Detecting the Marine Environmental Physical-Chemical Pollution by Biological Beacons and GIS program

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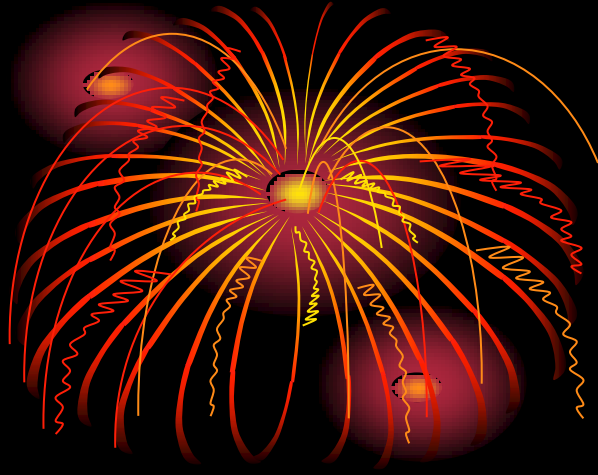


Introduction

- A fundamental challenge in Earth System science is the response of the marine ecosystem to changes in climatic forcing. Especially,
  - How will it affect ecosystem functions and
  - Sustainability of bio-resources to these changes.

- Datasets which allow us to map the distribution and relation between marine biota and environmental conditions are sparse.

- Satellite remote sensing can provide detailed information on a large scale for several bio-physical parameters, such as temperature and chlorophyll (Robinson, 2004). The challenge is to combine satellite data with the sparse in-situ datasets to generate distributions of higher trophic levels.

- Marine plankton are important indicators of environmental changes that associated with global warming and acidification of the oceans.
- Certain planktonic species considered a bio-indicator to certain types of physical-chemical pollution.
- Plankton play a role in the biological pump because much of the CO_2 is fixed by phytoplankton, and then eaten by zooplankton, eventually sinks to the seabed. Much of this carbon can be locked up in sediments and removed from the carbon cycle.

