Red Tide: A new threat to water resources in the Arabian Gulf Region

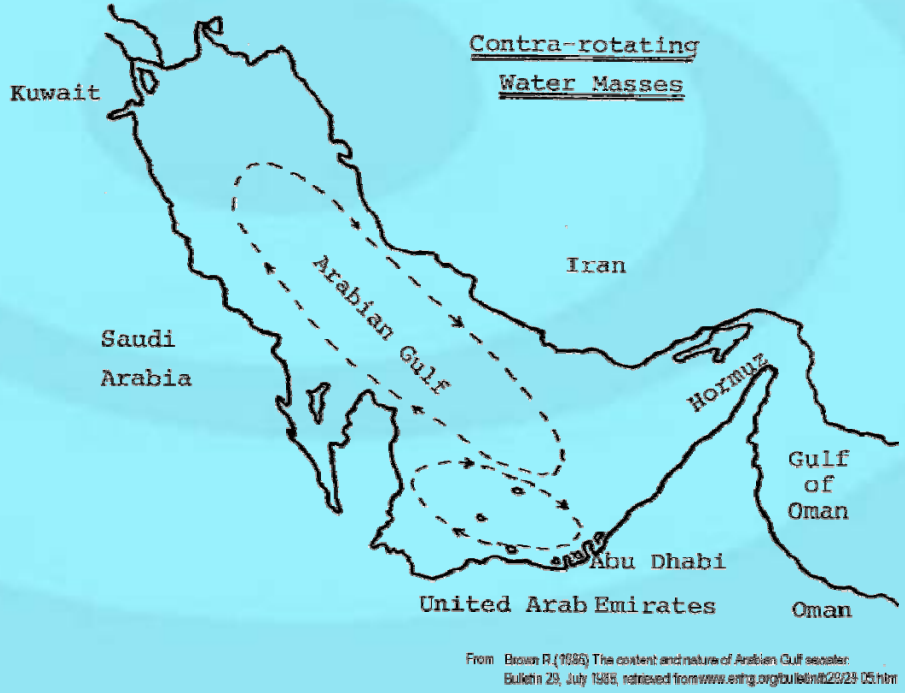
Dr. Muthanna A. Al-Omar

Head of Environmental Studies Department
National Energy and Water Research Center
Abu Dhabi Water & Electricity Authority
e-mail: m.alomar@adwea.ae

Arabian Gulf is an enclosed area of water with a relatively high evaporation rate, which exceeds the fresh water input through Shatt Al-Arab or through precipitation.

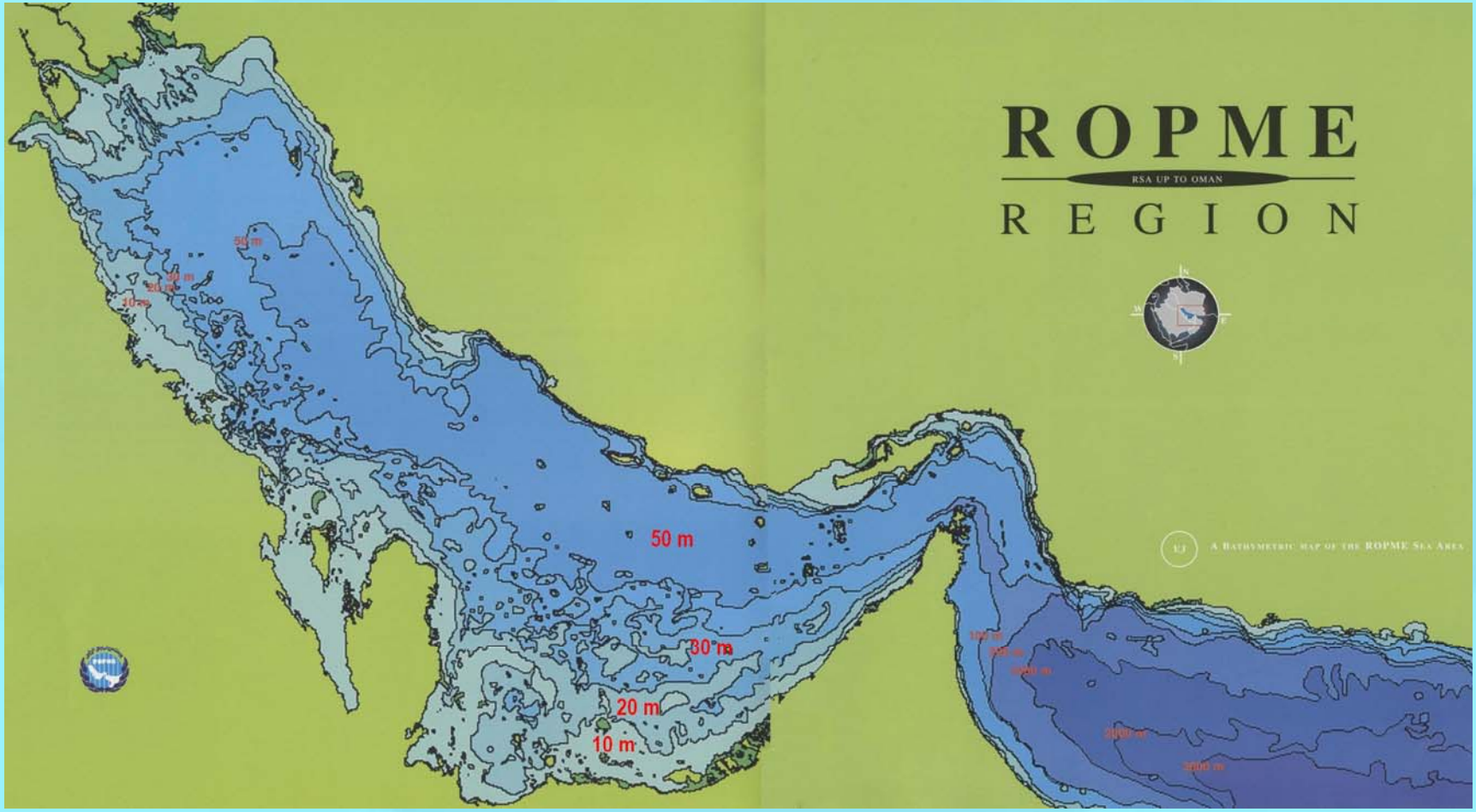
Water current flow within the Arabian Gulf

