The 1997/1998 HAB/Red Tide Blooms in Indonesian Waters

D. P. Praseno[1]; Y. Fukuyo[2]; R. Wiadiarti[3]; Badrudin[4]; Y. Efendi[5] and S. S. Pain[6]

[1]Research and Development Centre for Oceanology, LIPI; [2]Asian Natural Environmental Science Center, University of Tokyo; [3]University of Indonesia; [4]Lampung Province Fisheries Office; [5]Bung Hatta University, Padang - West Sumatra; [6]Larantuka District Fisheries Office, East Flores.

Abstract

The 1997 bloom of Trichodesmium sp. started in July 1997 off the coast of Lampung (1.2 x 106 trichomes/L) and reached its peak in August (4.2 x 106 trichomes/L). Sea water containing Trichodesmium used in brackish water ponds caused a decrease in shrimp production until 40%. The bloom was the second occurrence causing problems to brackish water ponds of this area, after a same incident in 1991. It seems that Trichodesmium blooms coincide with the El Nino phenomenon.

In 1997/1998 red tide/HAB have occurred in Ambon Bay, Mollucas caused by Alexandrium affine; in Larantuka (East Flores) probably caused by Gambierdiscus toxicus; and in Pieh Island (West Sumatra) caused by Gonyaulax spinifera. This paper also discusses 31 species of potentially harmful microalgae species so far identified from Indonesian waters.

Introduction

In the past red tide occurrences in Indonesian waters are difficult to detect due to the absence of monitoring personnel. Through the ASEAN-Canada Programme on Marine Sciences Phase-II and the IOC/WESTPAC Program on Red Tide, the problem slowly improved. The training courses held, both in Jakarta and Ambon, succeeded in training Fisheries personnel to identify red tides and to take steps to minimize harmful effects to human health and fisheries. Sometimes the victims were not aware of the danger and casualties still occurred.

Some natural phenomena could be linked to red tide occurrences. In the future these phenomena could be used as signs for early warnings. Natural phenomena, such as the El Nino and upwellings, could cause red tide blooms in several parts of Indonesia. Usually the beginning of rainy season is known as possible period for blooming of harmful species, due to input of nutrients from land. This paper reports on red tide/HAB occurrences in Indonesian waters during the 1997/1998 period. In addition 31 species of identified red tide/HAB microalgae Is discussed.

Red Tide Occurrences in 1997/1998

Red tide occurrences in Indonesian waters reported in this paper are only those which have significant effects to fisheries and human health. More outbreaks could have happened unnoticed, because many people are still unaware of the problem. Figure 1 shows locations where red tide/HAB has occurred in Indonesian waters.

East Lampung coastal waters.
During the dry season of 1997 Trichodesmium sp. began to bloom in the western part of Jawa Sea. In July 1997 the bloom extended until the eastern coastal waters of Lampung. Plankton samples were sent to Jakarta to be analyzed. Plankton consisted only of the filamentous cyanobacteria, Trichodesmium, with a density of 1.2 x 106 trichomes/L. Trichodesmium continued to develop and reached a maximum mass of 4.2 x 106 trichomes/L in August 1997.

The east Lampung coast is used for rearing brackish water fish and shrimp. The coastal sea waters is used in these ponds. Parts of the ponds, owned by fishermen, are traditionally managed, with direct use of available sea water. While ponds managed by private companies use adequate water management. Since coastal sea water containing Trichodesmium, the traditional ponds were affected causing shrimp mortality which reduced production until 40%. On the other hand, ponds with modern water management were unaffected. The filamentous cyanobacteria Trichodesmium seemed not to be toxic to fish, since fish was seen feeding on Trichodesmium without apparent harmful effects.

Shrimp kills which occurred in 1991 (Praseno, 1995) and that of 1997 could be related to the El Nino phenomenon. Both years, 1991 and 1997, were El Nino years. Trichodesmium usually bloom during the dry season, which generally started in June until November. In 1997 the dry season was very harsh due to the El Nino phenomenon. This condition triggered heavy blooms of Trichodesmium, which extended until East Lampung coastal waters. Between 1991 and 1997 no major blooms of Trichodesmium was observed in the area, and no shrimp mortality was reported from ponds in East Lampung. It is, therefore, recommended that the use of coastal sea water should be avoided during an El Nino year.

