

# COASTAL AND MARINE ENVIRONMENTS IN BAHRAIN: ANTHROPOGENIC IMPACTS AND CONSERVATION MEASURES



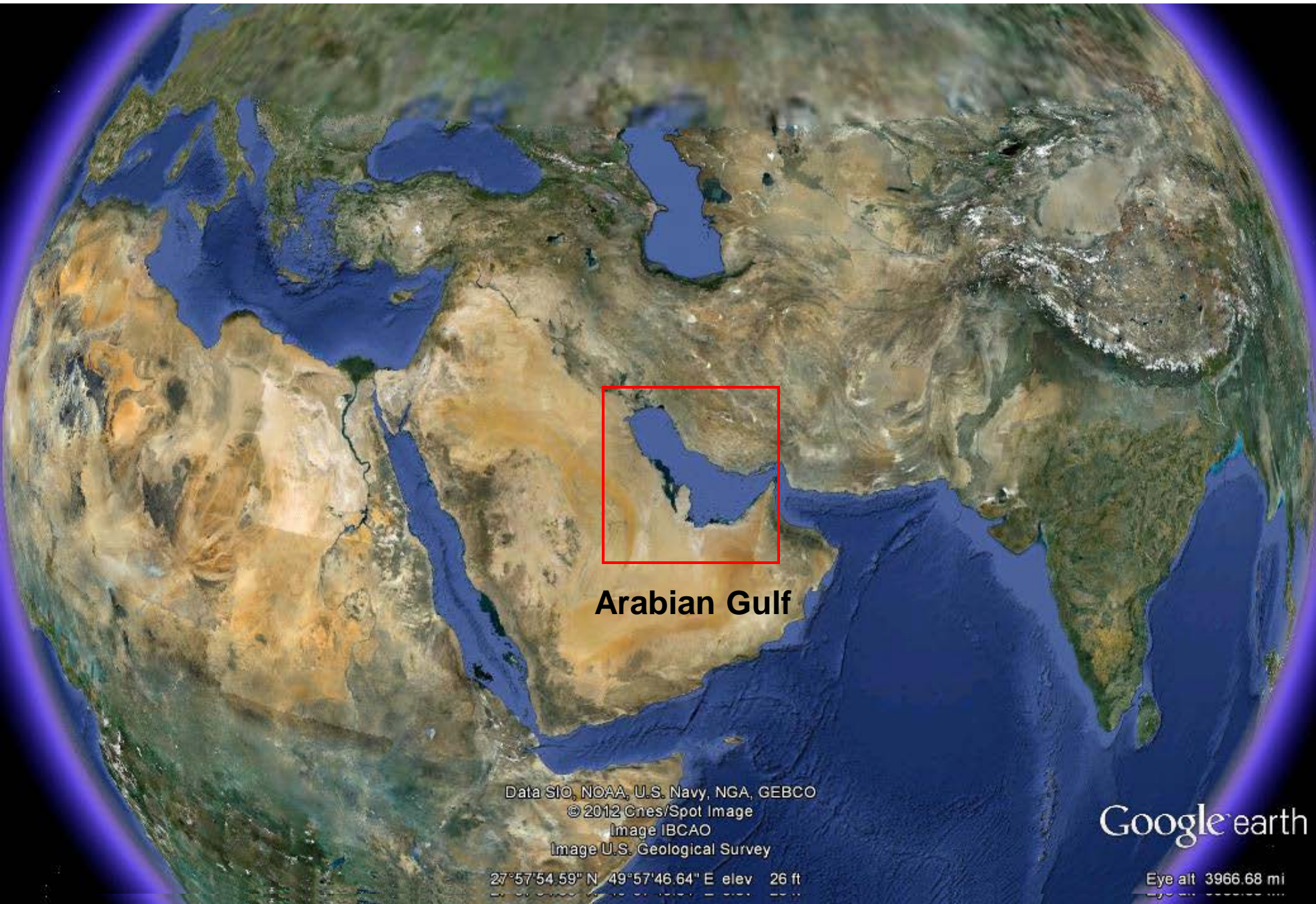
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**Littoral 2012: Coasts for Tomorrow  
27-29 November, 2012, Belgium**

# Outline

- Valued ecosystem components in Bahrain.
- Existing anthropogenic impacts in Bahrain.
- Measures that may contribute to protection of coastal and marine habitats in Bahrain.



**Arabian Gulf**

Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
© 2012 Cnes/Spot Image  
Image IBCAO  
Image U.S. Geological Survey

27°57'54.59" N 49°57'46.64" E elev 26 ft

Google earth

Eye alt 3966.68 mi



Kuwait

Iran

Saudi Arabia

Bahrain

Arabian Gulf

UAE

Oman

Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
© 2012 Cnes/Spot Image  
Image U.S. Geological Survey

Google earth

282 mi

26°26'51.91" N 53°16'30.72" E elev -63 ft

Eye alt 1083.24 mi

**Bahrain**

**Bahrain: 40 islands**  
**Land area: 762 km<sup>2</sup>**  
**Coastlines: 126 Km**  
**Marine area: 8000 km<sup>2</sup>**

**Hawar Islands**

16.26 mi

Image U.S. Geological Survey  
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Data SIO, NOAA, U.S. Navy, NGA, GEBCO