According to Brown (1986) Two clockwise-rotating water masses; one in the central gulf area and the other in Abu Dhabi-Qatar basin.



Brown R.(1986) The content and nature of Arabian Gulf seawater. Bulletin 29, July 1986, retrieved from www.enhg.org/bulletin/b29/29 05.htm

Bathymetry of the Arabian Gulf



Arabian Gulf is surrounded by rapidly developing countries.

In the Arabian Gulf, many sewage outfalls, industrial and desalination outfalls were identified (Gilbert 2007), beside oil pollution incidents, dredging and ballistic water discharge .

Nutrients (i.e. nitrates and phosphates) are believed to be discharged from many sources such as animal farms, slaughter houses, fertilizer factories, intensive marine culture operations and other sources. (Al-Yamani et al, 2006) in addition to ail pollution.

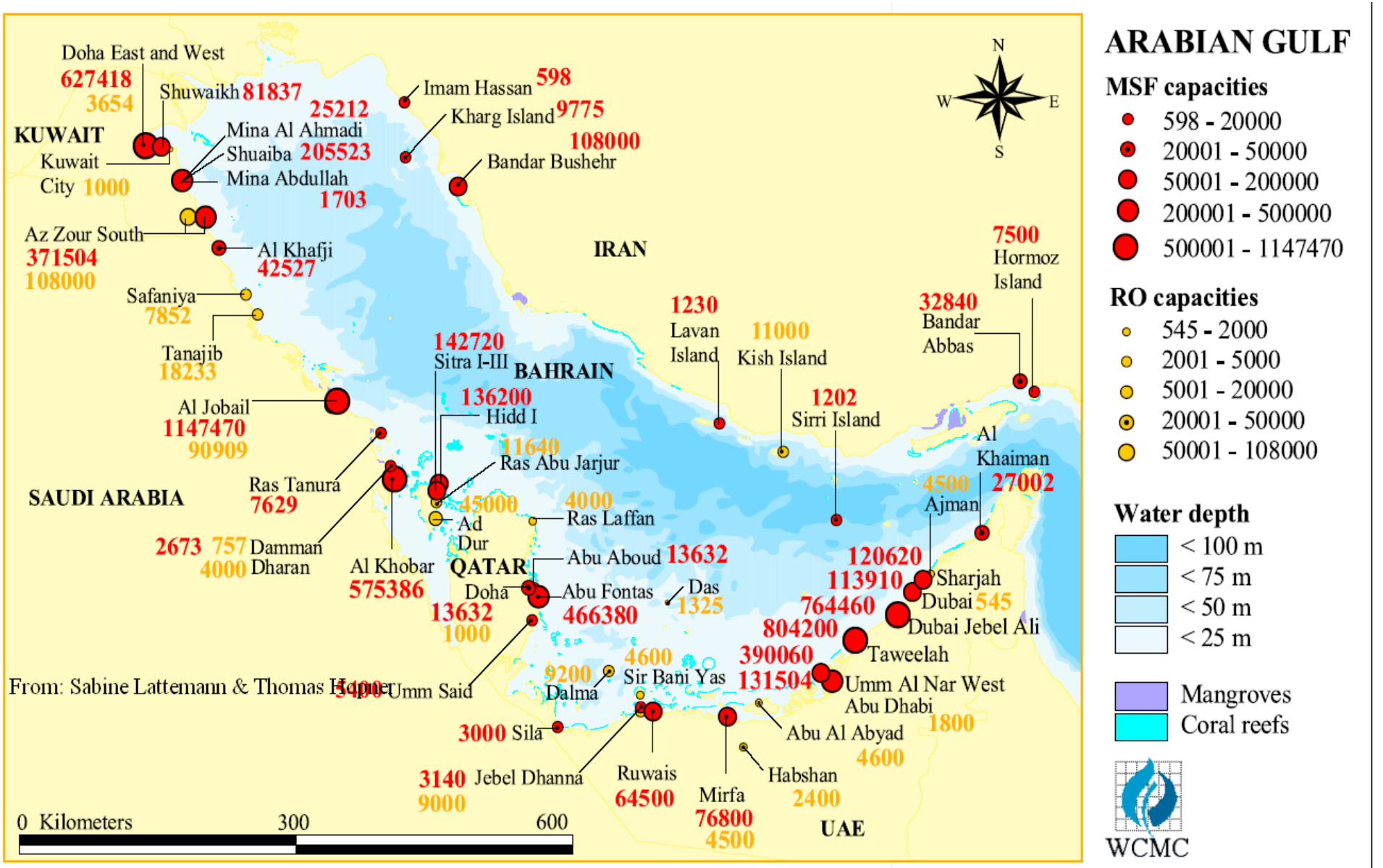
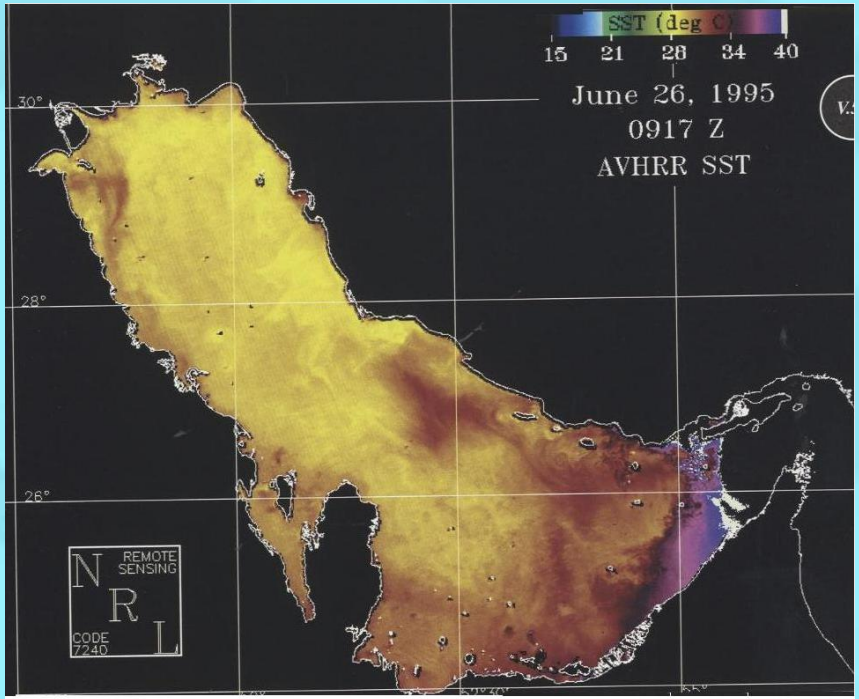


FIGURE A.3: MSF and RO plants in the Arabian Gulf. Data on coastline, corals and mangrove areas supplied by and copyright to World Conservation Monitoring Centre (WCMC) (2001). Included are all MSF and RO seawater desalination plants, of which locations could be identified. These account for more than 95 % of the overall capacity in the Arabian Gulf, based on Wangnick (1999). Water depth based on Gita Shenasi Cartographic & Geographic Institute.

