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Bima Bay Wiring, Natural Phenomenon Versus Pollution: a Review

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Abstract

The incident that occurred some time ago in Bima Bay, West Nusa Tenggara Province, which began to be seen on April 25/26 2022 is a phenomenon that is quite horrendous for residents of the City/Regency of Bima and outside the Bima area. According to several preliminary studies based on laboratory tests and local inspections, it is estimated that there are three possible causes, namely: (1) Sea Snot, (2) Algae Explosion and Metabolism (Algae Blooms) and (3) Oil Spill (Algae Blooms). oil spill). This study aims to examine the assessment of the sea on human health and welfare, in particular to examine the causes of seawater phenomena that occur in Bima Bay by considering many aspects. This study identifies and makes estimates based on data and facts that relate the phenomena that occur/pollutants to health effects on marine biota and on humans. It was carried out by observing the quality of sea water in Bima Bay based on the results of several laboratory tests on specimens taken on 27-29 April 2022. The test results of sea water samples taken on 27 April 2022 showed a high nitrate content. levels of 9.75 mg/l to 34.75 mg/l (water quality standard for nitrate content = 0.008 mg/l) and accompanied by an increase in ammonia level of 0.41 mg/l (water quality standard for ammonia content = 0, 3 mg/l) l). l) and phosphate content of 0.06-0.08 mg/l (Phosphate quality standard = 0.015 mg/l). Total ammonia, nitrate and phosphate are environmental parameters that contain nutrients which if present in high concentrations and even continue to increase in marine waters will cause eutrophication (bloom) which can be very dangerous for other marine biota by causing a decrease in dissolved oxygen, plankton growth which can cause decrease in fish population, bad smell, and bad taste and can cause the formation of biomass in the form of jelly. The biomass can be in the form of polysaccharides and proteins with an estimated containing bacteria, viral pathogens known as sea snot.

Keywords: Natural Phenomenon, Algae, Oil Spill, Lawata Bima Beach, Oil

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INTRODUCTION

The oceans are a huge part of the earth that cover more than 70% of the earth's surface, hold 97% of the world's water, host some of the most diverse ecosystems and support economies in countries around the world (Portner, et al., 2019). Microscopic organisms in the ocean are the main source of oxygen in the atmosphere by absorbing more than 90% of the excess heat released into the Earth's environment and nearly a third of carbon dioxide emissions. Oceans slow planetary warming and stabilize global climate (Gruber, et al., 1994 & 2007).

The oceans are vital to human health and well-being (Rockström., et al. 2009), as they provide food for billions of people, livelihoods for millions, and are a source of many essential medicinal ingredients (Ercolano, et al., 2019) . In addition, the ocean is a source of joy, beauty, peace and tourism (Martínez, et al. 2007). The oceans are very important for human health and well-being. The survival of vulnerable populations depends on the health of the oceans (The, 2019).

Despite its immense size, the oceans are under threat. Human activities are the main source of this threat (Portner, et al., 2019). Climate change and other environmental disturbances are causing sea surface temperatures to rise, glaciers to melt, and harmful Algae species and pathogenic bacteria to migrate to previously uncontaminated waters. The increasing volume of oceans accompanied by violent coastal storms can endanger the 600 million people worldwide who live within 10 meters of sea level (Whitmee, 2015). Rising CO2 concentrations in the atmosphere have led to ocean acidification, which in turn destroys coral reefs, interferes with oyster development and other health and dissolves calcium-containing microorganisms (Keeling., 2010). The oceans are deprived of oxygen (Portner, et al., 2019). In addition, declining fish stocks due to large-scale fishing, oil exploration, and underwater metal mining seriously threaten the seabed ecosystem (Cuyvers, Berry, Gjerde., 2018).

Coastal areas are important areas from various planning and management perspectives. The transition between land and sea in coastal areas has created diverse and highly productive ecosystems and provides tremendous economic value to humans (Baigo., et al. 2018). The problem that is very dominant for coastal, coastal and marine areas is the occurrence of pollution which results in a decrease in the quality and quantity of coastal and marine resources which will reduce usability, usability, productivity, carrying capacity and aquatic resources which in turn reduces natural resource wealth. Any changes in vulnerable ecosystems due to anthropogenic activities that can endanger the habitat of fish and other aquatic organisms (Gholizade., et al. 2016).

According to Selanno (2009) in Gemilang et al. (2016), increasing the concentration of waste both from land and from activities at sea will have an impact on changes in the physical, chemical and biological components of the waters as a whole (Gemilang & Kusumah, 2017). Nutrient enrichment in the aquatic environment has a positive impact, but at a certain level it can also have a negative impact (Baigo, et al. 2018). The content of nitrate and phosphate plays an important role in supporting the survival of various types of marine biota, but too high a content can trigger various negative impacts in terms of chemical and aquatic biology (Baigo, et al. 2018).