Greenhouse effect in higher layers

Atmosphere

Phytoplankton

Photosynthesis

CO_2

Feeding

Zooplankton

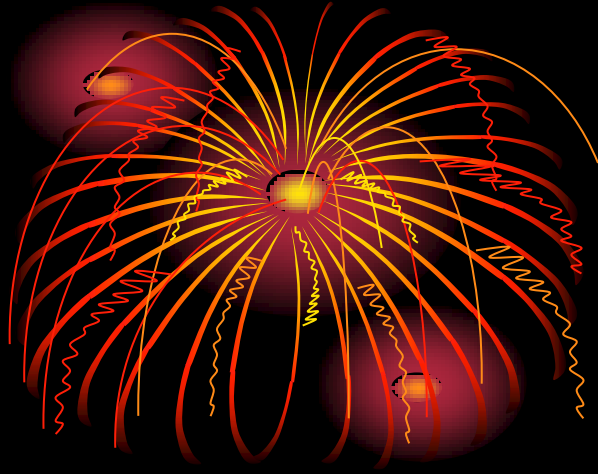
Feeding

Death

Death

Faeces

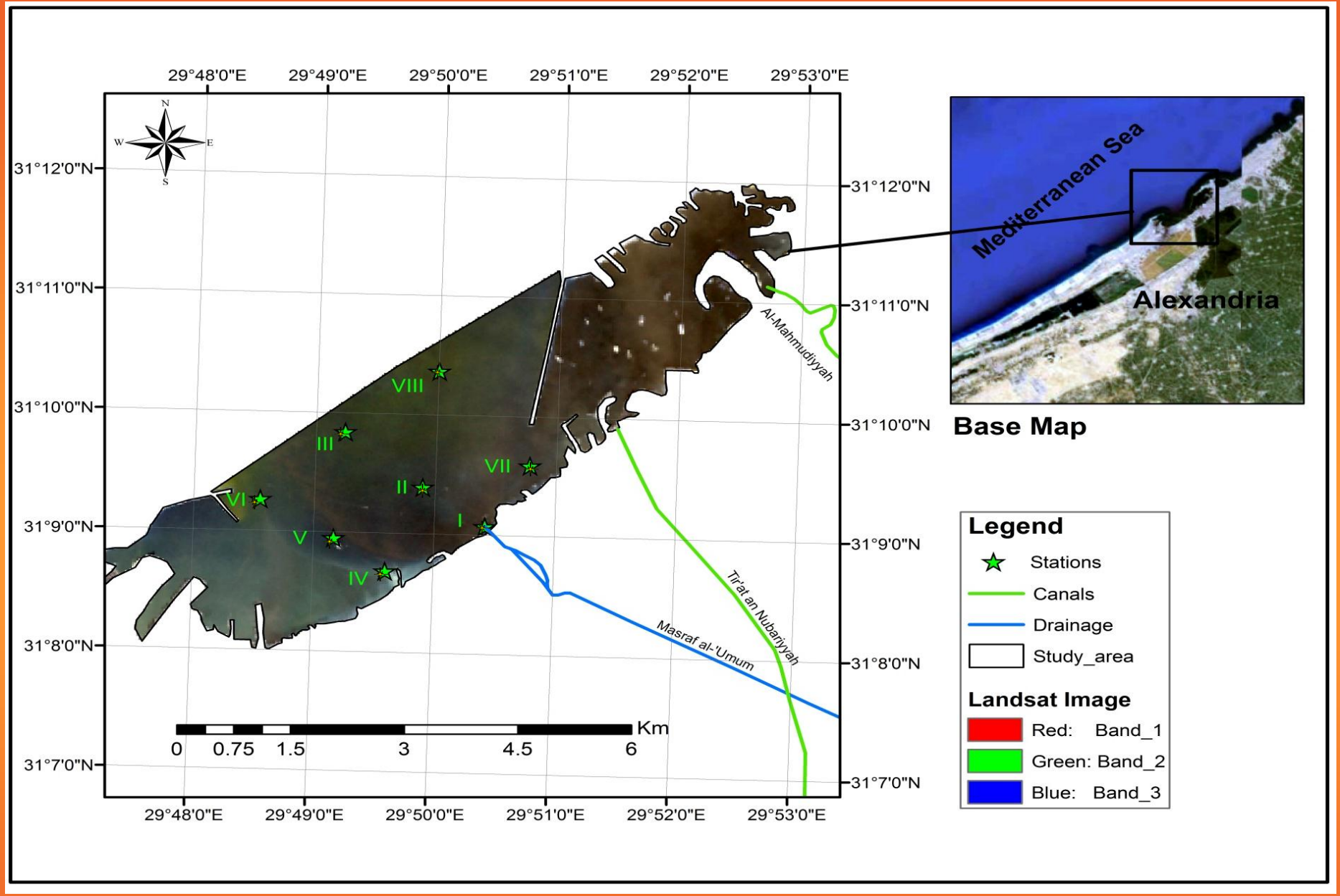
Seabed



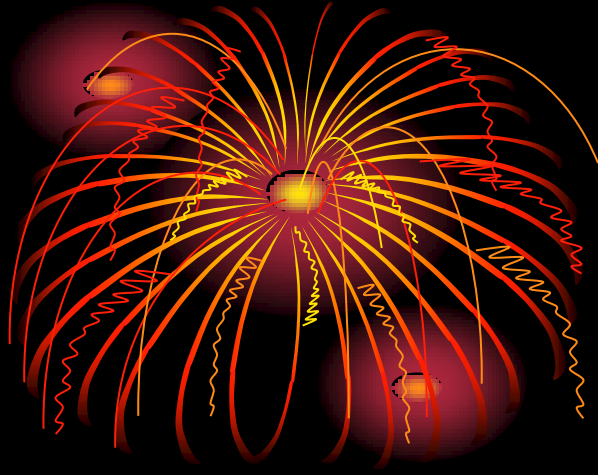
Study Area

Study area

Google earth map showing the location of the study area (El-Mex Bay).



Base map and satellite image (LANDSAT 7) showing El- Mex Bay and the main drains discharge into the bay.