Seawater temperature of the Arabian Gulf



Sea Surface temperature distribution in June -NOAA

ROPME 2000

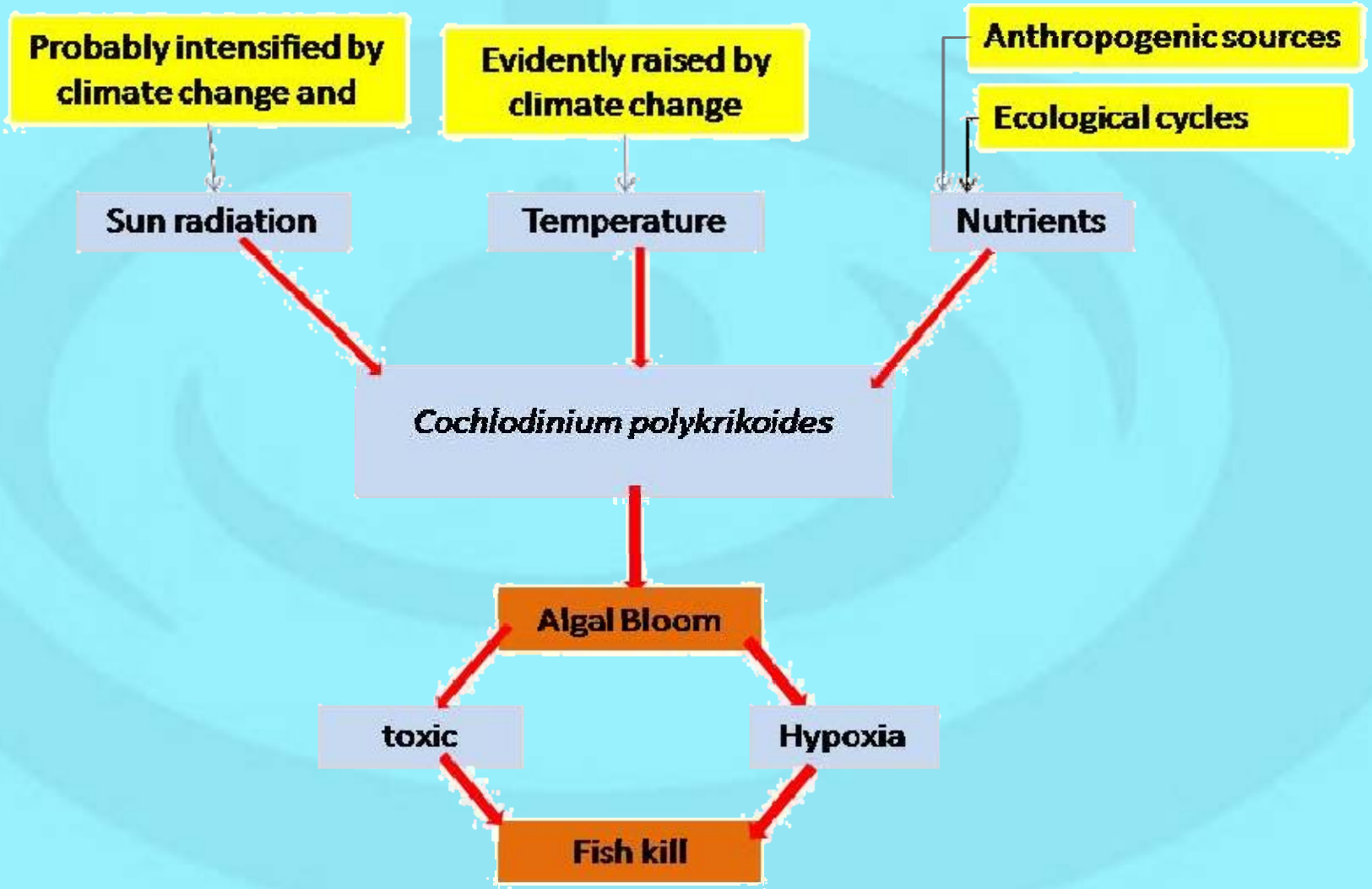
The intensive anthropogenic activities, under the shadow of climate change can lead to many negative environmental consequences, among them is the alteration of phytoplankton populations which in turn can lead to the phenomenon of red tide or the Harmful Algal Bloom (HAB).

Early in 2009 and throughout the year, there were many incidents of algal bloom in the Arabian Gulf
This presentations is a preliminary work, intended to shed light on the recently developed phenomenon of red tide in the Arabian Gulf, with emphasis on UAE coastline, since it was the most severely affected area, where the National Energy and Water Research Center at Abu Dhabi Water and Electricity Authority-UAE is conducting a comprehensive research project on the sources of nutrients in the region and vulnerability of Abu Dhabi coastline to HAB as compared to the Gulf of Oman.

The Algal bloom is caused by the rapid proliferation of dioflagellates

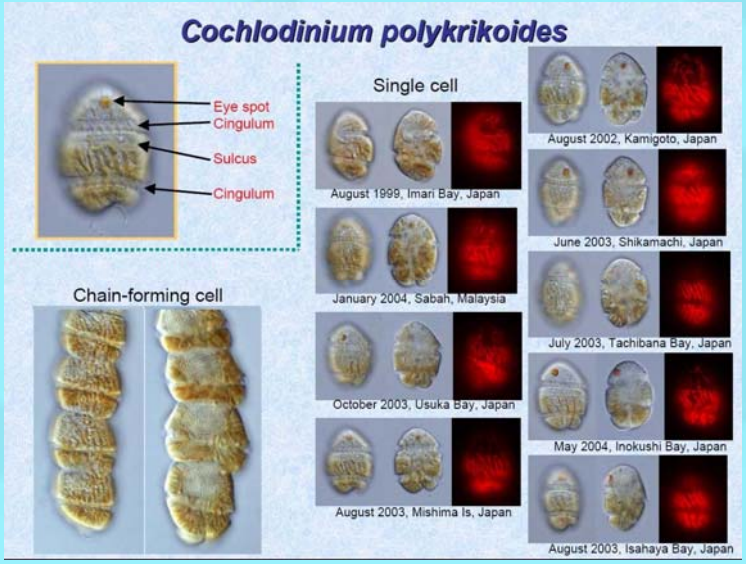
Dinoflagellates

These phytoplankton are always present in seawater, but only when their population density reaches a certain critical mass (about 1,000,000 cells/l) the HAB is said to occur. In some areas in Iran , concentrations of nine million to 27 million individual microorganisms per liter was reported.