The incident that took place some time ago in Bima Bay, West Nusa Tenggara Province, which began to be seen on April 25/26 2022 is a phenomenon that is quite shocking for residents of Bima City/Regency and outside the Bima area. According to several preliminary studies based on laboratory tests and local examinations, there are three possible causes that are estimated, namely: (1) Sea Snots, (2) Explosion of Algae Number and Metabolism (Algaee Blooms) and (3) Oil Spills (Algae Blooms). Spill Oil). Teluk Bima is the main waterway located in the north of Sumbawa Island, and is located in Bima City and Bima Regency (Encyclopedia. site: upwikims.cyou. accessed 04 May 2022).

Environmental pollution is a major threat that continues to grow and is the biggest cause of disease in the world and is responsible for around 9 million premature deaths per year (Landrigan PJ, et al. 2018). Marine pollution causes economic losses, hinders transnational economic development, and hinders the achievement of the Sustainable Development Goals (TPB) (Laurent, et al., 2019). Marine pollution is a very important component in environmental pollution but is not taken seriously from global pollution events (Landrigan, et al., 2020), which has various direct and indirect impacts on human health and the survival of marine life itself.

Here. The purpose of the review in this paper is to examine the impact of marine pollution on human health and welfare, in particular to assess the estimation of the causes of seawater phenomena that occur in Bima Bay by taking into account many aspects.

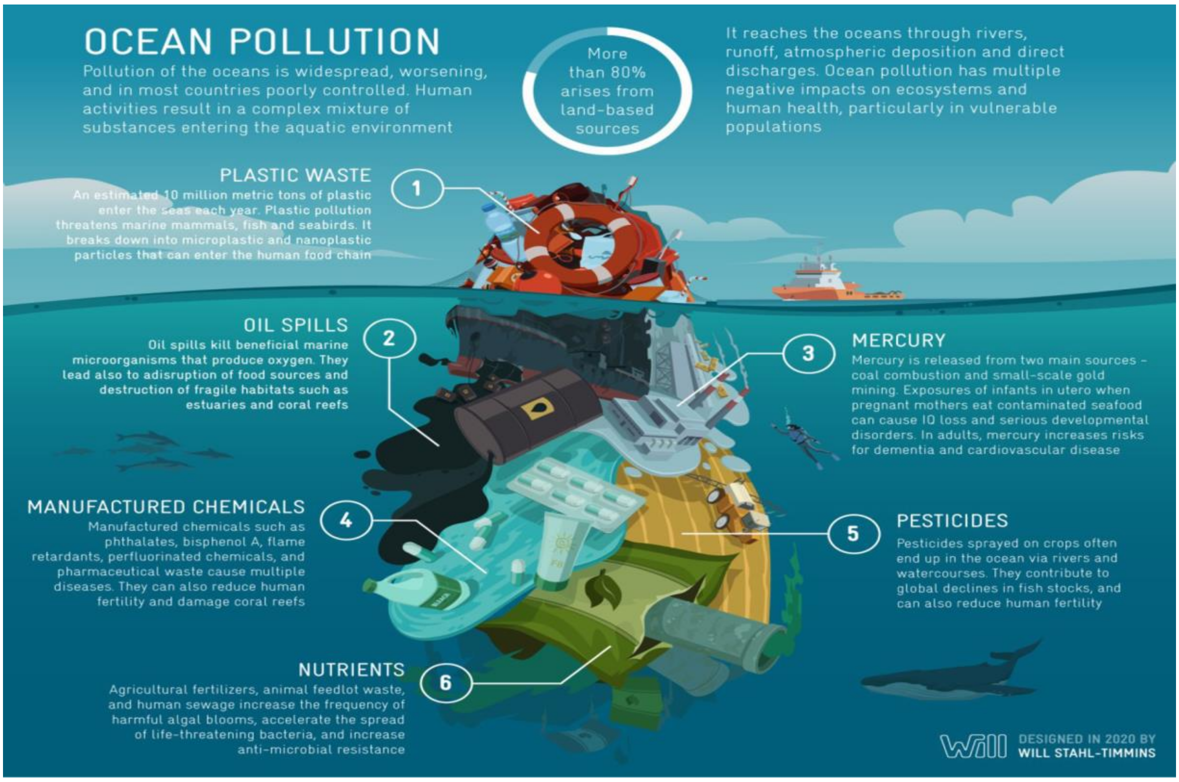

Figure 1. Marine pollution-causing complex (Landrigan PJ, et al. 2020).