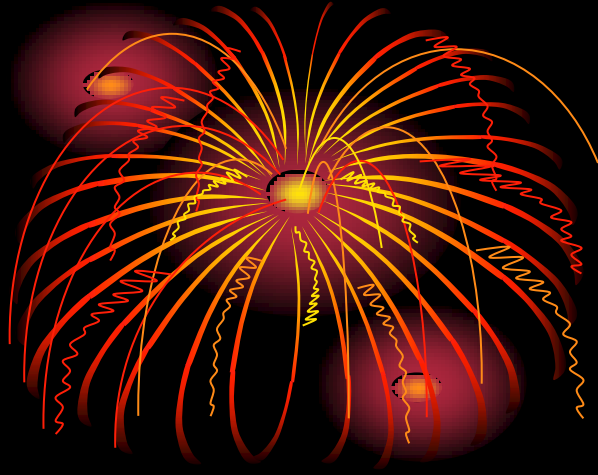
Aim of Work

Aim of Work

- Examine the spatial and temporal variability in abundance, diversity, community structure and dynamics of plankton and their relation with the environmental conditions.
- Using GIS (ARCMAP 10) to produce maps illustrates the organisms abundance, diversity and the prevailing environmental conditions.
- Using plankton organisms as bio-indicators to assess the environmental impacts in the bay and consequently the adjacent harbors.

Continue.....

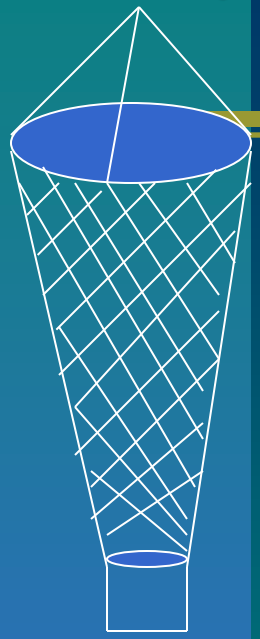
- Gain frame work about the future conditions and its effect on the ecosystem if the recent continues to happen.
- Planning prediction and recommendations to prevent the risks that threaten the environment.
- Collecting previous data in the same topic and area and comparing it with the present study to determine which changes happened in the environment and its impacts.



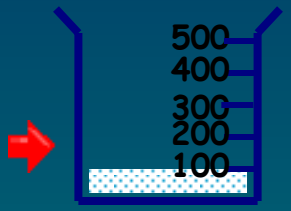
Study Methodology

Biological Parameters

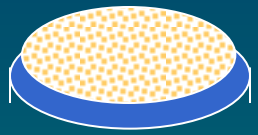
Zooplankton and Phytoplankton Biomass (Chlorophyll a)



Planktonic net

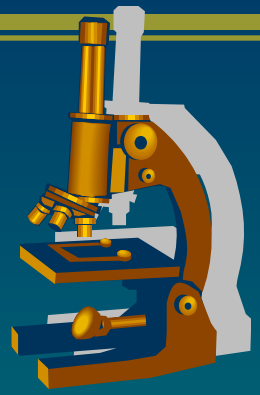


Sample concentrated to 100 ml

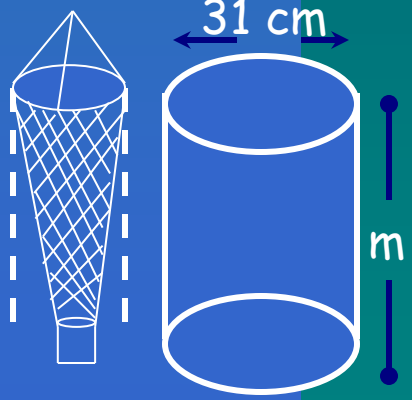


Petri-dish

All samples examined to be identified under binuclear microscope



Sub-sample of 5 ml examined to calculate the No./m^3



$$\text{No. of organisms/m}^3 = \frac{\text{No./5 cc}}{\text{V. of Sub-sample}} \times \frac{\text{V. of concentrated sample}}{\text{V. of filtered water}}$$

$$\text{Volume of filtered water} = \pi r^2 d \quad m^3$$

Physico- Chemical Parameters

1-Water temperature

By using an ordinary thermometer graduated to 0.1ºC.