Jakarta Bay.
In October 1997 a report on Trichodesmium bloom around Pari Island, Jakarta, was obtained. The position of bloom was 05° 49' 30" S and 106° 38' 00" E extending eastward. This bloom lasted for several days, reaching 06° 00' 00" S, and causing some fish kill at Pari Island. The fish kill was probably caused by oxygen depletion, since the killed fish were found in Pari Island lagoon. Analyzed plankton samples showed a concentration of 2.5 x 106 trichomes/L of Trichodesmium.

Trichodesmium bloom in the Jawa Sea was first reported by Delsman (1939). Trichodesmium usually developed in the open sea, away from the effect of river water. Therefore, the dry season would be the best time for Trichodesmium to bloom. During 1997/1998 the El Nino phenomenon promoted blooming even more.

Inner Ambon Bay, Moluccas.
Early November 1997, Dr. N. N. Wyadnyana reported red tide in the inner Ambon Bay. Sea water turned into a reddish-brown color and Gymnodinium catenatum was identified by Dr. Wiadnyana as the species causing the discoloration of sea water. Further analysis showed that this red tide was caused by Alexandrium affine (Wagey et al., 1998). This was the first Alexandrium affine bloom recorded for Ambon Bay, but so far no harmful effects were reported. Cell abundance reached a maximum of 60 x 106 cell/L, with an average of 2 x 106 cells/L (Wagey et al., 1998).Further more nitrate and ammonium concentrations were extremely high (50 mM) as compared to the average concentration of 1.5-6.0 mM. Wagey et al. (1998) also noticed that prior to the outbreak a thick haze resulting from forest fire was hanging over the bay for approximately two weeks. They suggest that this might have an

effect on the outbreak of Alexandrium affine. Water samples collected by Dr. Wiadnyana were sent to Jakarta. Alexandrium affine is shown on Figure 2.

Pieh Island, West Sumatra.

At the end of December 1997 red tide started to develop around the islands Pieh, Pandan, Air, Cubadak, Siberut and Sikuai, off the coast of West Sumatra in the Indian Ocean. Sea water turned into a reddish-brown color causing mass mortality of fish, crustaceans, mollusks and corals. On December 25, 1997, the bloom reached Pieh Island. Divers from the Bung Hatta University, who were conducting a survey on coral reef condition, were suddenly left in darkness due to sun blocking by a thick layer of phytoplankters.

Visibility, which usually reached 20 m, was only 0.5 m. The phytoplankton bloom formed patches with thickness of 1-5 m. Water temperature at 10 m depth was 10° C and at the surface 23° C. The normal water temperature for December (west monsoon) is between 29-30° C and between 27-29° C during the eat monsoon (Birowo et al., 1975). The low temperature indicates that upwelling was in progress, which enriched the upper layers and made possible for phytoplankton to bloom. The unusual condition may also develop due to the El Nino phenomenon. Water color returned to normal on January 3, 1998. The impact of the bloom was total coral destruction and disappearance of anchovies that only reappeared in June 1998. Water analysis showed that red tide was caused by bloom of the dinoflagellate Gonyaulax spinifera (Figure 3). Cell abundance of Gonyaulax spinifera reached 13.5 x 106 cell/L.

Identified Red Tide/HAB species

Praseno and Wiadnyana (1996) reported 20 possible Red Tide/HAB species from the Indonesian waters. Today the list expanded until 31 species (Table 1). Some of them are benthic microalgae belonging to the genera Gambierdiscus and Ostreopsis. Both genera are known able to produce Ciguatera Fish Poisoning (CFP) (Taylor et al., 1995).

Among the species, Pyrodinium bahamense var. compressum is proven to be harmful in Kao Bay, Halmahera, North Moluccas (Wiadnyana et al., 1994). This species is also identified from other locations, such as Ambon Bay, Biak - Irian Jaya, Jakarta Bay and Bangka Strait without developing into a bloom. Other harmful species are the cyanobacteria

Trichodesmium sp. which has caused shrimp kill in East Lampung shrimp ponds (Praseno & Adnan, 1994). The damaging effect may be caused by oxygen depletion as a result of decomposing process, rather then toxin release by this species. Another species responsible for mass mortality is the dinoflagellate Gonyaulax spinifera as mentioned above. Since the bloom of this species at Pieh Island, West Sumatra, was the first recorded incident for that location, it should be further monitored and studied. Its impact on the environment was very damaging. Coral reefs around the islands were totally destroyed, not to say of damage to anchovy fisheries.