METHOD

This research is a quantitative descriptive research with survey method. This research focuses on topics and phenomena that occur in Bima Bay. The discussion was carried out through observations of sea water quality in Bima Bay based on the results of several laboratory tests on specimens taken from 27-29 April 2022 by the Bima City Health Office and from several agencies that carried out inspections such as the Surabaya BBTKL. We identify and make estimates based on data and facts that relate phenomena that occur/pollutants to health effects on marine biota as well as on humans and divide them into three categories of estimated sources of causes, namely: (1) Harmful Algaee blooms; (2) Spill oil and (3) Sea snot. We also in this study consider not only the health effects of individual phenomena/pollutants, but also the complex mixture of chemical phenomena/pollutants and biological phenomena/contaminants found based on the results of observations and laboratory tests.

RESULTS AND DISCUSSION

Results of laboratory testing of seawater samples:

1. Test Results 1 (27 April 2022)

Table 1. Results of inspection of seawater samples

Parameter Test	Results	Seawater Quality Standard
Physics		
Odor	Fishy	Odorless / Fishy
Temperature	30^0C	Natural $\pm 3^0$C
Color	Yellowish cloudy	Natural
Turbidity	74,6 ntu	<5 ntu
TDS	19,8 ppt	20 ppm
Electrical conductivity	12,36 µmhos/cm	Max 2.250 µmhos/cm
Dissolved Oxygen	4,74 mg.l	>5 mg/l
Chemicals		

Parameter Test	Results	Seawater Quality Standard
pH	9,7	6,5-8,5
Free Chlor	0,36 mg/l	0,03 mg/l
Total Chlor	57 mg/l	
Nitrate	9,75 mg/l	0,008 mg/l
Nitrite	0,01 mg/l	0,01 mg/l
Ammoniac	0,41 mg/l	0,3 mg/l
Oil	0,0 mg/l	TTD

Information :
Sample type : Seawater
Pick up location : Wadumbolo waters
Sampling officers : Fathurrahmaniah, M.Si, Agus Hartyna, Amd. Kes
Source : Department of Environment and UPT. Labkesda and Maintenance of Medical Devices in Bima City
Reference : Decree of the Minister of Environment Number 51 of 2004

2. Test Results 2 (28 April 2022)

Table 2. Results of inspection of seawater samples

Parameter Test	Results (Sample 1)	Results (Sample 2)	Results (Sample 4)	Seawater Quality Standard
Physics				
Odor	Fishy	Fishy	Fishy	Odorless / Fishy
Temperature	31^{0}C	29,8^{0}C	29,0^{0}C	Natural ±3^{0}C
TDS	33,8 ppt	32,8 ppt	31,8 ppt	20 ppm
Electrical conductivity				Max 2.250 µmhos/cm
Chemicals				
pH	8,55	8,5	8,4	6,5-8,5
Dissolved Oxygen	0,0 mg/l	7,3 mg/l	6,13 mg/l	>5 mg/l
Salinity	25,3 ppt	24,8 ppt	25,7 ppt	±<5% of the mean seawater salinity
Conductivity	52,1 mS	49,7 mS	49,0 mS	
ORP	85,2 mS	92,2 mS	90,1 mS	
Heavy metal				
Arsen	0,001 mg/l	0,001 mg/l	0,001 mg/l	0,025 mg/l
Mercury	<0,001 mg/l	<0,001 mg/l	<0,001 mg/l	0,002 mg/l

Information :
Sample type : Seawater
Pick up location : Point 1 Wadumbolo waters
Point 2 Lawata Beach (1)
Point 3 Lawata Beach (2)
Sampling officer : Nahrio, Amd. Kes., S. Sos
Source : Bima City Health Office
Reference : Decree of the Minister of Environment Number 51 of 2004

3. Test Results 3 (29 April 2022)

Table 3. Results of inspection of seawater samples

Parameter Test	Results (Sample 1)	Results (Sample 2)	Seawater Quality Standard
Physics			
Odor	Fishy	Fishy	Odorless / Fishy
Temperature	31^{0}C	29,8^{0}C	Alami ±3^{0}C
Turbidity	52,6 ntu	50,1 ntu	<5 ntu
TDS	14,8 ppt	13,3 ppt	20 ppm
Chemicals			
pH	8,25	8,3	6,5-8,5
Free Chlor	0,09 mg/l	0,03 mg/l	0,03 mg/l
Total Chlor	21 mg/l	17 mg/l	
Nitrate	12,75 mg/l	34,75 mg/l	0,008 mg/l
Nitrite	0,09 mg/l	0,08 mg/l	0,01 mg/l
Phosphate	0,062 mg/l	0,080 mg/l	0,015 mg/l