2-Hydrogen ion concentration (pH)

Were measured in the field by using a pocket digital pH meter.

3-Salinity

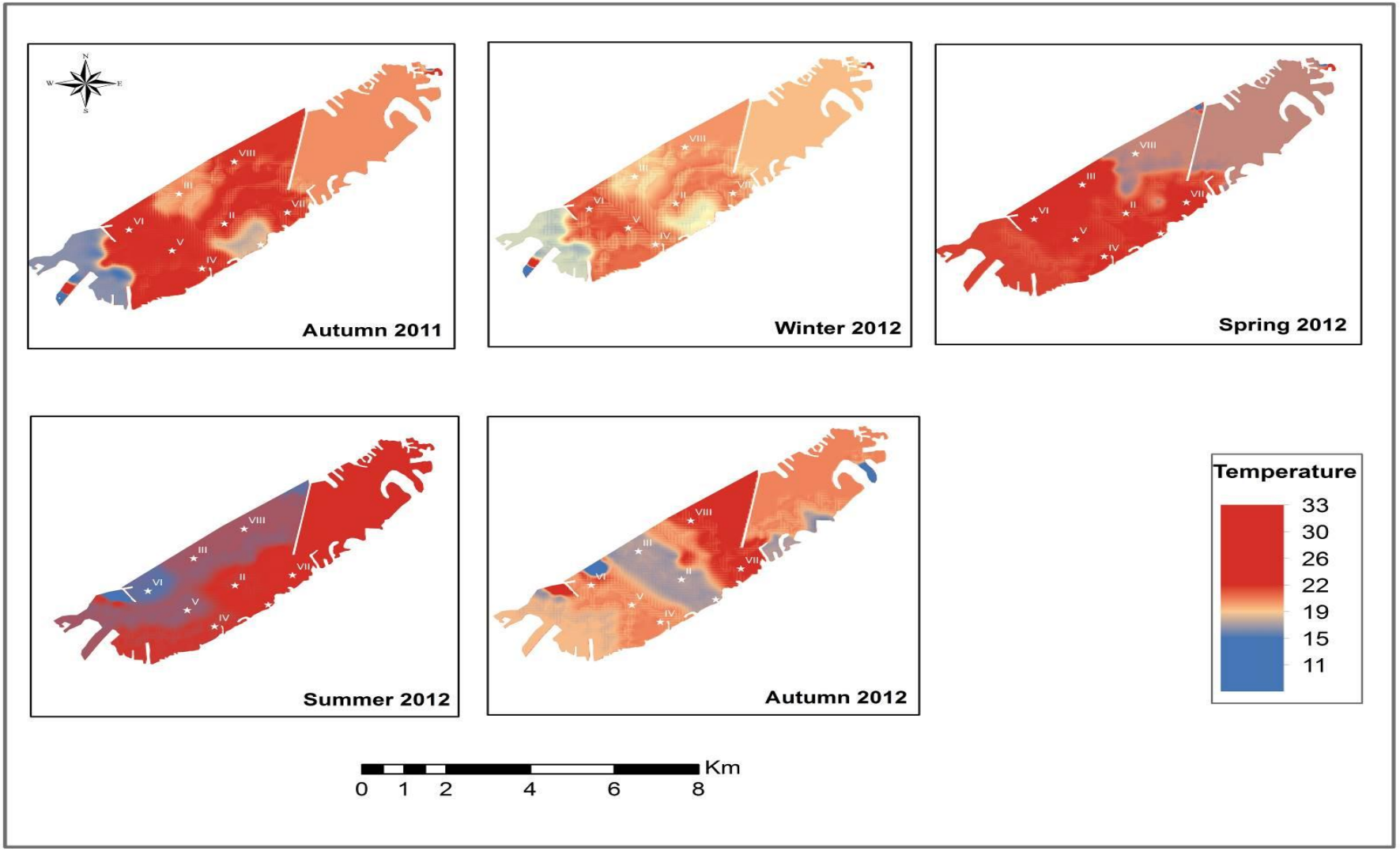
Measured by using Refractometer.