Other species are still to be proven for their harmful effects. Noctiluca scintillans is thought to contribute on fish kills in the Jakarta Bay (Praseno, 1995). Ammonia concentration was high following a green Noctiluca bloom. This incident seems to follow a cycle of 9 to 10 years and is correlated to monsoons and anomaly of water circulation in the Jawa Sea. This species also bloom in Ambon Bay (Wiadnyana & Sidabutar, 1997; Sidabutar et al., 1997) which usually started in August until March the next year. Cell abundance may reach 1.3 x

106 cell/L (Sidabutar et al., 1997). Although Noctiluca has not shown harmful effect in Ambon Bay, it should be noted that this species could be harmful as happened in Hongkong and the South China Sea (Ho, 1996).
Other dinoflagellate species of the genus Dinophysis with possible harmful effects are Dinophysis acuminata, D. acuta, D. miles and D. rotundata (Taylor et. al., 1995). All species are found in the Jakarta Bay, but never show harmful effects. D. acuminata was also found in the waters of Kuala Tungkal - Jambi, while D. miles was also found in Teluk Bayur, West Sumatra and East Flores. D. caudata is commonly found in Indonesian waters in small numbers (< 0.5 x 103 cells/L). Two species of the genus Gymnodinium (G. catenatum and G. pulchellum) were identified from the Jakarta Bay. G, catenatum, a PSP-producing species, was found in small numbers (< 200 cells/L) causing no harm. Vegetative forms of this species was found in November and December 1996, and again in March 1998. G. pulchellum was thought to be responsible for shrimp kill in brackish water ponds of Kamal - Jakarta (Praseno, 1995). The genus Prorocentrum is represented by six species, three of which are known as potential harmful species, e.i. Prorocentrum concavum, P. emarginatum, and P. lima. These species are found in the waters near Seribu Islands - Jakarta. P. lima is also found in Ujung Pandang - South Sulawesi and East Flores.

Two genera of benthic microalgae with HAB potentials were identified from Indonesian waters. The scarcity of work in Indonesian waters was the cause of the small number of identified species. Widiarti (1997) identified Gambierdiscus toxicus and two species of the genus Ostreopsis at Penjaliran Island, off the coast of Jakarta. The two species are Ostreopsis lenticularis and O. ovata. Two species of the genus Prorocentrum were also identified from that location, namely Prorocentrum emarginatum and P. concavum. Gambierdiscus toxicus was also identified from East Flores waters and is suspected to cause CFP in December 1997. Two species of diatoms with HAB capacities found in Indonesian waters are Pseudonitzschia pungens and Thalassiosira mala. Pseudonitzschia pungens is commonly found causing no problems. It is still difficult to separate this species from Pseudonitzschia multiserries due to the unavailability of SEM. This species is commonly found in Jakarta Bay and may reach 14.5 x 103 cells/L (September 1997). In March 1998 Thalassiosira mala was found abundant in the Jakarta Bay, reaching 55 x 103 cells/L. Fukuyo et al. (1990) reported mass mortality of bivalves in Chiba - Tokyo Bay on September 1951 during a bloom of this species.

The cyanobacteria, Trichodesmium erythraeum and T. thiebautii, were identified from the shape of bundles/colonies (Carpenter & Carmichael, 1995). Trichomes of Trichodesmium erythraeum form colonies where trichomes are arranged parallel to one another. While trichomes of T. thiebautii are twisted in a rope-like fashion. T. erythraeum is commonly found in East Lampung coastal waters, at times causing problems for brackish water shrimp culture. It seems that this species does not produce toxin, since fish was seen feeding on T. erythraeum without apparent harmful effects. T. thiebautii is found in waters near Seribu Islands - Jakarta, causing fish kill.

One species of Raphidophytes, Chattonella subsalsa, was identified from fresh samples of Jakarta Bay. Position of sampling station was 060 04' 02" S and 1060 49' 52" E. Cell abundance was very small (12 cells/L). No harmful effects was reported.

These HAB species were identified from limited locations in Indonesia. It is, therefore, believed that the number of HAB species will increase. Samplings and monitoring should be continued in the future. The vast size of the country made it difficult to monitor red tide/HAB occurrences properly.

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