Parameter Test	Results (Sample 1)	Results (Sample 2)	Seawater Quality Standard
DO	1,74 mg/l	3,61 mg/l	>5 mg/l
BOD	6,12 mg/l	8,33 mg/l	10 mg/l
Biology			
Escherica coli	$2{,}3x10^4$	Null	Null
Vibrio, sp	Null	Null	Null
Klebsiella, sp	Null	Null	Null
Bacillus, sp	Null	Null	Null
Pseudomonas, sp	Null	Null	Null

Information :
Source : BBTKL Surabaya
Reference : KepmenLH Number 51 Year 2004

Dangerous Algae Blooms

The test results of seawater samples taken on April 27, 2022 (Table 1) and April 29, 2022 (Table 3) showed high levels of nitrate, phosphate and increased levels of Ammonia. Total ammonia, nitrate and phosphate are environmental parameters that contain nutrients and nutrients which, if present in high concentrations and even continue to increase in marine waters, will cause eutrophication (blooming) which is very dangerous for other marine biota (Baigo H., et al. al. 2018). Ammonia concentration is high because the waters of Teluk Kima are a busy area with a lot of physico-chemical metabolism from human activities.

Ammonia, nitrate and phosphate are actually nutrients that support water fertility. Water fertility can be said as one of the supporting factors in determining the quality of a waters (Damar, 2004 in Santoso, 2006). The enrichment of nutrients in the aquatic environment has a positive impact, but at a certain level it can also have a negative impact. The positive impact is an increase in the production of phytoplankton and total fish production (Jones Lee and Lee, 2005; Gypens et al., 2009), while the negative impact is a decrease in oxygen content in the waters, a decrease in biodiversity and an increase in the potential for the emergence and development of dangerous phytoplankton species. more commonly known as Harmful Algael Blooms or HABs (Gypens et al., 2009). This is in accordance with the results of testing seawater specimens on April 27, 2022 (Table 1) as well as on testing point 1 samples on April 28 and 29, 2022 (Table 2). A significant decrease in dissolved oxygen levels can affect the photosynthesis process of some marine biota and can cause the death of aquatic organisms (Gypens et al., 2009).

The content of nitrate and phosphate plays an important role in supporting the survival of various types of marine life. As explained by Mustofa (2015), nitrate and phosphate are macronutrients that are needed by living things in large quantities (Heny BS. and Ernastin M., 1978). The high content of nitrate and phosphate in the aquatic environment can trigger the occurrence of nutrient enrichment (eutrophication) which can further disrupt the survival of various types of marine biota. The eutrophication process is generally characterized by a blooming of phytoplankton or algae followed by a decrease in dissolved oxygen content and mass mortality of marine life (Watkins SM, et al. 2008). Indirect nitrate toxicity in water occurs because nitrate can help excessive algae growth which can result in reduced dissolved oxygen levels in water (Hallberg, 1989).

Research conducted by the Faculty of Fisheries and Marine Sciences (FPIK) Bogor Agricultural University (IPB), where samples of sea water were taken on April 29, 2022. The results of rapid identification showed a very high abundance of phytoplankton from the class Bacillariophyceae (Diatom). The phytoplankton is thought to belong to the genus Navicula or Mastogloia with an estimated abundance ranging from 10–100 billion cells per liter.

Based on the sea water quality standard in Government Regulation No. 22 of 2021, the threshold for the abundance of phytoplankton for marine tourism and marine life is 1,000 cells per milliliter. The abundance of phytoplankton that exceeds the threshold is considered not good. Excessive concentrations of nutrients such as nitrogen, phosphorus, and silicates can trigger the rapid growth of phytoplankton in the water column. When the phytoplankton die, it will float on the sea surface forming a jelly-like brown layer.

This layer is a biological material in the form of phytoplankton (Bacillariophyceae) biomass which undergoes explosive growth (blooming). According to the IPB team, Blooming is thought to have occurred due to a combination of natural phenomena (climate and oceanography) and nutrient enrichment (eutrophication) of waters from non-point sources. Phytoplankton from the Bacillariophyceae class are not toxic producers, but they still have an ecological and social impact in the form of a lack of oxygen for marine biota (Venancio, et al., 2019).

Many toxin-producing algae, pathogenic bacteria, viruses, fungi, and protozoa originate from marine and estuarine environments (Landrigan PJ, et al. 2020). Algae are biota that are very important for aquatic food webs and are producers of fixed carbon as an important nutrient for aquatic ecosystems and provide oxygen. Free-living plankton are Algae species that dominate the oceans. In coastal and estuarine areas, cyanobacteria, as well as dinoflagellates, diatoms, and cryptophytes occur seasonally and are vital components of ecosystems (Young CS, Gobler CJ. 2018).