EXTECH

Results

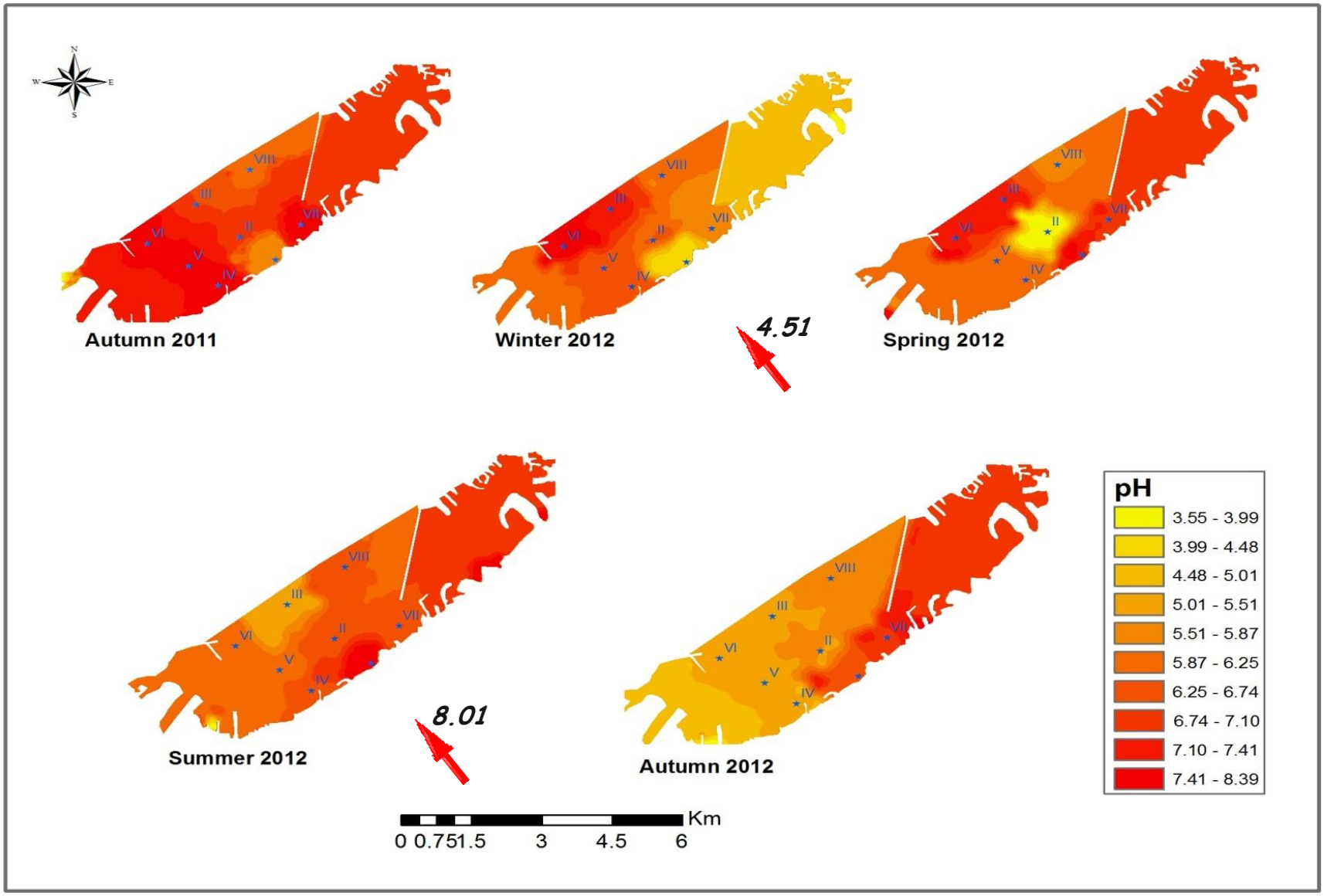
Physico-chemical Parameters

1. Water temperature (°C)



