

# **RED TIDE RISING**

## **An Investigation of Recent Increased Harmful Algal Blooms in the United Arab Emirates**

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Global Climate Change: The Science, Social Impact and Diplomacy of a World Environmental  
Crisis

Graduate Research Paper

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**Abstract**

Red tide algae bloom is a phenomenon which has been occurring in the Arabian Gulf Region for hundreds, perhaps thousands of years. However, in recent years, both the harmful effects and duration of the blooms have intensified. Along the United Arab Emirates' east coast near The Gulf of Oman, red tide has devastated the marine environment and has also been detrimental to the local tourism and fishing industries.

While red tide is a naturally occurring process, there is speculation that the increase of anthropogenic activity (i.e. shipping traffic, oil spills, construction and coastal development) in the region is taking a toll on the environment. The recent exponential growth of the UAE in terms of both population and urban development may be a contributing factor in the increasing intensity of red tide in the UAE.

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## **1. Introduction**

Harmful Algal Blooms, otherwise known as HABs, are caused by microscopic single-celled plants known as phytoplankton that live in the sea. They are commonly known as 'red tides' because they cause the sea to take on a red color (Figure 1). Proliferations of HABs cause fish kills, disruptions to microbial ecosystems, and seafood contamination (Glibert, 2007). Although these algal blooms are thought to occur naturally, they are also attributed to, and exacerbated, by anthropogenic activity (Glibert, 2007). The purpose of this research paper will be to show possible anthropogenic links to the increasing toxicity of red tide and the impact on the local economy. In addition, mitigating measures which may be adapted from precedent examples will also be presented.



**Figure 1-** Red Tide along the coast of Ras Al Khaimah, UAE  
(Source: The World Online)

## **2. Background Information on Red Tides**

The formation of HABs occurs when algae, in response to favorable conditions in their environment, proliferate to form dense concentrations of cells or "blooms." In most instances, toxic species are normally present in low concentrations, with little to no impact on the environment or human health. Toxicity in general depends on their presence in high cell concentrations (Van Dolah, 2000).

Over the past three decades, harmful or toxic algal incidents have occurred with increasing regularity and geographical dispersion. Contributing factors to the problem may be directly or indirectly anthropogenic through the introduction of non-indigenous species via ballast water transport, local and regional environmental change caused by eutrophication or contaminant loading, and the increase in greenhouse gases (Van Dolah, 2000).

The abnormal production of algal blooms cause mass mortality of marine lives by depleting the oxygen levels in the environment. The depletion of oxygen occurs when phytoplankton release CO<sub>2</sub> and intake dissolved oxygen during bloom periods. Some blooms achieve a high level of biomass. When this biomass decays as the bloom dies off, oxygen is consumed, leading to widespread mortalities of plants and animals in the affected area. These "high biomass" blooms are sometimes linked to excessive pollution inputs (Anderson, 2007). From a regional perspective, this type of mass mortality of marine organisms was recorded in the Gulf of Oman twice, one at Al- Ghubrah in September 1988 and another at Barka in September 2000 (Thangaraja, Al-Aisry, & Al-Kharusi, 2007).

### **3. Anthropogenic Culprits**

The Arabian Gulf Region coastal and marine environment is increasingly under threat due to a number of catalysts, of which HABs are a byproduct. The main issues facing coastal and marine environments are pollution resulting from land-based sources, and oil related activities which include oil exploration, industry, and transport (Aljenaid, Alsabbagh, Musa, & AlMarzouki, 2008).

#### **3.1 Coastline Development**

Large scale coastal development is affecting the coastal environment in a number of ways. Urban expansion, industrial development and tourism along the coasts are a significant source of environmental degradation. Human activities such as dredging, land reclamation and land filling are worsening the situation by increasing nutrient levels of the water via dust and particulate matter (Al Qubaisi, 2006). The accelerated rate of coastal development has manifested itself along the Arabian Gulf coasts in the form of residential, mixed- use, and resort mega-projects. Sedimentation from these operations suffocates the surrounding coral reef communities and has an adverse effect on other ecosystems to which ocean currents transport the suspended sediment (Aljenaid, Alsabbagh, Musa, & AlMarzouki, 2008).