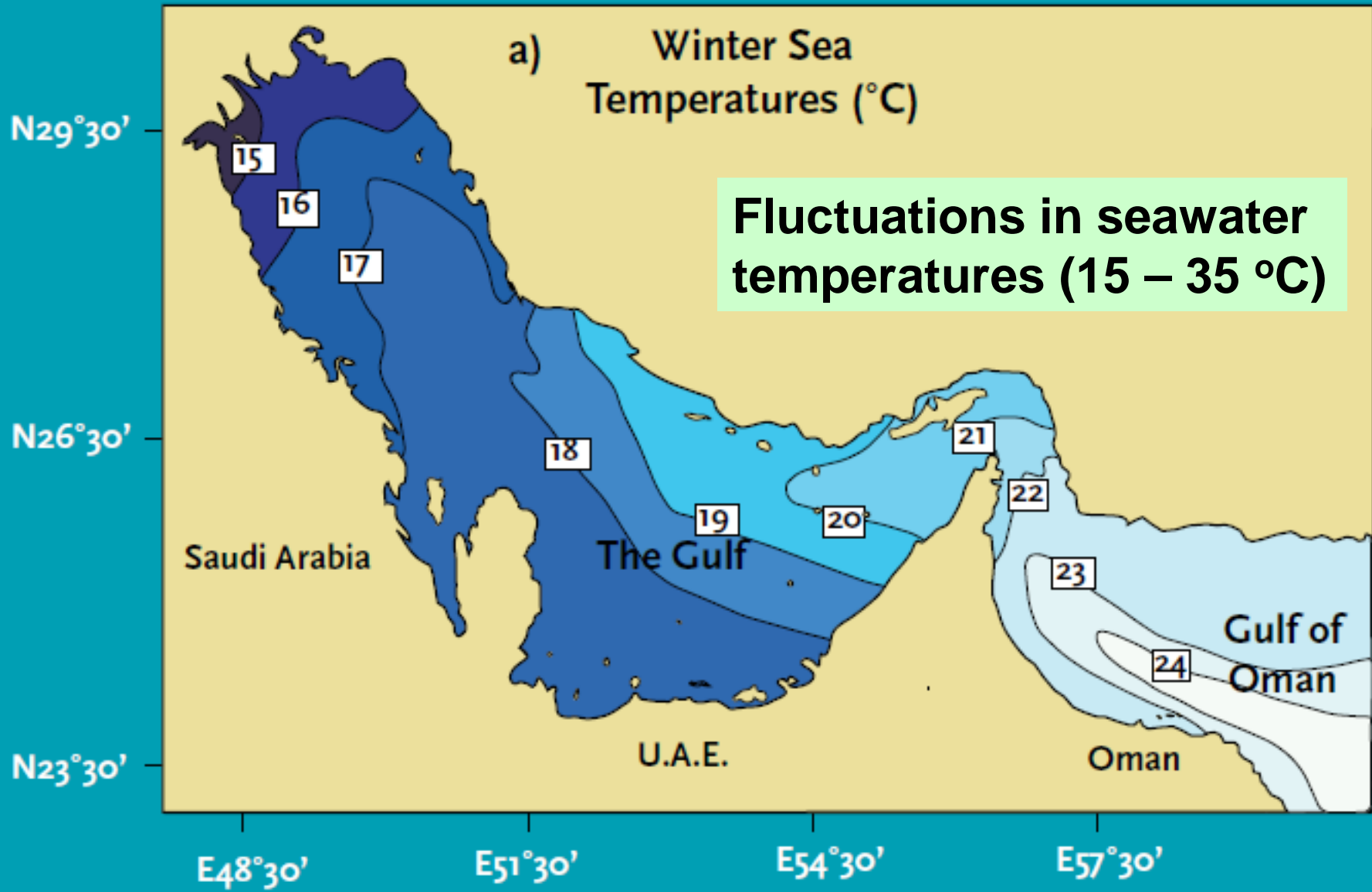
Google earth

25°55'44.73" N 50°39'46.64" E elev -4 ft

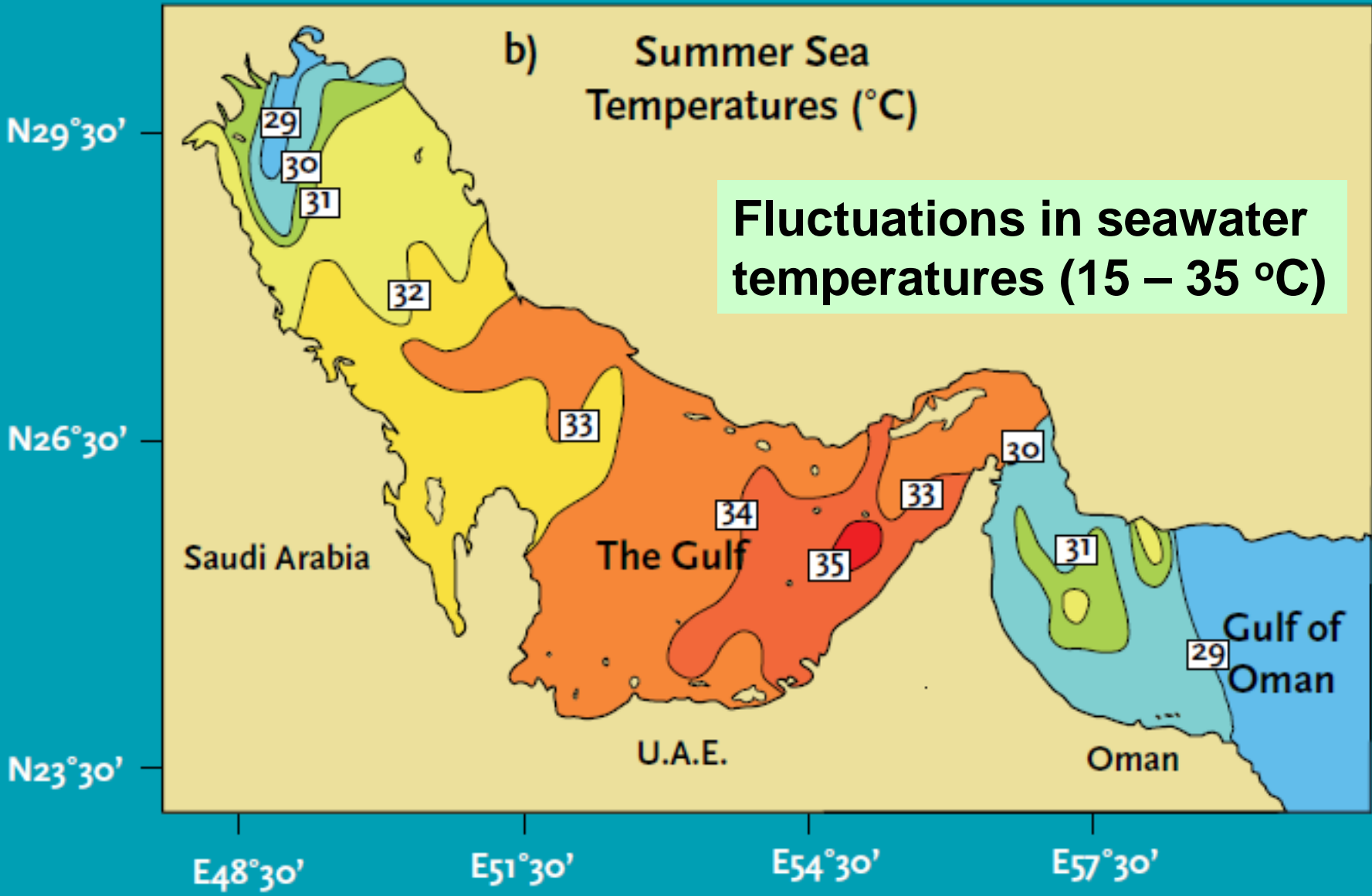
Eye alt 70.06 mi



# **Physical Characteristics of the Arabian Gulf**

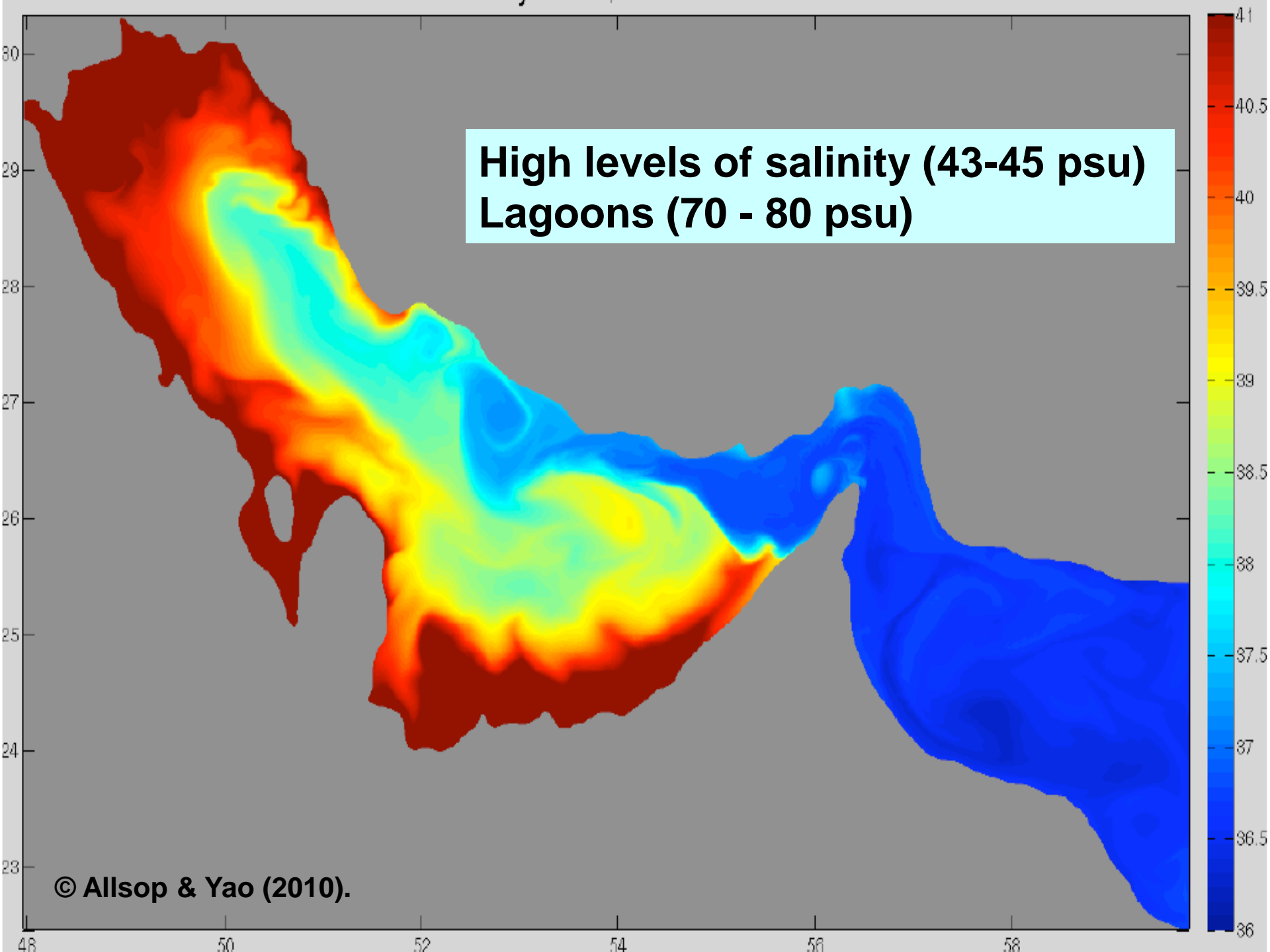


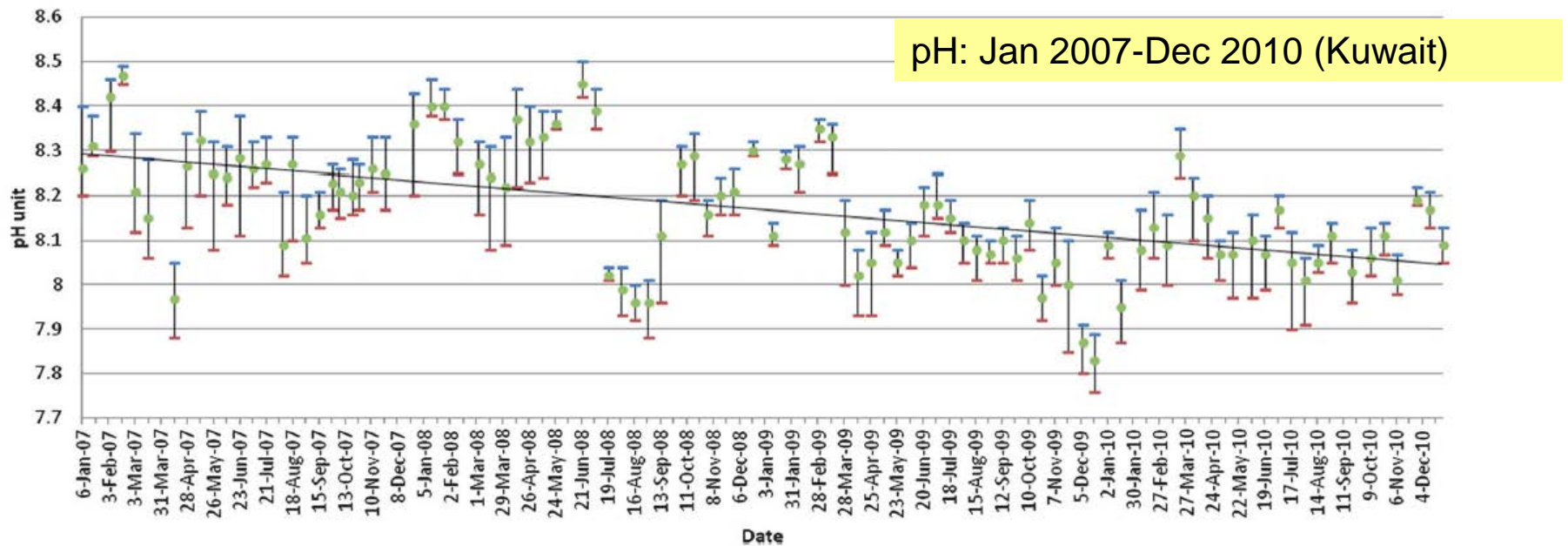
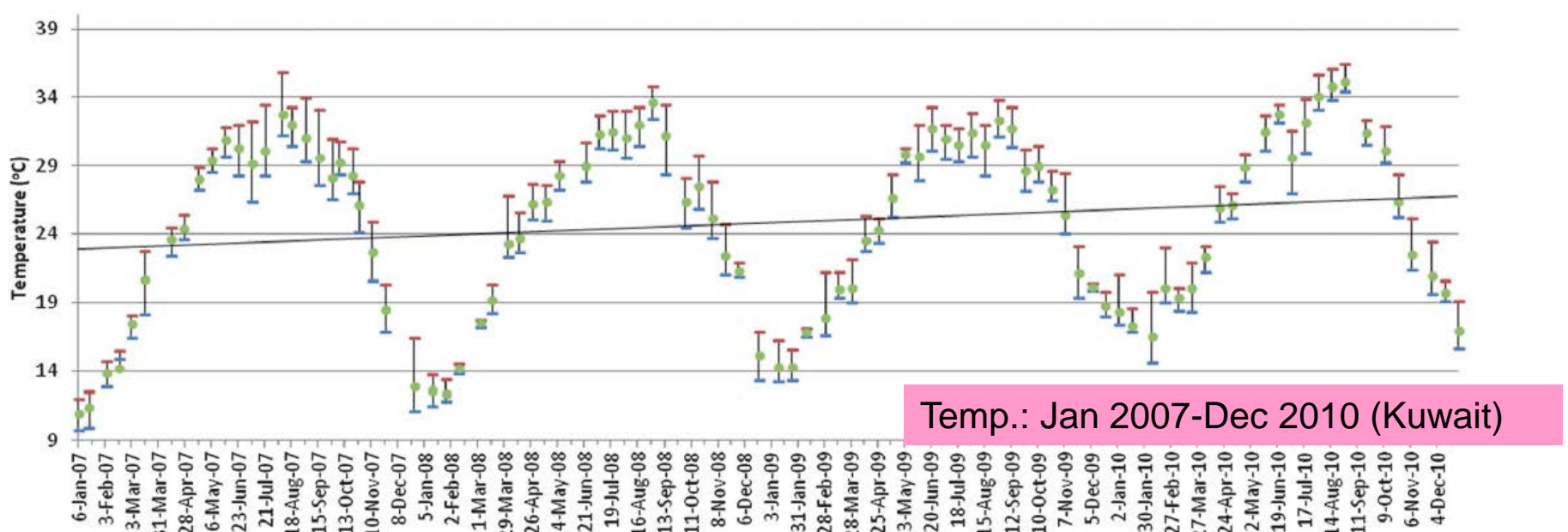
© Van Lavieren et al. (2011). Managing the growing impacts of development on fragile coastal and marine ecosystems: Lessons from the Gulf. UNU-INWEH, Hamilton, ON, Canada.



© Van Lavieren et al. (2011). Managing the growing impacts of development on fragile coastal and marine ecosystems: Lessons from the Gulf. UNU-INWEH, Hamilton, ON, Canada.







© Uddin et al. (2012). Acidification in Arabian Gulf – Insights from pH and temperature measurements. Journal of Environmental Monitoring ,14: 1479-1482.