The phenomenon of Algaee blooms based on the findings of the IPB team above remains a concern even though in testing the results of the samples taken, the phytoplankton biomass of Bacillariophyceae is not a poison producer, but further testing must still be carried out. Anderson and White, 1992; Coulson et al., 1968; Landsberg, 2002 states that toxins produced by harmful algae/Harmful Algaee blooms (HAB) are known to cause death and adverse health effects for other marine biota, humans and wildlife. HAB toxins can also cause economic losses, especially for aquaculture and fisheries (Hoagland et al., 2002).

The IPB team who discovered the type of Algae Bacillariophyceae (Diatom) was in accordance with several previous studies. This type of algae is a saprophytic algae but can also be dangerous if the amount is excessive (Young CS, Gobler CJ. 2018). According to Maeda Y, et al (2018), marine microalgae are very important for human health not only because they provide food for aquaculture and produce various pharmaceutical compounds. On the downside, some species of algae are dangerous and produce strong toxins. When a high density of this species accumulates in the ocean area and forms Harmful Algaee Blooms (HAB), the accumulated Algae dumps inorganic nutrients in the water column which allows bacteria to enter including pathogens and decompose organic matter. The consequence is a decrease in dissolved oxygen in the water which causes fish death, and various adverse ecological impacts (Hallegraeff G, 2003).

HAB is not a new phenomenon, but the frequency and magnitude of HAB occurrence continues to increase in several regions of the world (Anderson DM, et al., 20120). This increase has been attributed to three factors, namely: (1) Increased marine pollution, especially from coastal waters by nitrogen and phosphorus leading to eutrophication, nitrogen sources from agricultural waste, and septic tank waste from injection wells; (2) Sea surface warming; and (3) Ocean acidification. The increase in the frequency and severity of HAB is associated with changes in weather patterns such as global warming events and changes in ocean currents (Lefebvre KA, et al. 2016).

HAB causes various diseases in humans such as: (1) Paralytic Shellfish Poisoning (PSP) caused by saxitoxins (STX), a powerful neurotoxin that acts on other nervous system receptors. PSP usually begins with a tingling sensation or numbness in the face, neck, fingers, and toes (Wiese M, et al. 2010); (2) Amnesic shellfish poisoning (ASP) caused by domoic acid (DA), a potent poison that targets glutamate receptors in the central nervous system (Muha N, et al. 2011); (3) Diarrhetic shellfish poisoning (DSP) associated with exposure to okadaic acid and dinophysis toxins. This syndrome presents with diarrhea, nausea, vomiting and abdominal pain, but no deaths have been reported (Morabito S, et al, 2018); (4) Neurotoxic shellfish poisoning (NSP) is caused by brevetoxins (BTX), neurotoxins that cause depolarization of nerves, muscle cells and heart. NSP produces a mixture of gastrointestinal and neurological symptoms – nausea, vomiting, diarrhea, and abdominal cramps, paralysis, convulsions, and coma (Watkins SM, et al. 2008); (5) Ciguatera Fish Poisoning (CFP) is caused by the consumption of fish and shellfish that have accumulated ciguatoxins (CTX) (Darius HT, et al. 2018) and (6) Clupeotoxism is a form of human poisoning related to HAB caused by consumption of contaminated fish and crustaceans by palytoxin (PTX). Symptoms include gastrointestinal, neurological, and cardiovascular symptoms, as well as weakness, cough, and muscle aches (Hamade AK, et al. 2012–2014).

Oil Spill

Based on the results of laboratory tests conducted by UPT. Labkesda Kota Bima on sampling on 27 April 2022 (Table 1), did not find any oil and fat content including the estimated presence of oil sourced from PT. Pertamina Bima which is located right in front of Wadumbolo waters where the first sample was taken and is the initial center for the formation of phenomena in seawater in Bima Bay. Oil content was not detected on examination of the specimens taken including the examination of samples on the 3rd day (29 April 2022). The parameters of the oil tested by the laboratory were not detected, as well as on organoleptic examination, where the specimens taken did not have an oil aroma.

Some of the news and information that first surfaced regarding the phenomenon of sea waters in Bima Bay were the possibility of contamination from the oil tank owned by PT. PERTAMINA Bima. This assumption is reinforced by the fact that this phenomenon was first formed in the waters of Wadumbolo which is right in front of PT. Pertamina Bima where there is an oil storage ship docked. One of the information and news that is sticking out is from CNN Indonesia which was published on April 27, 2022. This assumption continues to stick out in the community with the change in the color of the sea waters, especially around the location of PT. PERTAMINA Bima. (https://www.cnnindonesia.com/nasional/20220427164910-20-790548/walhi-teluk-bima-ntb-diduga-tercemar-limbah-pertamina/accessed 02 May 2022). Although the seawater specimen testing, both physical and chemical descriptions and tests did not show an estimate of oil pollution, it must still be a concern.