Nowhere in the world has the effect of coastal development and land reclamation been more evident than in the UAE. In recent years, the city-states of Dubai and Abu Dhabi have undertaken enormous development projects along the Arabian Gulf coast. The Palm Islands, which are being built on the coast of Dubai, are the world's largest man-made islands. The project increased Dubai's shoreline by 120 kilometers, and more than 100 million cubic meters of rocks and sand were used for land reclamation and island formation (Aljenaid, Alsabbagh,

Musa, & AlMarzouki, 2008). The sediments and wastewater runoff from these development sites produced the necessary raw materials (organic matter, suspended solids, nutrients and pathogenic micro-organisms) which causes eutrophication, resulting in algal blooms forming mainly in enclosed coastal lagoons and bays (Aljenaid, Alsabbagh, Musa, & AlMarzouki, 2008). In Dubai, many of these coastal lagoons and bays where red tide occurred were man-made, as was the case near Palm Jumeirah (Arnold, 2009) and Dubai Festival City on Dubai Creek (Landais, Dead Fish Floating in Dubai Creek, 2008) (Figure 2).



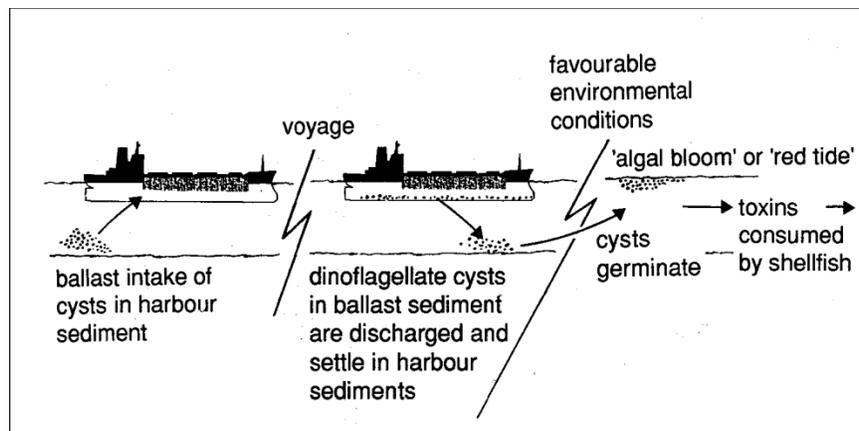
**Figure 2-** *Dead fish floating on the surface of the Dubai Creek at Dubai Festival City (Source: Gulf News)*

### **3.2 Water Ballast from Tanker Traffic**

The introduction of invasive marine species into new environments by ships' ballast water has been identified as one of the greatest threats to the world's ecosystems. Shipping transports over 80 percent of the world's commodities and transfers approximately 3 to 5 billion tons of ballast water internationally each year (Elshorbagy, 2005). Maritime transport is increasingly posing threats to the Arabian Gulf as huge amounts of oil and commercial cargo are

transported through these waters. Sixty percent of the world's exported oil is transported through the Strait of Hormuz alone (Aljenaid, Alsabbagh, Musa, & AlMarzouki, 2008). The UAE occupies a strategic location along southern approaches to the Strait of Hormuz.

Ballast water from shipping traffic can transfer a range of species of microalgae (Figure 3), including toxic species that may form harmful algae blooms (Raaymakers, 2002). Recently, the Environment Agency- Abu Dhabi (EAD) recorded HABs near the islands of Jarnain, Zirko, Bu Tinah and Sharjah's Sir Abu Nuair. In the past, species that are capable of causing HABs have been recorded in those areas as well as Delma, Al Yasat, Sir Bani Yas and Arzanah. It is worthwhile to note that Sir Bani Yas and Arzanah are known areas that experience oil tanker traffic (Al Qubaisi, 2006).