Valued ecosystem components in Bahrain

# Seagrass beds



High Productivity,  
Nursery grounds,  
Feeding areas  
(turtles and dugongs)

Al-Wedaei, Naser, Al-Sayed & Khamis (2011). Assemblages of macro-fauna associated with two seagrass beds in Kingdom of Bahrain: Implications for conservation. *Journal of the Association of Arab Universities for Basic and Applied Sciences*, 10:1-7.

**Three  
seagrass  
species in  
Bahrain**



*Halodule uninervis*



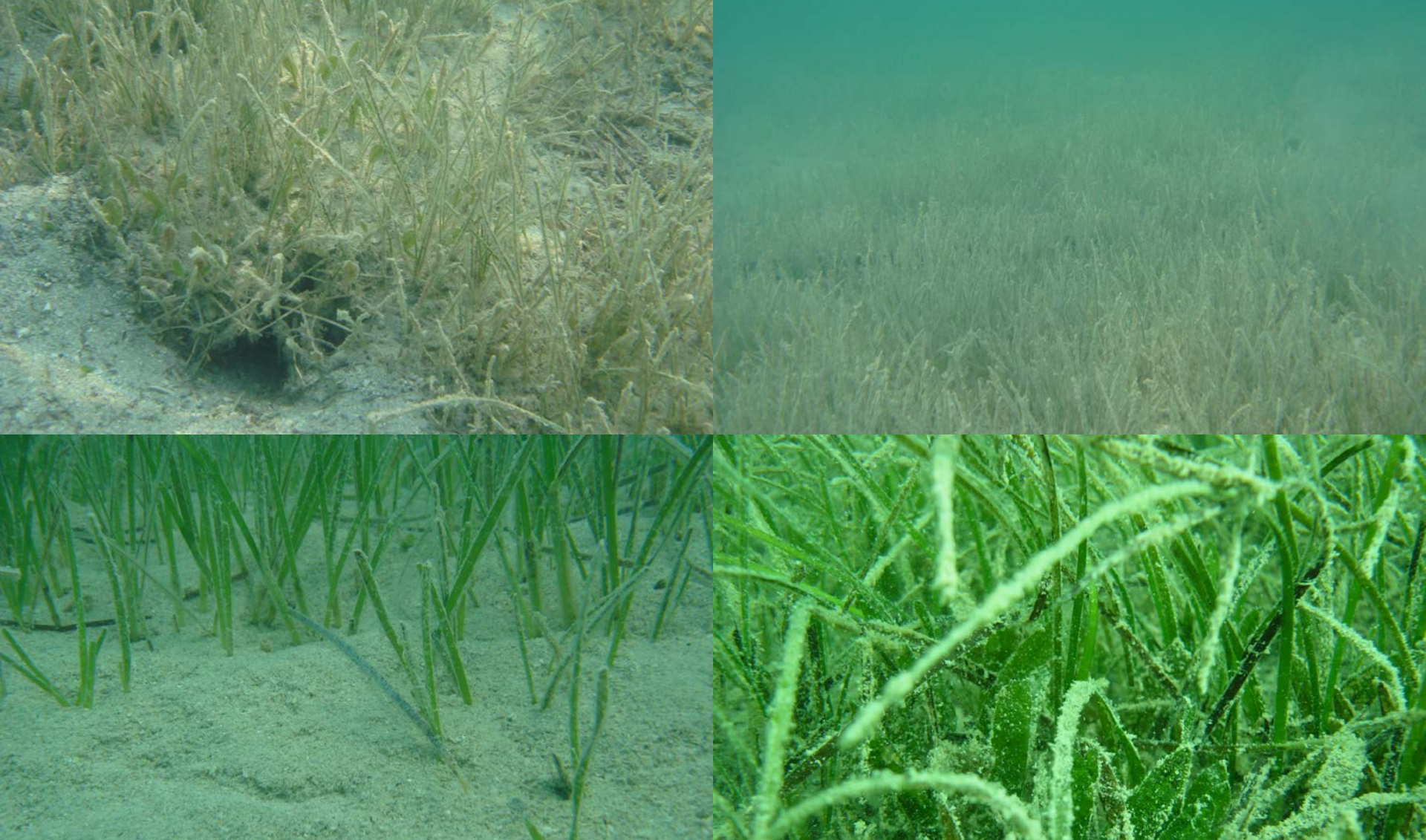
*Halophila stipulacea*



*Halophila ovalis*

Al-Wedaei, Naser, Al-Sayed & Khamis (2011). Assemblages of macro-fauna associated with two seagrass beds in Kingdom of Bahrain: Implications for conservation. Journal of the Association of Arab Universities for Basic and Applied Sciences, 10:1-7.