Oil pollution in marine habitats is caused by oil extraction and transportation, including tanker accidents and operational discharges (Blackburn et al. 2014). Oil spills can cause immediate, prolonged and widespread environmental toxicity (Brussard et al. 2016). Crude oil and petroleum products are mixtures of complex and heavy light hydrocarbons, toxic metals, and other chemicals. Polycyclic aromatic hydrocarbons (PAHs) are highly hazardous components. When oil spills and leaks release toxic chemicals into the ocean or the environment, these spills accumulate in the food web; kill fish, birds and marine mammals; destroy commercial fisheries, and shellfish beds; releasing volatile toxic chemicals such as benzene into the atmosphere; and dirty coastlines (Landrigan J., et al. 2020).

Most of the oil spills that enter the marine environment initially float and form slicks that spread on the surface of the water. These slicks are transported horizontally by wind and currents. The oil is then trapped in the water column under the slick through dispersion with or without dispersant chemicals (Maes, 2004). Organisms that use these habitats may be exposed to petroleum chemicals that cause a variety of toxic effects (Incardona et al. 2014, 2015; Buskey et al. 2016). The impact of oil on organisms in the water column is biologically significant (Lewis & Ricker 2020). Efforts to characterize impacts on biological communities in the water column are generally based on oil observations, chemical measurements of petroleum-associated hydrocarbons in the environment and different biota, population monitoring, laboratory-based toxicity testing, and dose-dependent determination of toxic effects of chemical compounds found in oil (Martínez-Gómez et al. 2010).

The ecosystem effects of the oil spill include disturbance of food sources for marine biota, destruction of estuary habitats and coral reefs, and coastal contamination. Marine life and coastal wildlife, including birds and mammals, can be exposed to oil-based pollutants through ingestion, absorption and inhalation and if consumed by humans can cause digestive problems, bleeding, kidney and liver damage, reproductive failure and anemia. PAHs contained in oil spills have been shown to cause DNA damage in marine species and have been associated with liver, lung and cardiac lesions in seals (Council NR. 2003, Pérez-Cadahía B, et al. (2006).

Toxicity testing is important to determine how oil exposure impacts organisms. Toxicological data can inform emergency and mitigation responses, assess the type and magnitude of damage to natural resources and predict future consequences of these events (Kirby et al. 2007). Environmental conditions, including temperature, salinity, and dissolved organic matter, can alter toxicity through complex exposure dynamics (Ramachandran et al. 2006). Standard toxicity tests are essential for making decisions on prevention and control measures regarding oil spills (Colvin et al. 2020).

Burton, et al. (2021) conducted a bioassay test to track oil spill events that will affect the life of marine organisms in US waters using a modified tool from 2 systems, namely: the sediment ecotoxicity assessment ring (SEA Ring) and the drift particle simulator (DPS). This tool is called Drifting exposure and effects assessment ring (DEEAR) Technology which can improve future assessments to ascertain adverse oil toxicity in real time and, therefore, become a useful tool for response and damage assessment.

DEEAR technology provides a new and unique ability to relate exposure and adverse effects of oil spills. DEEAR technology trials in San Diego Bay and off the coast of Santa Barbara, California, USA, demonstrated the unique ability to simultaneously assess real-time oil exposure and effects on invertebrates and fish in the water column over a 24-hour period (minimum). This technology could improve future assessments to ascertain adverse oil toxicity in real time and, therefore, become a useful tool for response and damage assessment.

Sea Snot

Sea snot can be defined as an accumulation of white-brown, jelly-like material that appears for a short period of time on the ocean surface. Although the phenomenon of sea snot and the reasons for its occurrence is a complex subject, it can be said that sea snot is mostly composed of organic structures consisting of a mixture of carbohydrates and proteins (Yücel et al. 2021).

Danovaro et al. 2009 stated that the sea snot formation event that occurred in the sea in the Turkish Mediterranean some time ago actually started in the early 1700s which occurred in the Sea of Marmara in September-October 2007 (Aktan, 2008). As recently as December 2020, sea snot formation was scientifically recorded in Turkey's Anakkale Strait above an assemblage of hard, gorgonian, coralligenous, and spongy corals (Özalp 2021). After that, Balkis-Özdelice et al. (2021) found that the bacterium Phaeocystis pouchetii (Pic. 2) produces mucilaginous foam in the Sea of Marmara. This foamy and filamentous formation affects fishing activities carried out by fishermen (Keleÿ et al. 2020).

Figure 2. Phaeocystis pouchetii (Hariot) Lagerheim, 1893. motile cell c. 5 µm long, colony up to 1.5-2 mm (Fukuyo, et al., 1990).

