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Report of mass fish mortality along the Eritrean coast and islands

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Abstract

Fish mass mortality is not common events in the Eritrean Red sea waters before this time. Field observation, interview and group discussion with fishermen were conducted to confirm the information regarding fish mortality along the coast and islands. The field observation conducted along the coasts of Halibay, Emberemi, Millennium Beach Hotel and Gurgusum Beach confirmed the fish death. In the same time the interview and group discussion with fishermen assured fish mortality along different sites of coast and islands from the end of August up to the first week of September. According to the response of fishermen interview and discussion, fish were observed having wide opened and flared gills with frequent and increased opercular movements. It was concluded that the probability of fish death could be combination of algal blooms, oxygen depletion and increasing temperature. This research has tried to identify the cause of fish death and suggest continuous research and monitoring the algal blooms.

Keywords: Fish, mortality, algal blooms, Red sea, Eritrea

1. Introduction

Eritrea is located in the horn of Africa along the southern coast of the Red Sea. The total Eritrea's coast line is about 3300 km long which is about 1350 km lies along the continental shore and 1950 km around over 350 islands. The total area of Eritrea's Exclusive Economic Zone (EEZ) is about 120,000 km². This part of the Red Sea is known for its wide continental shelf, which is dotted by a large number of low-lying coralline islands. Eritrea's continental shelf area is about 56,000 km², which is the largest of all the countries along the Red Sea. The waters of the southern part of the Eritrean Red Sea are highly productive due to allochthonous advection of monsoon up-welled nutrient rich waters through Bab El Mandab. This productivity supports substantial populations of over 1000 species of fish, 220 species of corals, and other varieties of marine organisms.

Fish mass mortality events are unusual along the coast and islands of Eritrean Red Sea. The fish mass mortality can be defined as a sudden and unexpected death of large number of fish with in short period of time in defined geographic area. Although many events that cause fish mass mortality remain unknown, there are a range of fish deaths causes. These causes include low dissolved oxygen levels, high or low temperatures, drought or dry conditions, algae and algal blooms, acidic runoff, pesticide/chemical pollution, dumping of waste fish or bycatch, disease/infections.

Throughout the world's coastal waters, the harmful algal blooms (HAB) have increased during the last century due to water eutrophication and climate change that cause frequently severe impacts on coastal resources, local economies and public health [1]. Harmful algal blooms (HAB) are caused by microalgae that result harmful and toxic incidents intensifying and spreading over the world [2]. Such microalgae cause negative effects include biotoxins, physical damage and anoxia and hypoxia [3]. Hypoxia is defined as the physiologically stressful for fish, shellfish, and invertebrates with extended exposure to anoxia being fatal to most aquatic organisms. When a fish exposure to hypoxia condition causing both lethal and sub lethal effects. It can also affect the fish to reduce its feeding, reproductive, growth, and metabolism. The effects of hypoxia on fish not only vary depending the fish species [4], but also according to the frequency, intensity, and duration of the hypoxic events [5]. Red tide is one of the harmful algal blooms that result fish mortality, damage mariculture, threatens the marine environment and the osmosis membranes of desalination plants [6].

Based on literature information, five harmful algal blooms of which three blooms are caused by dinoflagellates, one by raphidophytes and one by cyanobacteria were recorded in Red sea during the last three decades [1]. It is reported that the rise in temperature might stimulate the proliferation of some phytoplankton particularly cyanobacteria [7]. The capacity and monitoring endeavors to study and detect harmful species and harmful events have significantly increased over the last 40 years. As a result the research report, harmful events have been increased across the world's seas. Today among the approximately 10,000 beneficial species of marine phytoplankton, some 200 taxa are harmful that produce toxins responsible for wild or aquaculture fish kills. Non-toxic microalgae attaining high biomass can also cause Harmful Algal Blooms (HABs) by forming seawater discolorations, anoxia [8]. However studies regarding phytoplankton and harmful algal blooms are limited in the Eritrean coast along the southern Red sea. This study is intended to report the probable cause of fish mass mortality along the coast of Emberemi and the Dahlak Archipelago islands happened from mid-month of August up to first week of September 2021.

2. Materials and Methods

In the first week of September, information has been received about the fish mass mortalities from the fishermen in Eritrean waters Red sea. The outbreak of mass mortalities quickly triggered us to conduct emergency visit to some sites along the coasts of Halibay, Emberemi, Millennium Beach Hotel and Gurgusum Beach. The field visit enabled us to record fish kill patterns, identify the affected fish species and collect environmental information to investigate the probable cause of mortalities. Questionnaires were prepared to interview fishermen at the landing site known as Gbi, Massawa port. The questions were designed to explore sites, frequency, duration of mortalities, the condition of the sea during the time of fish mortalities, number and type of affected fish and probable cause of their death. Totally thirteen fishermen who were in the sea during the time of fish death were interviewed separately and secretly in

landing site in order to avoid influences among each other in their responses. Furthermore open group discussion with a group of fishermen was held in the landing site. The purpose of the group discussion was to allow fishermen to express their ideas about the fish mass mortalities, distribution and range of events, the condition of the sea, types and amount of fish death with potential probabilities of fish death causes, the implications on their fishing activities from their experience without restriction. Over all the methods which were field visit, questionnaires and group discussion were intended to equip us useful information and clue to rectify the probable causes of fish mass mortalities along the coast and islands of Eritrean water, southern Red sea.