Anthropogenic activities contribute directly or indirectly to the loss of seagrass beds due to direct physical removal and burial, and the increase in turbidity levels.

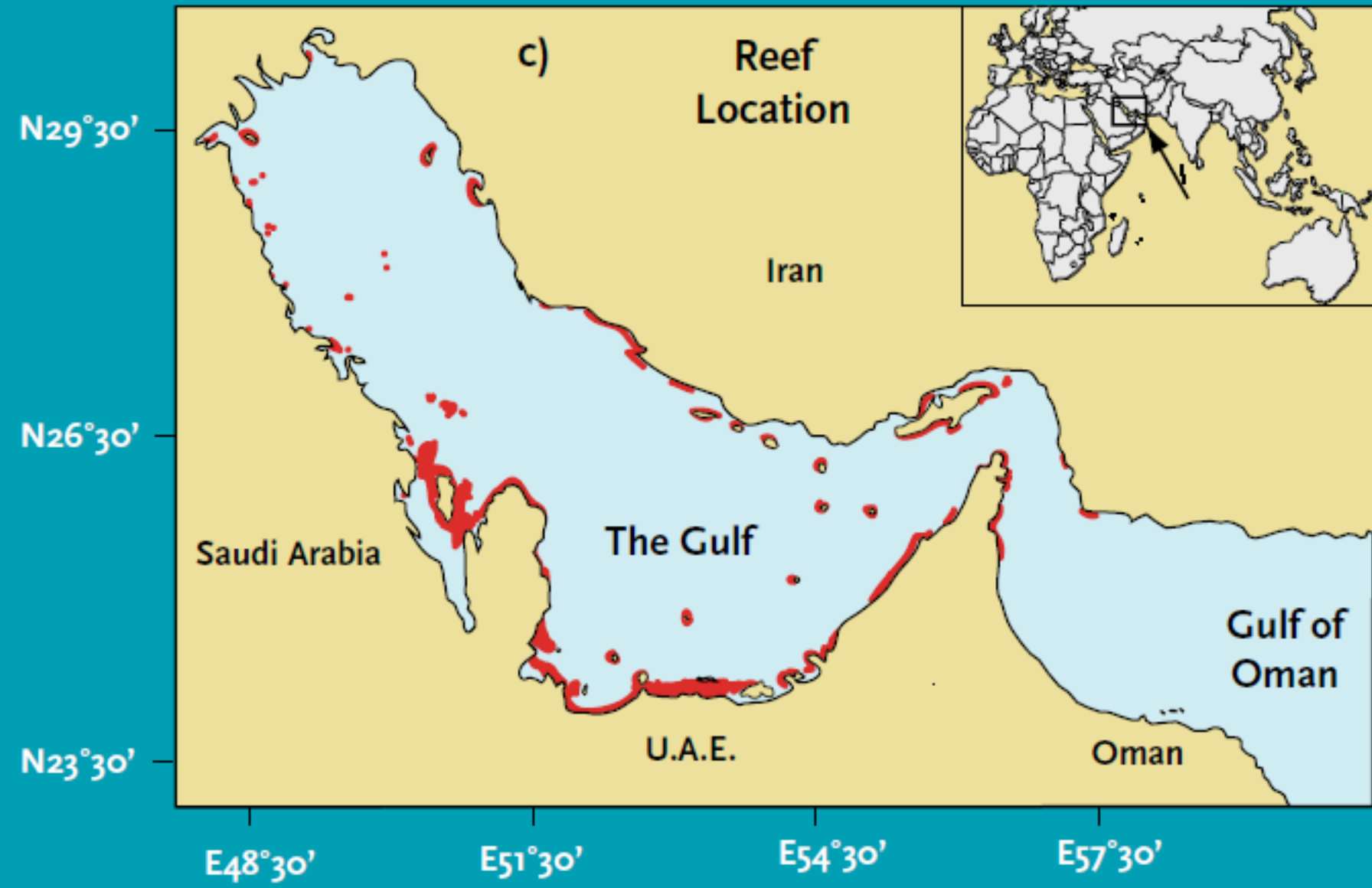


Al-Wedaei, Naser, Al-Sayed & Khamis (2011). Assemblages of macro-fauna associated with two seagrass beds in Kingdom of Bahrain: Implications for conservation. *Journal of the Association of Arab Universities for Basic and Applied Sciences*, 10:1-7.



Coral reefs

© BNR-COB



© Van Lavieren et al. (2011). Managing the growing impacts of development on fragile coastal and marine ecosystems: Lessons from the Gulf. UNU-INWEH, Hamilton, ON, Canada.



Renewable sources of seafood, maintenance of genetic, biological and habitat diversity, and recreational values.



© GEOMATIC

Naser, H. (2012). Coral reefs in Bahrain: anthropogenic threats and conservation. Coral Reefs of the Gulf Conference. New York University Abu Dhabi Institute. Abu Dhabi, 17-19 January 2012.

Impacts on coral reefs: natural stresses such high levels of temperature and salinity, bleaching events (1998, 37- 39 °C); and sediment runoff from dredging and reclamation activities and the increasing levels of domestic, and industrial pollution.

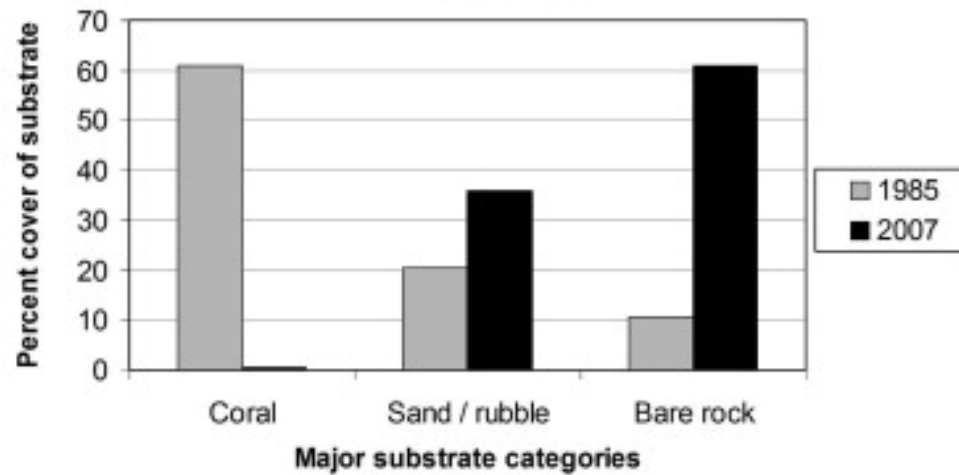


© GEOMATIC

Naser, H. (2012). Coral reefs in Bahrain: anthropogenic threats and conservation. Coral Reefs of the Gulf Conference. New York University Abu Dhabi Institute. Abu Dhabi, 17-19 January 2012.



The three largest reef cover categories on Fasht Adhm, 1985 and 2007



# Muddy and Sandy flats

High productivity, benthos diversity, feeding grounds for birds



Al-Sayed, Naser, Al-Wedaei, (2008). Observations on macrobenthic invertebrates and wader bird assemblages in a protected marine mudflat in Bahrain. *Aquatic Ecosystem Health and Management*, 11(4): 450-456.