Yıldız T. and Gönülal O. (2021) in their research using the interview method and filling out online questionnaires to fishermen around the Marmara sea in Turkey found that 89.1% (188 people) of fishermen who participated in the survey thought that sea snots would affect the process. fishing in addition to its main effect on marine biota itself such as clogged fishing hooks, nets carrying sea snots cause a heavy net load, and an increase in the workload of fishermen, not to mention the possibility that sea snots contain pathogenic microorganisms that can endanger health. Another important issue affecting the fishing industry due to sea snot is the decline in fish consumption (Yıldız T and Gönülal O., 2021).

The culture of microorganisms including pathogens was carried out after the 3rd sampling by BBTKL Surabaya on April 29, 2022 (Table 3). The culture results showed that some of the pathogens tested and estimated to be seen in samples such as Vibrio, sp, Bacillus, sp were actually reported with negative results. Microorganisms that were reported to be abundant were found in the sample test, namely Escherica coli bacteria.

The presence of abundant Escherica coli bacteria can be triggered and supported by an increase in the levels of several chemicals such as nitrate, nitrite and phosphate as indicated on the results of the examination on the first day (27 April 2022) and on the 3rd day (29 April 2022) (Table 1 and 3) with NO2 levels according to sea water quality standards but NO3 levels reaching 9.75 mg/l which far exceeds water quality standards (0.008 mg/l). This indicates the occurrence of large-scale production of nitrate (NO3) in seawater in the waters of Bima Bay. Although Escherica coli is included in the category of saprophytic bacteria, its abundant presence is a major indicator of the presence of other, more dangerous pathogens (Yıldız T and Gönülal O., 2021). In addition, the abundant concentration of Escherica coli actually has the opportunity to become pathogenic and harmful to marine biota (Alaerst and Sartika, 1987).

The amount of nitrate and phosphate content in the aquatic environment is often used as an indicator of fertility and environmental pollution of coastal waters. According to Effendi (2003) and Mustofa (2015), the classification of water fertility levels based on nitrate content include: oligotrophic (0-1 mg/l), mesotrophic (1-5 mg/l) and eutrophic (5-50 mg/l) waters.), while based on orthophosphate content, they include: oligotrophic (0.003-0.010 mg/l), mesotrophic (0.010-0.030 mg/l) and eutrophic (0.03-0.1 mg/l) waters.

High levels of NO3 have a risk of pollution and are actually not good for seawater biota itself (Yıldız T and Gönülal O., 2021). One source of phosphate and nitrate is in addition to natural processes such as eutrophication, it can also come from the use of pesticides from agricultural land, these pesticide precursors are carried away when the soil is eroded (Mustofa, 2015). Agricultural and plantation land around Bima Bay is land located in the mountains and hills with a sloping geographical condition and some of it leads to Bima Bay. The use of pesticides on agricultural land has the possibility and opportunity to pollute the waters of Bima Bay, especially during the rainy season. Pesticide residues carried can be in the form of nitrates and phosphates which can mix with nitrates and phosphates that are naturally present in marine waters.

The addition of the concentration of waste both from land and from activities at sea will have an impact on changes in the physical, chemical and biological components of the waters as a whole (Baigo H., et al. 2018). Changes in environmental quality due to anthropogenic activities as well as due to natural factors will slowly have a direct or indirect impact on aquatic biota and will also have an impact on humans as consumers (Landrigan PJ, et al. 2011).

The presence of nitrogen compounds such as nitrite and nitrate in the aquatic environment is a serious problem that must get mutual attention. High nitrate concentrations in waters can stimulate the growth and development of aquatic organisms if supported by the availability of nutrients (Alaerst and Sartika, 1987). Excess nitrate can reduce dissolved oxygen which can lead to a reduction in fish populations, bad smell, and bad taste (Ratna J., et al. 2017).

Chemical Pollution (Heavy Metals)

The release of toxic metals including major heavy metal wastes such as mercury into the environment has occurred since the start of mining activities and has been increasing since the beginning of the Industrial Revolution (McConnell JR, et al., 2008). Mercury is the largest metal pollutant in the oceans that poses a high risk to human health (Landrigan PJ, et al. 2011). Over the past 500 years, human activities have increased the total Mercury in the environment including the oceans by about 450% above the threshold for natural compensatory capabilities.

Currently, about 70% of mercury circulates in the environment. The presence of large amounts of mercury in the environment and the potential for climate change to re-mobilize this mercury complicates projections of future exposures and their impact on human health. It is estimated that 2,220 tonnes of mercury are currently exposed to the environment each year as a result of human activities. These emissions account for about 30% of current mercury emissions, and another 60% of current mercury emissions result from environmental recycling of anthropogenic mercury previously stored in soil and water, while the remaining 10% comes from natural sources such as volcanoes (Landrigan PJ, et al. 2020).