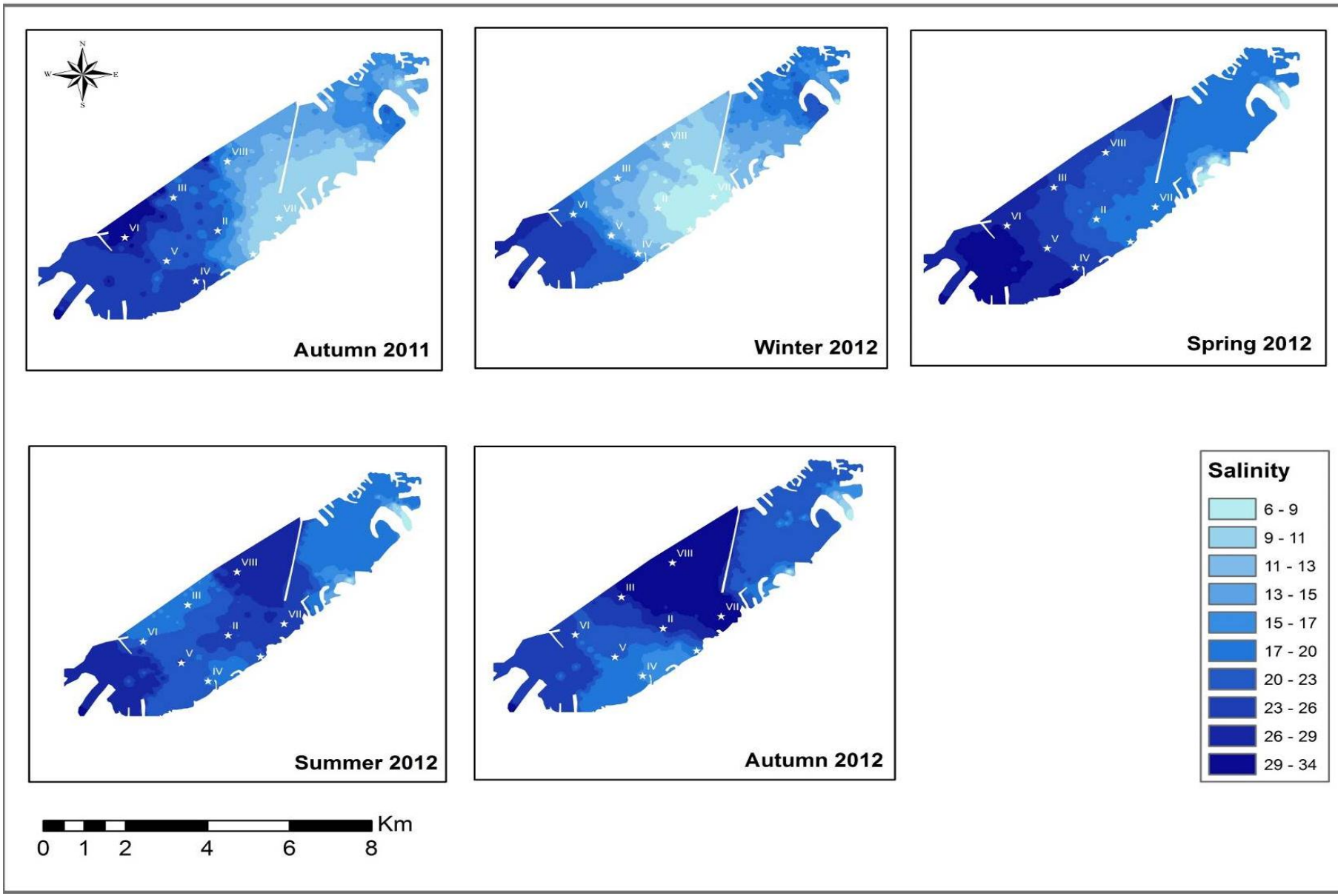
Variations of water temperature (°C) at different stations during the study period