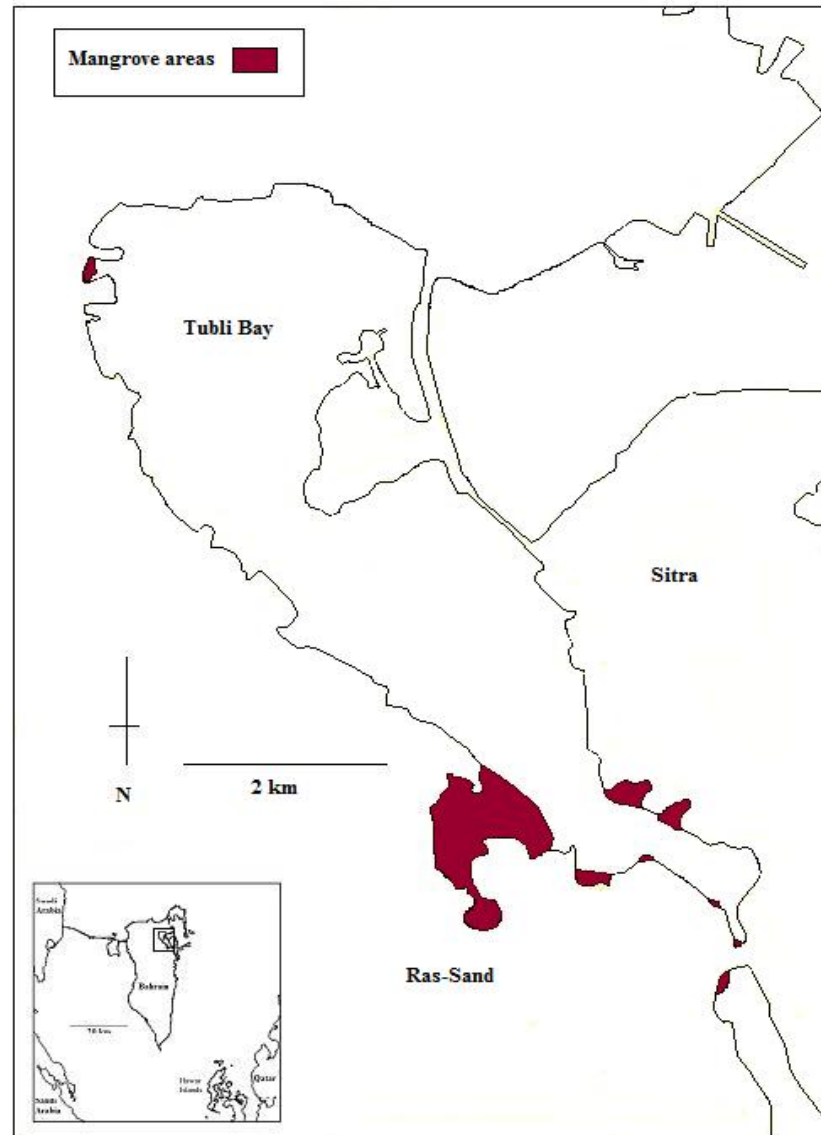
**Mangrove swamps** *Avicennia marina*

Provide food, shelter and nursery areas for a variety of terrestrial and marine fauna



Naser & Hoad (2011). An investigation of salinity tolerance and salt secretion in protected mangroves. Proceeding of Gulf II: The state of the Gulf ecosystem: functioning & services. Kuwait, 7-9 February 2011.

Due to reclamation, mangroves are currently limited to sheltered areas in Tubli Bay

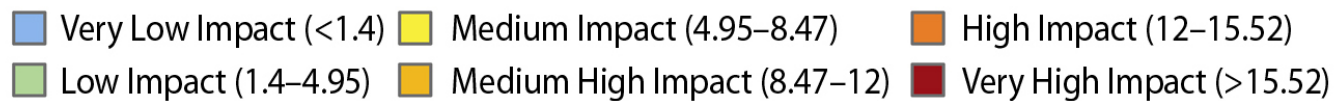
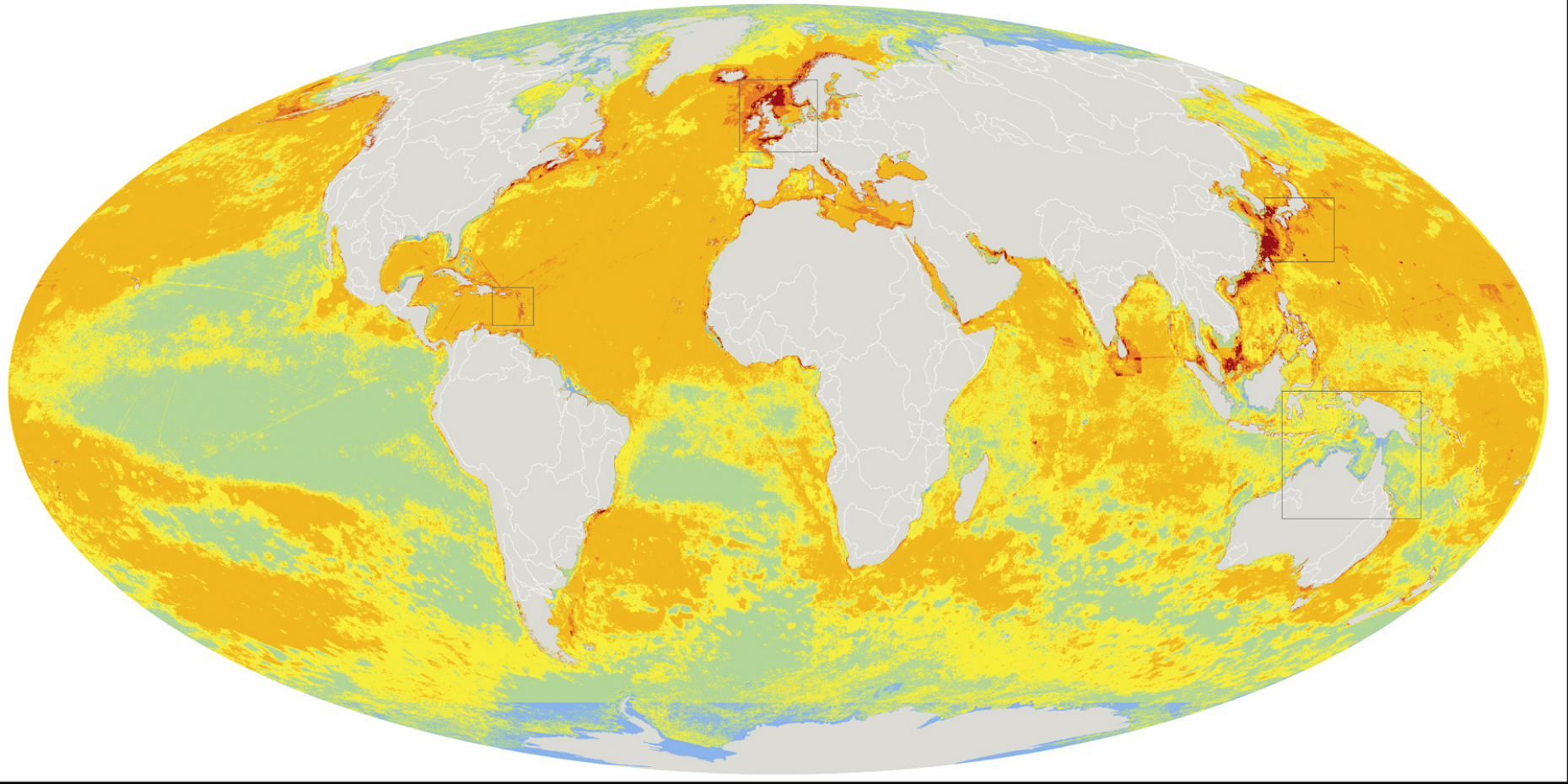


Naser & Hoad (2011). An investigation of salinity tolerance and salt secretion in protected mangroves. Proceeding of Gulf II: The state of the Gulf ecosystem: functioning & services. Kuwait, 7-9 February 2011.

# Anthropogenic impacts affecting coastal and marine environments in Bahrain



# The Arabian is considered among the highest anthropogenically impacted regions in the world



© Halpern et al. (2008). A global map of human impact on marine ecosystems.

*Science*, 319: 948-952.