**Figure 3- Potential Transfer of Toxic Algae in Ballast Water**  
(Source: BRS Australia)

#### **4. Impact on Industry**

The steady decline of fish stocks is another issue that may have significant impacts on food sufficiency in the region, where fish marine resources constitute a major source of protein as

well as a major source of income (Aljenaid, Alsabbagh, Musa, & AlMarzouki, 2008). Similarly, the tourism industry has experienced recent setbacks, as beaches in Dubai have had to be closed by the authorities in April 2009.

#### **4.1 Fisheries**

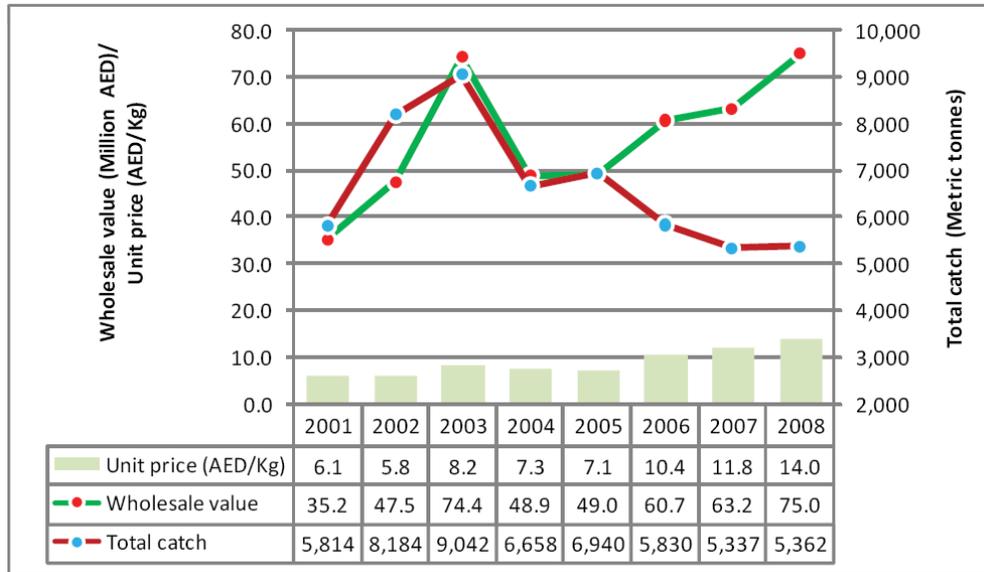
Red tide is by no means a recent phenomenon in the Arabian Gulf Region. Bedouin folklore describes the phenomenon as the water's 'menstrual cycle', and fishermen dreaded it for the havoc it wreaked on their harvests (Jabateh, 2008). Fish kills have been observed over recent years along various parts of the Gulf Region. Eutrophication, manifested as red tides and depletion of oxygen, was the most likely cause (Aljenaid, Alsabbagh, Musa, & AlMarzouki, 2008). As recently as June 2009, the fishing industry in the emirate of Fujairah located on the UAE's eastern shores has suffered due to red tide that affected the local waters, resulting in a large number of fish kills (Menon, 2009)

Though the decreasing trend in fish harvests can, in part, be attributed to overfishing, the proliferation of HABs may create a self-perpetuating feedback effect, whereby the resulting biomass of dead, dying, and decomposing fish coupled with sustained extreme environmental conditions provide an environment suitable for the development of numerous other red tide algae species (Glibert, 2007).

The EAD has reported an increasing occurrence of HABs in Abu Dhabi waters (Al Qubaisi, 2006). Abu Dhabi and Ras Al-Khaimah have experienced its share of declining catches in recent years. Fishermen reported the scale and density of the tide had never been seen before over such a

large area. As fishing stocks dwindled, the cost increased sharply (Todorova & Naylor, 2009).

Figure 4 shows the correlation between declining trend of Total Catch per metric tons and rising wholesale prices between the years 2001 to 2008 in the Abu Dhabi Emirate (Environment Agency – Abu Dhabi, 2008).



**Figure 4-** Trend of wholesale revenues earned by Abu Dhabi fisheries sector in the period 2001 – 2008 (Source: Environment Agency - Abu Dhabi)

## 4.2 Tourism

The tourism industry is both a contributor and a victim to the increased red tide phenomenon.

