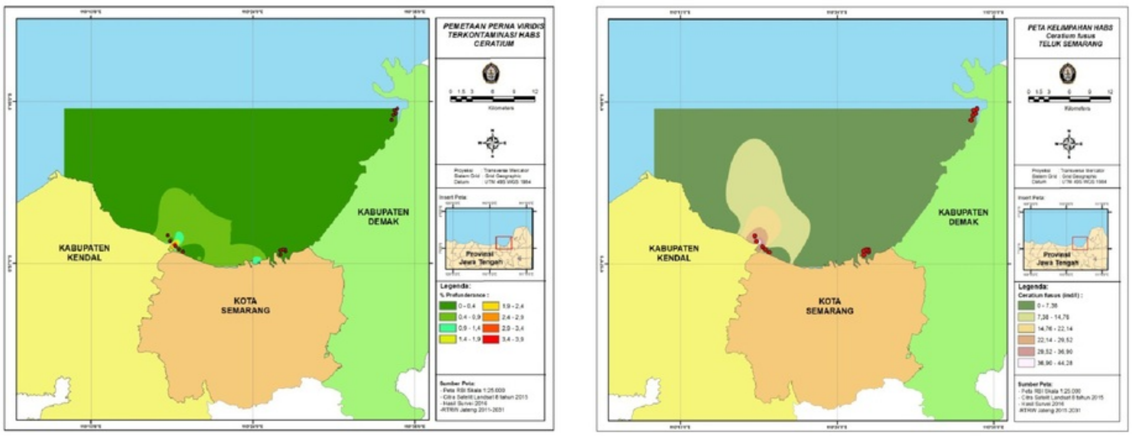

Figure 5. Mapping *P. viridis* Contaminated Ceratium HABs in East season (A) and the Transition season (B)

There are five (5) factors that cause the *blooming of* phytoplankton and harmful phytoplankton trigger HABs [12], namely: eutrophication, or nutrient enrichment; The existence of the clan *Pyrodinium* cyst at the base of the waters back into phytoplankton HABs when lifted to the surface layer through two mechanisms, namely: The mechanism through rising water masses *(upwelling)* and mechanism under the influence of tectonic earthquakes; biological, which means that the lack of predators as predators of the HABs-causing species; Large-scale hydrometeorological changes; And Heavy rains and the entry of fresh water into the sea in large numbers.

Biota cause HABs produce toxins in the body which can then be transferred to shellfish or fish through the food chain. The presence of toxic in the body of the shell may not cause death to the shell, but when eaten by humans it can cause health problems and even death [7]. Toxins produced is a stable molecule, which can not be decomposed by high-temperature cooking methods and food processing [13]. The process of accumulation of toxins takes place in the food chain, where the last consumer is the largest toxic accumulation. Results of research have shown that contaminants Tricodesmium and Ceratium positive contaminated *on P. viridis.* However, the genus has no characteristics as a biotoxin, its adverse effects the environment such as oxygen depletion.

4. Conclusion

Based on the results of the research, the conclusions obtained are as follows:

1. Green mussels *(Perna viridis)* positive contaminated HABs phytoplankton. They are from genus Ceratium and Tricodesmium, that does not have the characteristics as biotoxin
2. Spatial distribution and abundance of Tricodesmium genus Fitoplankton is wider and taller than the HABs Phytoplankton genus Ceratium.

5. Acknowledgment

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