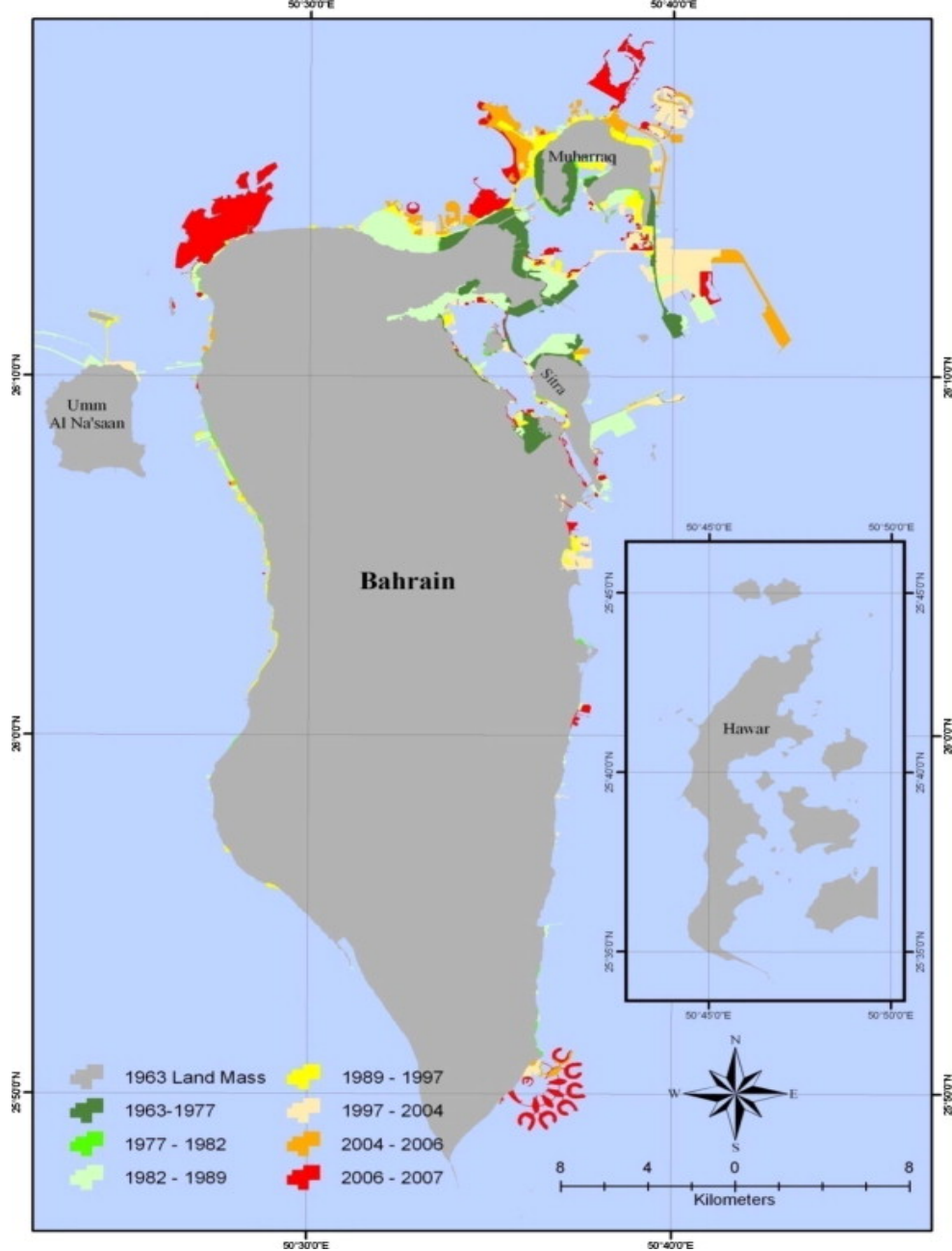
# Reclamation and dredging activities



Presently, reclamation activities have resulted in adding 91 km<sup>2</sup> representing an increase of 11% of the total land area.



Naser, H. (2011). Effects of reclamation on macrobenthic assemblages in the coastline of the Arabian Gulf: A microcosm experimental approach. *Marine Pollution Bulletin*, 62: 520-524.



© Zainal et al. (2012). The cumulative impacts of reclamation and dredging on the marine ecology and land-use in the Kingdom of Bahrain. *Marine Pollution Bulletin*, 64: 1452-1458.

October 2002

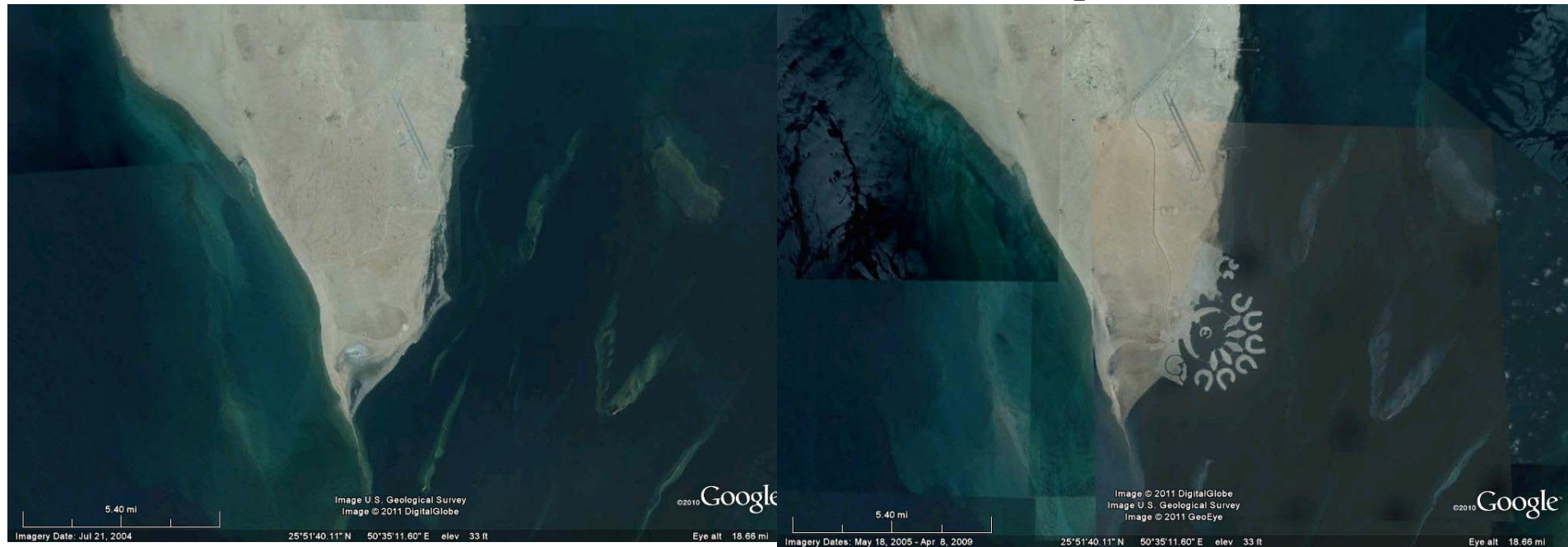
May 2010



© Google Earth

May 2004

September 2009



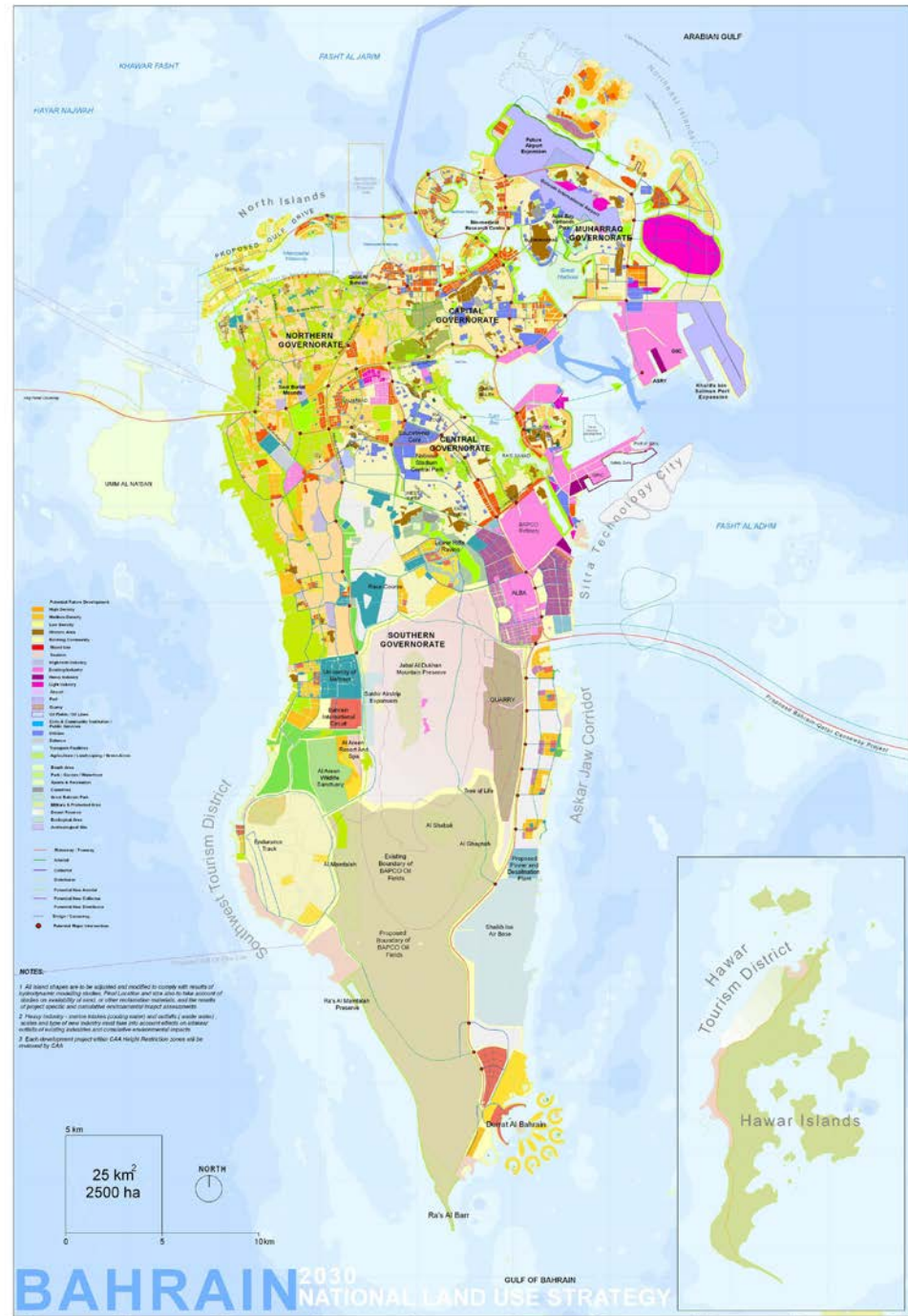
© Google Earth

2012



# Bahrain National Land Use Strategy 2030

Coastal environment will continue to be the major focus for developmental projects