3. Results

Field observation confirmed the information of fish mortalities along the coast of Halibay, Emberemi, Millennium Beach Hotel and Gurgusum Beach. In the field trip conducted, trigger fish, buffer fish were found dead and splashed along the northern Massawa coast [fig.1]. All interviewers responded that they observed fish mortalities in different sites during their fishing time. Fish mortalities were seen in at Gemhile, Kormelil, Dehil, Nora, around Dahlak, Seleit, Aucan, Hawatib, Dehil fedel, Dhuladya, Hermil, Isratu, Debihe, Dahlak thur, Emberemi and Harat according to the interviewed fishermen. The type of fish kills were Porcupine fish, Jacks and Trevallies, Snappers, Bonitos, Groupers, Puffer fish, Silver grunt, Triggerfish, Spanish mackerel and other small pelagic fish. The affected fish were observed having wide opened and flared gills with frequent and increased opercular movements. All interviewed fishermen agreed that the sea was luminescent during the night, very calm and hot in weather and dirty almost reddish in color. The interviewed fishermen responded that the fishes could have been died from high temperature when they were asked the probable cause of the fish mortality. The fishing activities were affected due to the fish mortalities events. The fishes which were being caught were either spoiled or easily spoiled immediately after brought to the deck from the sea.





Fig 1: Dead fish observed along the coast of Emberemi northern Massawa.

4. Discussion

The probability of cause for fish mass mortality along the coast and islands of Eritrean Red Sea could be combination of algal blooms, increasing temperature and oxygen depletion. The maximum and minimum sea surface temperature in Dahlak Archipelago regions were 34.4 °C and 31.8 °C respectively in the month of August. The minimum temperature was recorded in the first week of August then the temperature begun to increase up to mid-month of September. With increasing temperature and algal blooms, the amount of dissolved oxygen could be decreased up to the level that caused fish mortality as there is inverse relationship between oxygen and temperature [9]. Although there have not been intensive and detail studies regarding algal blooms in Eritrean Red sea waters, some studies indicated the events of algal blooms in the summer especially from June up to September in southern and central part of the Red sea where Eritrean Red sea waters included to support our current study.

Red tides and harmful algal blooms studies in Yemeni coastal waters Red sea showed that extensive bloom of *Peridinium quinquecorne* in the coast of Al-Hodeidah city in June 2012 when water temperature was 33 °C and the salinity was 37%. This extensive bloom was accompanied with discoloration of water to brown and caused massive fish kills mostly sardines [10]. Another extensive bloom caused by the toxic dinoflagellates *P. bahamense* and var. *bahamense*, along coast of Al-Hodeidah city was reported in August 2013 when temperature was 32 °C and salinity was 37%. Other toxic and potential toxic species were also reported in the Al-Hodeidah coastal waters during the period November 2012 and September 2013 [11]. These extensive algal blooms could be due to high concentration of nutrients coming from intermediate water inflow through the Gulf of Aden during summer [12].

The bloom of harmful dinoflagellates *P. bahamense* was reported in Red sea lagoon north of Jeddah, Saudi Arabia. The peak of this bloom was recorded in November 2013 correlating with high temperature in the time of the year. It was also demonstrated that *P. bahamense* can produce saxitoxin in which highest toxin production occurred with peak and culmination of the bloom [13]. In addition to

dinoflagellates blooms, southern Red sea coasts of Saudi Arabia have experienced a large bloom of the harmful raphidophyte *H. akashiwo* during May and June 2010. The intensity of *H. akashiwo* bloom that may cause ichthyotoxicity and mortality of fish in the Red sea [14]. Extensive surface bloom of *T. erythraeum* was also observed in southern Red Sea of Saudi Arabia including Al-Lith, Doga and Farasan islands [15].

During summer the monsoon – driven wind reversal modifies the circulation dynamics at Bab-el-Mendeb strait causing a subsurface influx of colder, fresher, nutrient – rich water from Indian Ocean. The subsurface intrusion plays significant role in the development of southern Red sea phytoplankton blooms. The southern Red sea experiences higher phytoplankton blooms in summer than the rest of the year. The summer concentration occurs in the large part of southern basin particularly pronounced around the eastern shore and Dahlak islands. The summer blooms period reaches maximum in July and terminates in August but the termination date may vary between July and September [12].

5. Conclusion

This research confirmed the death of fish along the coast and islands of Eritrea, Red Sea from mid-August up to the first week of September. Although no information about harmful algal blooms in Eritrea, the literature review indicated that many harmful and toxic species of algae occurred along the Red Sea coasts. Among these micro-algae species, *H. akashiwo*, *N. scintillans*, *P. bahamense*, *P. bahamense* var. *bahamense* and *Trichodesmium* sp were associated with the occurrence of harmful algal bloom events and have been confirmed to be toxic in the Red Sea areas. This study suggests the establishment of monitoring and management program for harmful algal blooms in Eritrean Red Sea coastal waters. Further this study recommends strong link and collaborative efforts among research division, governmental authorities and fishermen.

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