Probably intensified by climate change and
Evidently raised by climate change
Anthropogenic sources
Ecological cycles
Sun radiation
Temperature
Nutrients
Cochlodinium polykrikoides
Algal Bloom
toxic
Hypoxia
Fish kill

The Arabian Gulf also faced the development of red tide during 2009 threatening different locations on the coast of UAE, Diba, Fujairah and Qeshm Island in Iran. The species responsible for the HAB and the fish kill is called

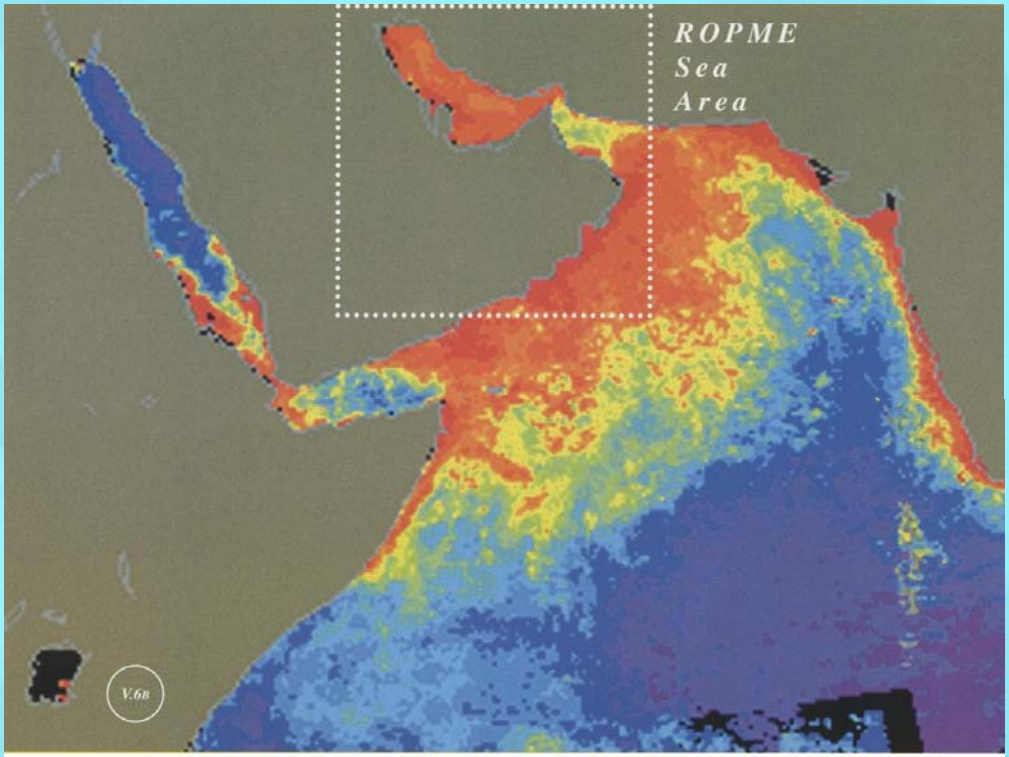
Cochlodinium polykrikoides



It is non-toxic to fish, nevertheless, fishes may be killed as a result of oxygen depletion which is know to occur simultaneously with HAB. This phenomenon consequently may seriously threaten water resource and aquatic life in the region.

A study by ROPME in 2006 identified C. *polykrikoides* as one of 337 species of phytoplankton living in the Gulf's waters.

Red color correspond s to higher concentrati ons



Distribution of Phytoplanktons in ROPME sea area and the indian ocean. in summer ROPME 2000

According to “The National”* The problem is much worse than experts in the UAE had estimated, having affected more than 1,000 km of coastline in the region, and experts say it has destroyed thousands of tones of fish and marine mammals.

---

* The National: Red tide turns into regional issue; Vesela Todorova Last Updated: January 13. 2009 8:30AM UAE / January 13. 2009

Outfall of Fujairah power plant.

Nov. 23, 2008

Fujairah Nov. 23, 2008

Previously reported incidences in the Neighboring Countries-1

Oman:

According to the Director-General of Fisheries Research, Oman has been maintaining a record of red tide outbreaks since 1988. In some years tens of tones of dead fish have washed up on Omani shores. At Muscat and the Batinah region of Oman, the scores of dead fish that have collected on the beach have all accumulated toxins, making them unsafe [Bradsley Prabhu, C. (Aug. 2008)].

Previously reported incidences-2

Oman-contd.

The highest massive fish kills were reported in 2001 to 2002 when 27 tonnes of dead fish came ashore along Batinah, Sur and south of Oman [Vaidya 08].

The Director of the Marine Conservation Department at the Ministry of Fisheries reported that the red tide is occurring usually between July and September due to monsoon winds and currents [Vaidya 08].

During 2008 the red tides were first reported sometime in July, with a second outbreak recorded on August the latest incidence was reported in Aug 2008.