Effluents from desalination plants

Wastewater discharges from desalination plants are associated with high temperatures, salinities, and a range of chemical and heavy metal pollutants



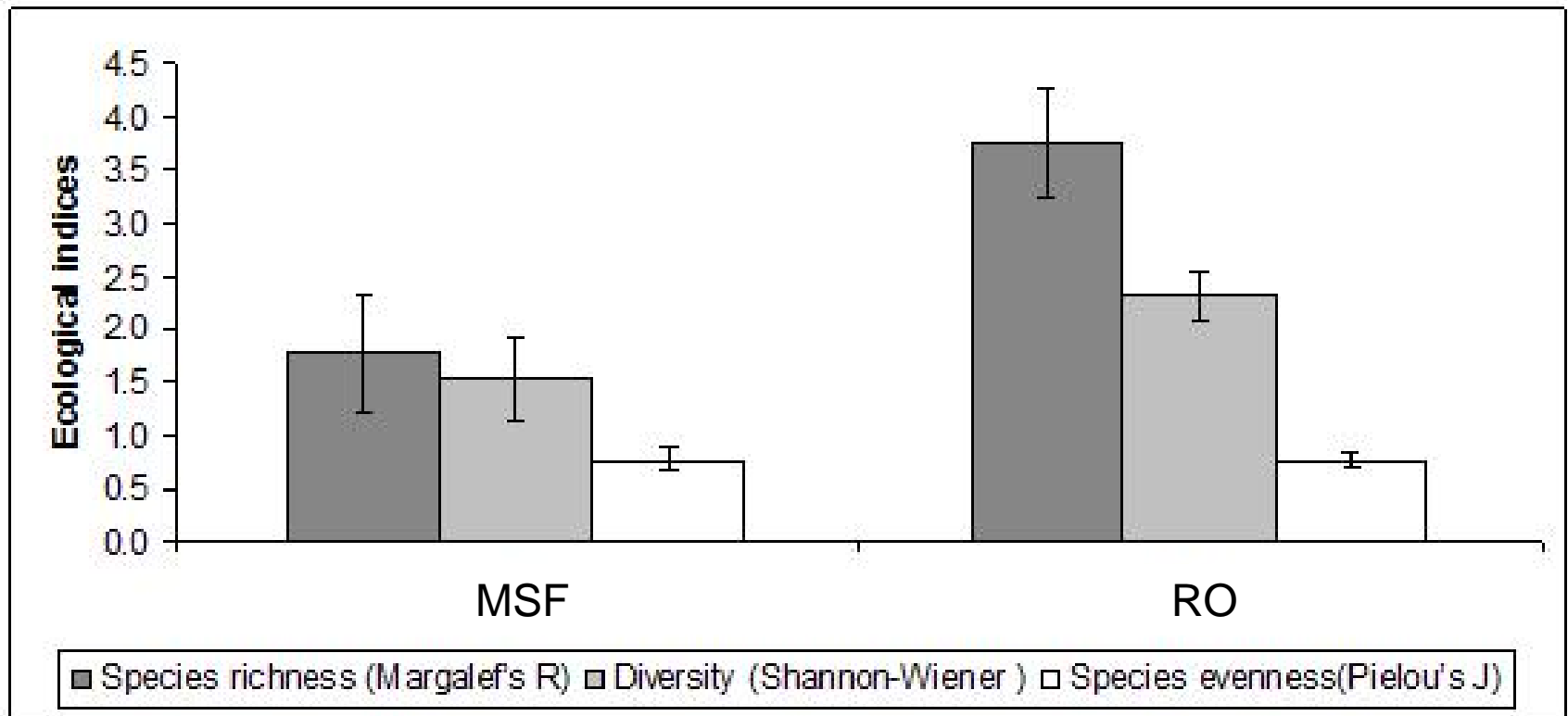
Naser, H. (2012). Effects of multi-stage and reverse osmosis desalinations on benthic assemblages in Bahrain, Arabian Gulf. Under submission.

Reduced levels of biodiversity and abundance were recorded in stations adjacent to outlets of desalination plants reflecting severe impacts on macrobenthic assemblages.



Naser, H. (2012). Effects of multi-stage and reverse osmosis desalinations on benthic assemblages in Bahrain, Arabian Gulf. Under submission.

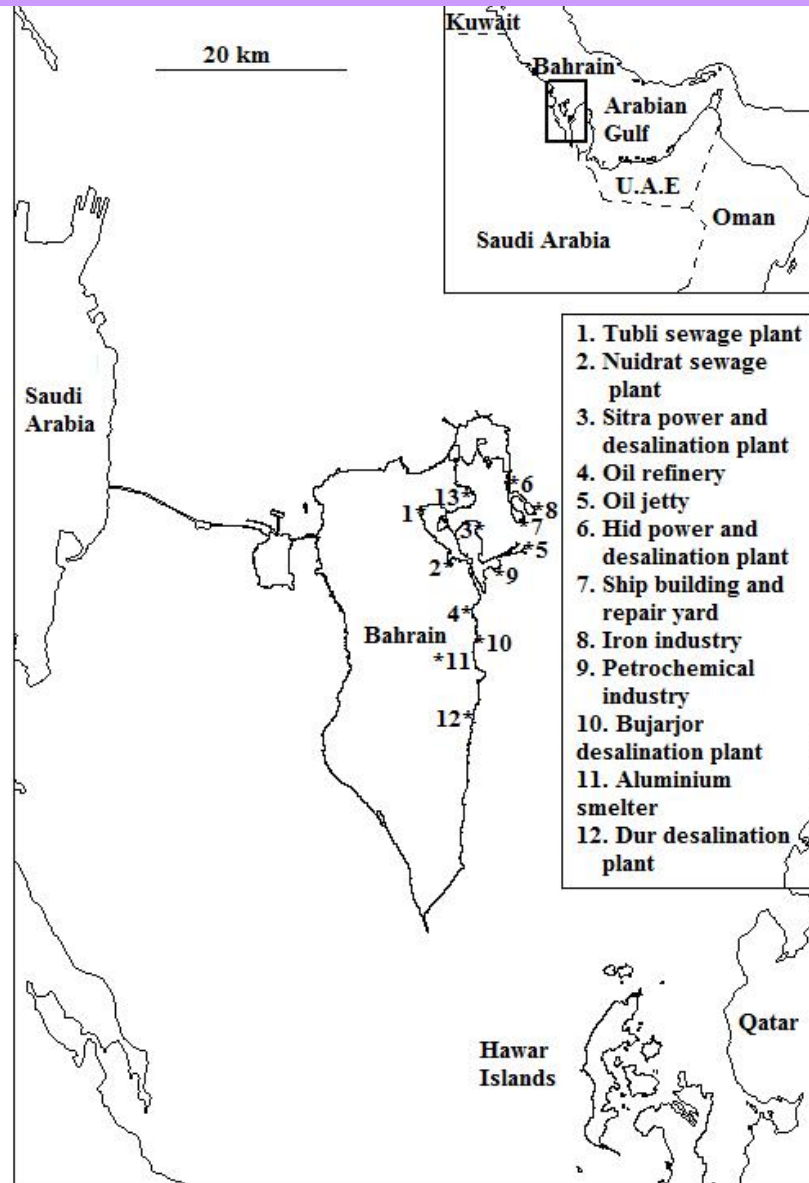
# Multi-Stage Flashing (MSF) VS brackish water Reverse Osmosis (RO) technologies



Naser, H. (2012). Effects of multi-stage and reverse osmosis desalinations on benthic assemblages in Bahrain, Arabian Gulf. Under submission.

## Industrial and other land-based activities in Bahrain

Oil refinery, aluminum and petrochemical industries produce effluents associated with hydrocarbons, ammonia, phenols, phosphorous and heavy metals



Naser, H. (2012). Metal concentrations in marine sediments influenced by anthropogenic activities in Bahrain, Arabian Gulf. In: Metal contaminations: sources, detection and environmental impacts, Shao Hong-Bo (Editor), NOVA Science Publishers, Inc. New York, pp. 157-175.