Tourism causes environmental degradation through extensive development, adding pressure to the coastal areas, and stress on the marine environment. In many places, mass tourism has led to soil erosion and associated run-off into the marine environment, increased waste discharges into the sea, loss of natural habitats, and higher pressure on endangered species (Aljenaid, Alsabbagh, Musa, & AlMarzouki, 2008).

In early 2009, hotels, diving centers and beaches were hit by red tide along the east coast of the UAE, resulting in significant losses in revenue. The lack of oxygen in the affected waters resulted in the suffocation of hundreds of tons of fish. Coral reefs, the habitat of reef sharks, sea turtles and tropical fish, had been devastated by the algae, attacking the tiny organisms on which the reef survives. Algae-contaminated water was visible from the corniche in front of the Atlantis hotel at The Palm Jumeirah. The bloom caused problems for the hotel's expansive aquarium and water-park facilities, as the algae had infiltrated the seawater intake mechanisms. (Todorova & Naylor, Red Tide Threatens Dubai Shore, 2009). In April 2009, a red tide of algal bloom forced the Dubai Municipality to close two beaches in the Jumeirah resort area (Arnold, 2009).

## **5. Conclusions**

The increasing occurrence of algal blooms is most likely a result of a combination of two elements: natural factors and anthropogenic activities. As previously illustrated, the activities associated with the enormous construction developments and the introduction of invasive microbial species via ship ballast water to the region's waters have magnified the amount, intensity, and toxicity of red tides.

HABs have had considerable economic impacts, including the costs of monitoring programs, short- and long term closure of harvestable shellfish and fish stocks, reductions in seafood sales, large-scale mortalities of marine life, impacts on tourism and tourism-related businesses, and medical treatment of exposed populations (Anderson, 2007).

## **6. Recommendations**

Increasing concern about levels of pollution in the marine environment has led to the adoption of a number of preventative measures to maintaining the quality of the oceans. The recent development of new remote sensors and software applications have transformed remote sensing into a powerful tool for use in monitoring marine water quality, and is particularly germane to oil related pollution and other important water quality parameters in the Gulf's marine environment (Loughland & Saji, 2008).

In the emirate of Fujairah, environmental authorities have installed artificial reefs off the coast of Fujairah with the hope of replenishing the marine environment on the east coast which has suffered from the devastating effects of red tide (Figure 5). Fujairah's Dibba Municipality had previously placed around 400 concrete dome structures to act as artificial reefs in four already existing protected areas (Landais, 2009).



**Figure 5-** *Molds for artificial reef structures*  
(Source: Gulf News)

The issue of red tide is not only endemic to the UAE. The proliferation of HABs has affected the entire Arabian Gulf Region. A comprehensive plan must be implemented on a governmental level to prevent and/or mitigate the increasing toxicity of red tides. To this end, there have been initiatives undertaken by the affected countries of the region that have transpired this year, which are steps in the right direction.

In response to the growing threat of red tide, a three-day meeting of experts from the region was held in Kuwait in January 2009, organized by the Kuwait-based Regional Organization for the Protection of the Marine Environment (ROPME) (Todorova, Red Tide Turns into Regional Issue, 2009). ROPME is a regional framework for co-operation between the eight coastal States of the region (Bahrain, Iran, Iraq, Kuwait, Oman, Qatar Saudi Arabia, and the United Arab Emirates), which was established in 1979 with the aid of the United Nations Environment Programme. Also in January 2009, a workshop was conducted in Oman under the auspices of The Food and Agriculture Organization of the United Nations. This workshop acknowledged the need to take active measures, in conjunction with ROPME, in response to damage inflicted on the fishing industry from algal blooms (Regional Commission for Fisheries, 2009).

These meetings clearly indicate the seriousness by which the respective countries in the Arabian Gulf intend to address red tide and HABs. However, it is imperative that the action items from these workshops be followed through. As the UAE becomes more of a regional and global hub for commerce and tourism, the need to stem the red tide of HABs takes on a greater urgency.

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