Previously reported incidences-3

Kuwait

The first incidence of red tide in Kuwait was reported in 11 and 12 May, 1999 [Rao et al] Followed by a massive one in August and September 2001 involving over more than 2500 metric tons of dead fishes, this event was preceded by a small fish kill (100–1000 dead fish per day) in aquaculture net pens associated with a bloom. Cell numbers of dinoflagellate exceeded 106 l−1 in some locations. [Gilbert et al 2002]

Previously reported incidences-4

Iran

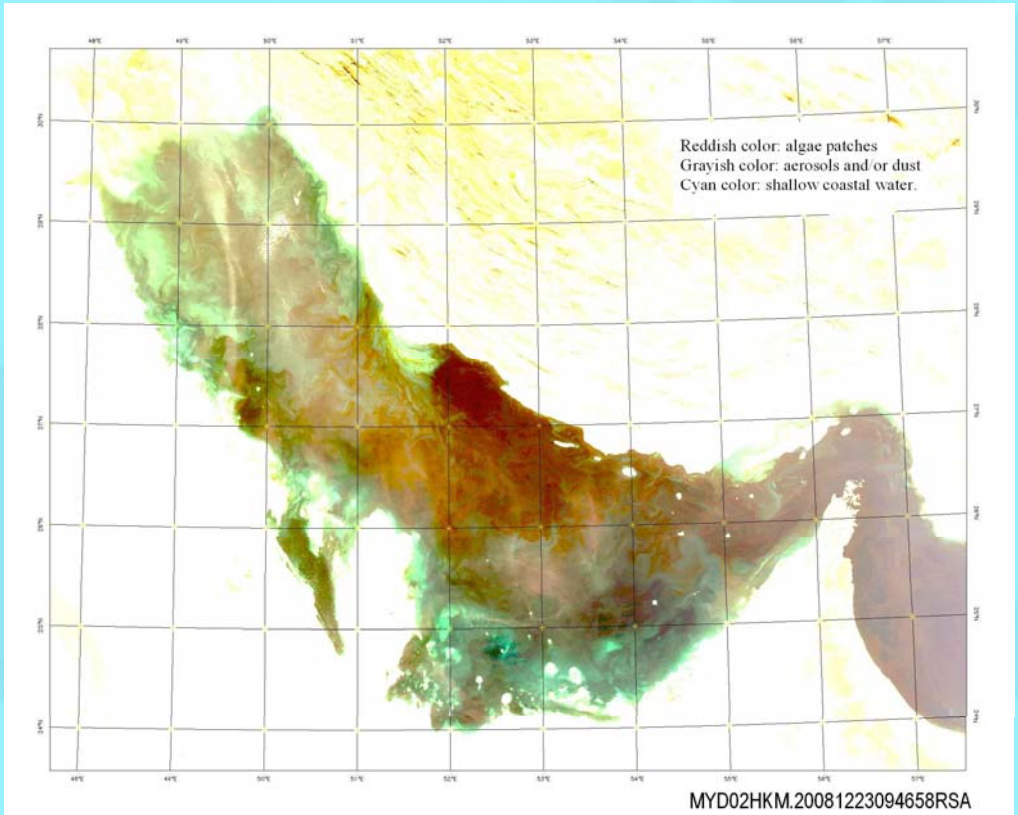
Thirty to forty five (30-45) tons of fish and marine mammals were reported.

The phenomenon also endangers various corals too. Coral bleaching is the first sign that a coral might be dying because of the bloom.

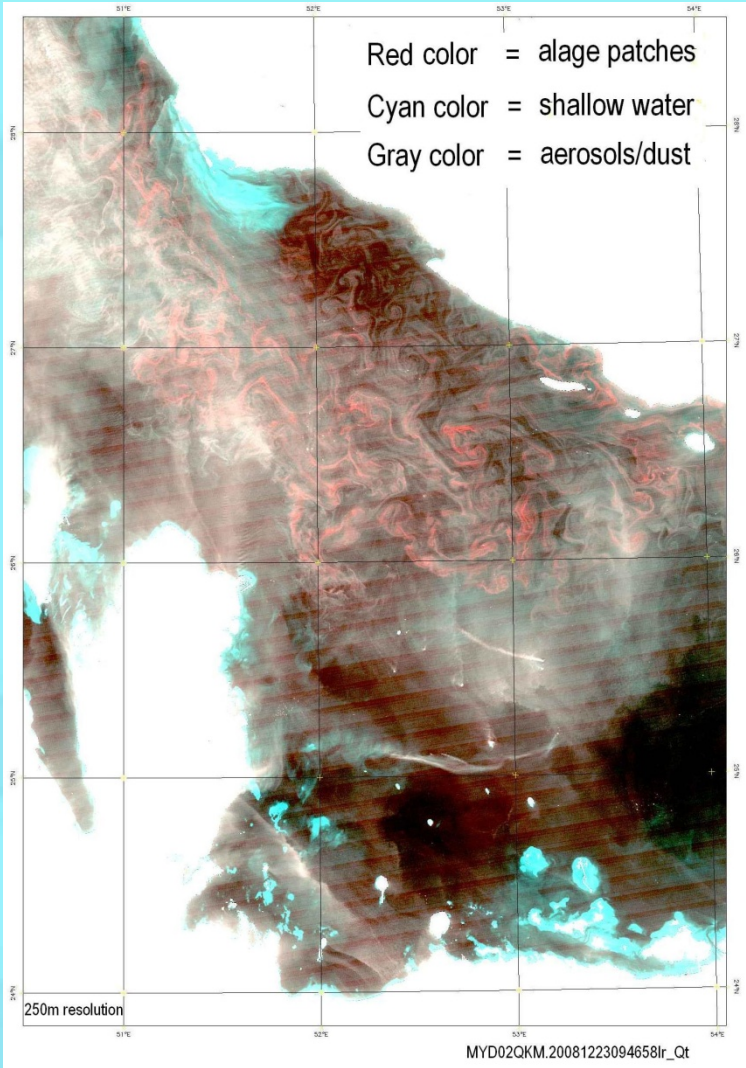
Red bloom usually occurs in the summer time.