# Macrobenthos were severely affected by hydrocarbons and heavy metals from the main oil refinery in Bahrain



Naser, H. (2010) Testing taxonomic resolution levels for detecting environmental impacts using macrobenthic assemblages in tropical waters. *Environmental Monitoring & Assessment*. 170: 435-444.

# Sewage discharges



Reduced biodiversity and abundance of macrobenthos were recorded near the outlet of the major sewage treatment plant in Bahrain; some stations were devoid of macrobenthos reflecting severe sewage pollution.

Naser, H. (2010) Testing taxonomic resolution levels for detecting environmental impacts using macrobenthic assemblages in tropical waters. *Environmental Monitoring & Assessment*. 170: 435-444.

# Measures that may contribute to protection of coastal and marine habitats in Bahrain





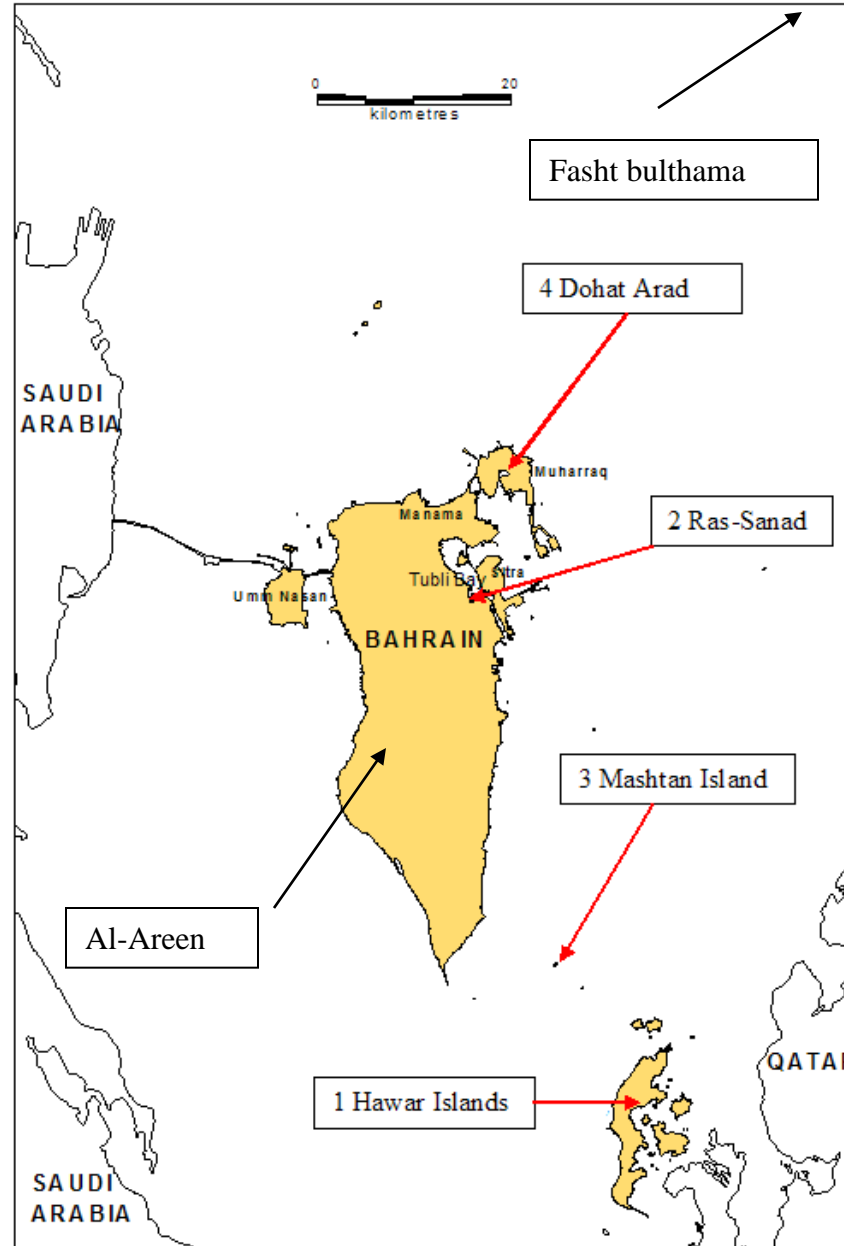
# Marine protected areas



Protected area	Ecological importance
<b>Hawar Islands</b>	<b>seagrass beds, algal mats, dugongs, turtles and dolphins. Largest breeding colonies of the endemic Socotra Cormorants: 200,000 individuals</b>
<b>Tubli Bay</b>	<b>sheltered lagoon, last remaining mangrove, ecosystems in Bahrain, breeding birds.</b>
<b>Mashtan Island</b>	<b>Offshore island, seagrass and algal mats, dugongs and turtles.</b>
<b>Duwhat Arad</b>	<b>Tidal mudflat, feeding ground for important shorebird populations.</b>
<b>Fasht bulthama</b>	<b>Small reef characterized by relatively high levels of diversity and cover (&gt; 50 %)</b>

Naser, H. (2011). Human impacts on marine biodiversity: macrobenthos in Bahrain, Arabian Gulf. In: *The importance of biological interactions in the study of Biodiversity*, J. Lopez-Pujol (ed.), InTech Publishing. pp. 109-126.

# Marine protected areas in Bahrain



# Environmental Impact Assessment

- EIA was adopted in Bahrain in 1998 to protect the environment and to reduce environmental degradation associated with major developmental projects.
- Most of developmental projects in Bahrain are related to the coastal and marine environments.

# Environmental Impact Assessment

- Some shortcomings in EIA reports, including limited ecological surveys, inadequate evaluation of impacts, neglecting cumulative and long-term impacts, and failing to address adequately mitigation and monitoring measures.

Naser, H., Bythell, J., Thomason, J. (2008). Ecological assessment: an initial evaluation of ecological input in environmental impact assessment reports in Bahrain. *Impact Assessment and Project Appraisal*, 26 (3): 201-208.

# Legal instruments and higher environmental policies

- National, regional and international laws and agreements:
- Environmental law, regulation of fishing, protection of wildlife, environmental quality standards for wastewater effluents, declarations of protected areas, and banning of catching endangered species, etc.
- Further enforcement is required.

Naser, H. (2011). Human impacts on marine biodiversity: macrobenthos in Bahrain, Arabian Gulf. In: *The importance of biological interactions in the study of Biodiversity*, J. Lopez-Pujol (ed.), InTech Publishing. pp. 109-126.

# Legal instruments and higher environmental policies

- Regional and international conventions: Convention on Biological Diversity, Ramsar convention, UN Framework Convention on Climate Change, and Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution.

Naser, H. (2011). Human impacts on marine biodiversity: macrobenthos in Bahrain, Arabian Gulf. In: *The importance of biological interactions in the study of Biodiversity*, J. Lopez-Pujol (ed.), InTech Publishing. pp. 109-126.

# Legal instruments and higher environmental policies

- Bahrain launched the National Environmental Strategy in 2006 (NES), which indentifies mechanisms by which principles of sustainable development can be implemented.
- Action plans for implementation and enforcement are required.

Naser, H. (2011). Human impacts on marine biodiversity: macrobenthos in Bahrain, Arabian Gulf. In: *The importance of biological interactions in the study of Biodiversity*, J. Lopez-Pujol (ed.), InTech Publishing. pp. 109-126.

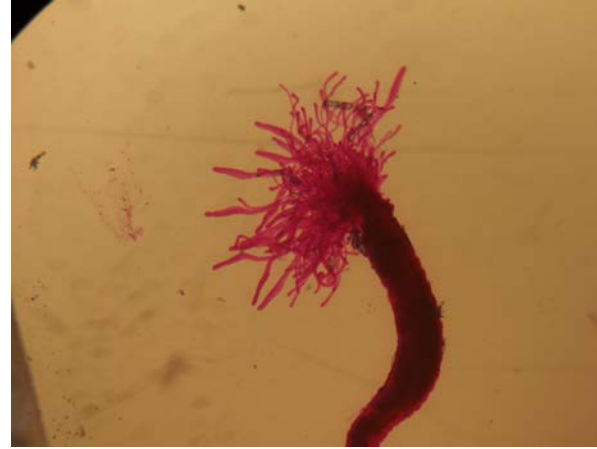


# Environmental monitoring and scientific research

- Holistic monitoring for the biological, chemical and physical aspects of the marine environment is required.
- Identifying and describing species are required to assess the biodiversity and to understand the structure and function of marine organisms.

Naser, H. (2011). Human impacts on marine biodiversity: macrobenthos in Bahrain, Arabian Gulf. In: *The importance of biological interactions in the study of Biodiversity*, J. Lopez-Pujol (ed.), InTech Publishing. pp. 109-126.

# Limitation in taxonomic keys and guidelines



Thank you