Methylmercury is a persistent pollutant in the ocean. bioconcentrations of mercury move up the food web, so that apex predatory species such as tuna and bluefish and marine mammals can accumulate concentrations of methylmercury in their tissues that are 10 million times or greater than those in surrounding waters. Consumption of metal mercury in marine life causes: (1) rapid loss of neurocognitive function in adults and (2) cardiovascular effects.

Other heavy metals such as arsenic (As) can contaminate seawater biota if the concentration exceeds the quality standard (0.025 mg/l), Arsenic effects on health if humans consume it from various contaminated sources at high concentrations, including marine fish in the form of death (above 6000 ppb). in food or water), at concentrations of 300-3000 ppb in water or food, stomach and digestive irritation occur (vomiting and diarrhea) and decreased production of red and white blood cells, abnormal heart rate and damage to blood vessels and if consumed more than 100 micrograms. /M3 inhaled air causes throat and lung irritation (McConnell JR, et al., 2008).

Several other types of heavy metals that can contaminate marine waters are: Al (aluminum), Hg (mercury), Pb (plumbum / lead), Zn (zinc / zinc), Cr. (chromium), Cu (cufrum / copper), Cd (cadmium), Co (cobalt), and so on. Some of the heavy metals have a negative impact on the human body, for example the emergence of several dangerous diseases (Ratna J., et al. 2017).

Qualitative and quantitative heavy metal laboratory tests carried out on the 2nd sampling by the Environmental Health Team of the Health Office on 28 April 2022 (Table 2) did not show an increase in the concentration of heavy metals arsenic and mercury. The low concentration (according to the water quality standard KepmenLH Number 51 of 2004) indicates that there is no contamination of the sea waters of Bima Bay by heavy metals arsenic and mercury. Although only tested with 2 heavy metal parameters (Aresn and mercury), the authors assume that the estimation of the phenomena that occur in these waters is not from heavy metals, but it is possible to carry out a more complete heavy metal test.

Marine Bacteria, Viruses, and Protozoa

Microorganisms such as bacteria and viruses are abundant in the oceans. Each cubic centimeter of seawater on average contains one million microbial cells, while global seaports are estimated to contain 4–6×1030 microbial cells (Whitman, 1998). While most of the bacteria in the oceans are harmless to humans, some are pathogenic. Natural marine pathogens of great importance to human health include Vibrio cholerae, Vibrio vulnificus, Vibrio parahaemolyticus, and , sp (Landrigan PJ., et al. 2018).

Climate change, warming sea levels, and worsening ocean pollution can expand the natural geographic range of marine pathogens and microorganisms in the oceans. Harmful bacteria can move into estuaries, bays and areas of the ocean that were not previously inhabited by these microorganisms. Microbial infections contribute to the degradation of fragile marine environments such as coral reefs which contribute to shellfish mortality in the wild and agricultural areas, thereby affecting the economy (Landrigan PJ., et al. 2018).

Vibrio bacterial species are a major cause of disease and death. Vibrio cholerae is the species of greatest concern because it has strong monsoon defenses, and warmer water temperatures can lead to increased species concentrations in estuaries and coastal waters including bays and harbors (Ceccarelli D, et al. 2019). The warming of coastal waters caused by climate change tends to further increase the abundance of Vibrio bacteria and expand the geographic range of these bacteria. There are some indications that after extreme weather events such as storms, droughts, and tropical storms, the species composition of Vibrio, sp shifts and this shift is driven by the discharge of inorganic waste and nutrients into coastal waters (Landrigan PJ., et al. 2018).

Escericia coli bacteria detected in the sample test were the only aquatic bacteria that had the greatest abundance in the sample compared to other pathogenic bacteria such as Vibrio, sp, Klebsiella, sp etc. The abundance of Escericia coli was in line with the increase in nitrate and ammonia levels in the testing of seawater chemical parameters (Table 1). The presence of these bacteria is not only caused by the natural eutrification process, but can also be caused by external pollutants. Eutrophication that occurs causes nutrient enrichment which if excessive can cause the formation of biomass in the form of jelly (Danovaro, R., et al. 2009). The biomass can be in the form of polysaccharides and proteins with estimates containing bacteria, pathogenic viruses known as sea snot (Keleş, G., et al, 2020), or contain abundant phytoplankton which can be dangerous in the form of Harmful algae blooms (HAB) (Young CS). , Gobler CJ. 2018).

CONCLUSION

The author compiled and determined the cause of the phenomenon in Bima Bay, West Nusa Tenggara Province, namely Sea Snot with the main cause of harmfull algae blooms and the abundance of Eschericia coli bacteria caused by increased levels of nitrate, phosphate and ammonia in seawater around Bima Bay which caused eutrophication. blooming) to form biomass in the form of jelly.

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