From Red tide endangers marine life in Persian Gulf. Sun, 22 Feb 2009, Press TV website, http://www.presstv.ir/

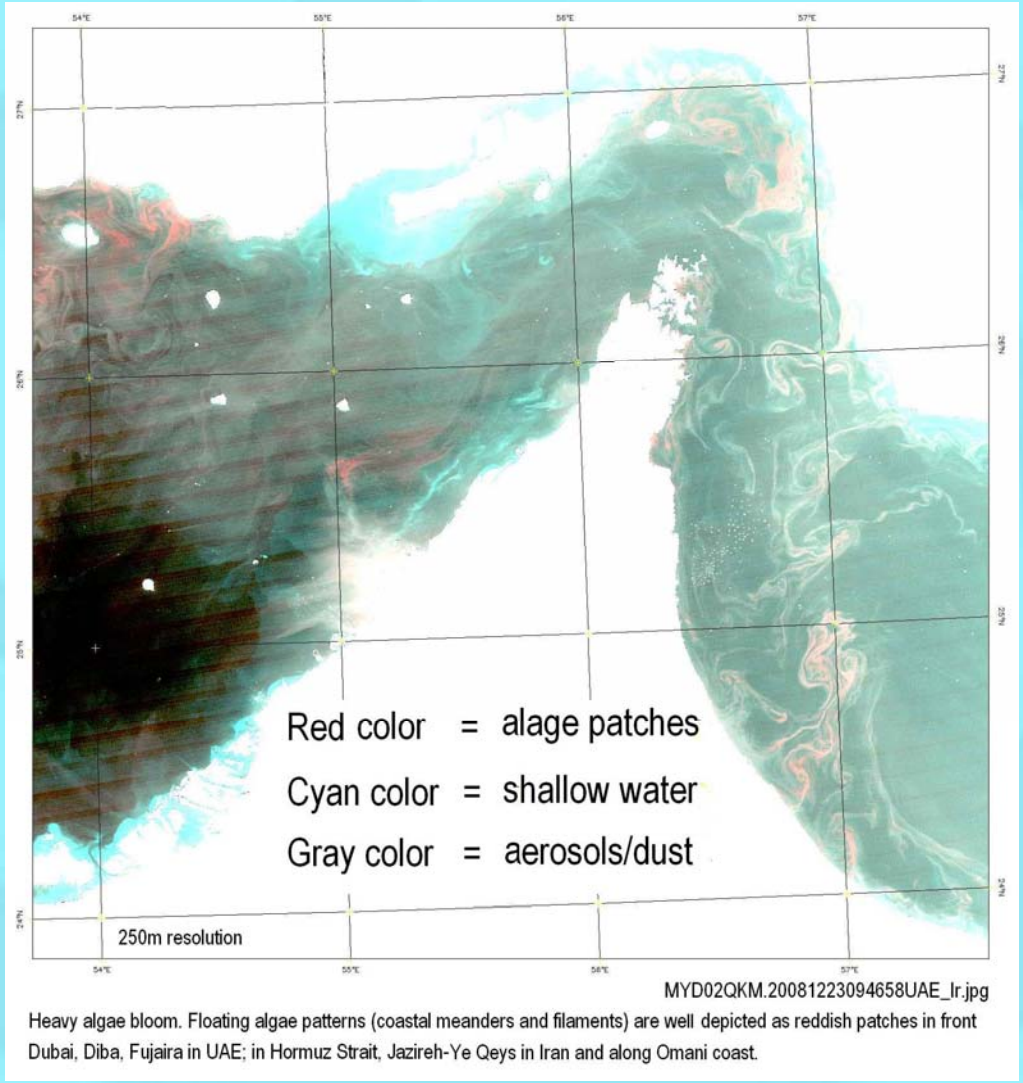
Satellite imageries during summer 2009 reported the distribution of the HAB as follow in the Arabian Gulf.



High biological activity in ROPME Sea Area. Reddish- greenish filaments are representing high chlorophyll concentration and algae patches. Algae bloom are well depicted in front of Diba, Fujaira, Dubai in UAE , near Qeshm Island, Kad Forur, Jabrin in Iran and Ras Laffan in Qatar.



Heavy algae bloom. Floating algae patterns (coastal meanders and filaments) are well depicted as reddish patches in front of Dubai, Diba, Fujaira in UAE; in Hormuz Strait, Jazireh-Ye Qeys in Iran and along Omani coast.



MYD02QKM.20081223094658UAE_lr.jpg

Heavy algae bloom. Floating algae patterns (coastal meanders and filaments) are well depicted as reddish patches in front Dubai, Diba, Fujaira in UAE; in Hormuz Strait, Jazireh-Ye Qeys in Iran and along Omani coast.

Seawater quality parameters in Fujaira-2009

PARAMETERS	Surface water Near Shore	Surface water Away from shore	BOTTOM water NEAR shoreline	BOTTOM away from shoreline
BOD, mg/L	2.90	3.00	2.15	2.35
Total Hardness, CaCO3 mg/L	9404.50	9279.50	9274.00	9437.00
Alkalinity as CaCO3, mg/L	125.00	126.50	126.00	126.00
Bicarbonates, mg/L	150.50	150.50	151.75	149.50
Nitrogen Nitrates, mg/L	3.33	3.33	3.20	2.98
Nitrogen Nitrites, mg/L	0.00	0.00	0.00	0.00
Phosphates, mg/L	0.04	0.02	0.03	0.00
Sulfates, mg/L	2701.75	2766.25	2731.75	2660.75
Chlorides, mg/L	21530.50	21757.50	21668.75	21757.50
Chlorophyll a, mg/m³	0.00	0.00	0.00	0.00
Algae, cfu/L	172.50	115.50	78.75	93.50
Silica, mg/L	0.59	1.02	0.34	1.70
Calcium, mg/L	475.75	466.75	465.25	469.75
Potassium, mg/L	564.00	566.75	563.25	563.25
Sodium, mg/L	11563.00	11575.75	11523.00	11385.00
Magnesium, mg/L	1996.50	1973.50	1970.00	1994.75
Aluminum, µg/L	24.25	21.00	107.00	28.75
Iron, µg/L	56.00	77.25	66.25	113.25
Copper, µg/L	2.80	2.96	4.00	4.90
Mercury, ng/L	0.00	0.00	0.00	0.00
Zinc, µg/L	5.45	6.00	5.20	5.50
Manganese, µg/L	3.70	1.80	2.30	2.53
Cadmium, µg/L	0.00	0.20	0.00	0.20
Lead, µg/L	2.33	3.35	0.00	5.05
Strontium, mg/L	13.00	15.00	14.50	13.50

Seawater quality parameters in Taweelah-2009

PARAMETERS	Surface water NEAR Shoreline	Surface away from shoreline	Bottom water NEAR Shoreline	Bottom away from shoreline
BOD, mg/L	2.10	2.25	2.47	2.30
Total Hardness, CaCO3, mg/l	9047.17	8868.00	9021.17	8978.50
Alkalinity as CaCO3, mg/L	133.00	130.67	134.00	131.00
Bicarbonates, mg/L	162.33	159.67	163.50	160.17
Nitrogen Nitrates, mg/L	3.47	3.52	3.52	3.50
Nitrogen Nitrites, mg/L	0.00	0.00	0.00	0.00
Phosphates, mg/L	0.04	0.04	0.03	0.05
Sulfates, mg/L	2667.17	2604.67	2697.17	2564.33
Chlorides, mg/L	24756.17	23987.83	24819.17	24076.67
Chlorophyll a, mg/m³	0.00	0.00	0.00	0.00
Algae, cfu/L	97.50	51.67	110.83	80.83
Silica, mg/L	1.71	2.04	1.92	2.03
Calcium, mg/L	491.17	487.00	491.17	504.50
Potassium, mg/L	642.00	612.33	618.50	618.17
Sodium, mg/L	12298.83	11921.33	12147.67	11839.17
Magnesium, mg/L	1905.17	1863.17	1893.00	1874.50
Ammonia, µg/L	32.67	36.83	33.50	35.00
Iron, µg/L	98.12	61.00	89.17	64.67
Copper, µg/L	3.48	2.85	6.38	3.30
Mercury, mg/L	0.00	0.00	0.00	0.00
Zinc, µg/L	5.77	4.77	3.80	6.37
Manganese, µg/L	2.90	2.33	1.45	1.10
Cadmium, µg/L	0.00	0.00	0.00	0.00
Lead, µg/L	1.47	0.00	1.32	0.00
Strontium, mg/L	13.50	11.17	10.67	10.67

Recommendation for Mitigation:

- Reducing nutrient loads in coastal waters through controlling pollution caused by human activities;
- Eliminating the introduction of exotic species through ballast water; and
- The responsible movement of hatchery-reared or wild-caught fry and fingerlings
- Direct control of harmful algal blooms has been proposed using:
- A variety of chemical controls to inhibit or eradicate HAB species and organisms;
- Physical controls that remove organisms from the water, (i.e. skimming the water surface); and
- Biological controls using viruses, parasites and bacteria. http://www.livefoodfishtrade.org/aquaculture/part2/requirement2_5/index.htm

Thank you
for your kind attention