2. Hydrogen ion concentration (pH)



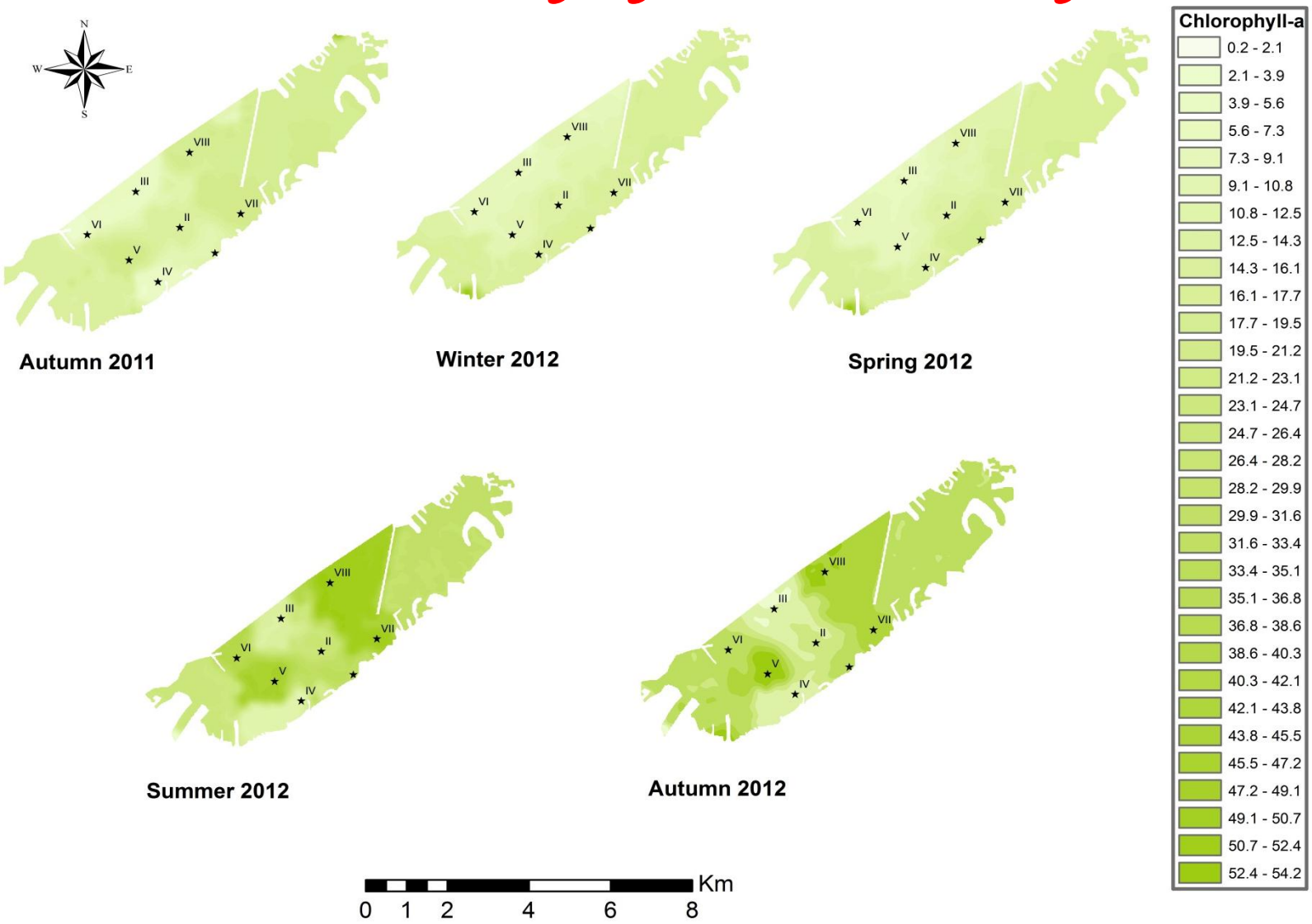
Variations of pH values at different stations during the study period

3. Salinity (‰)

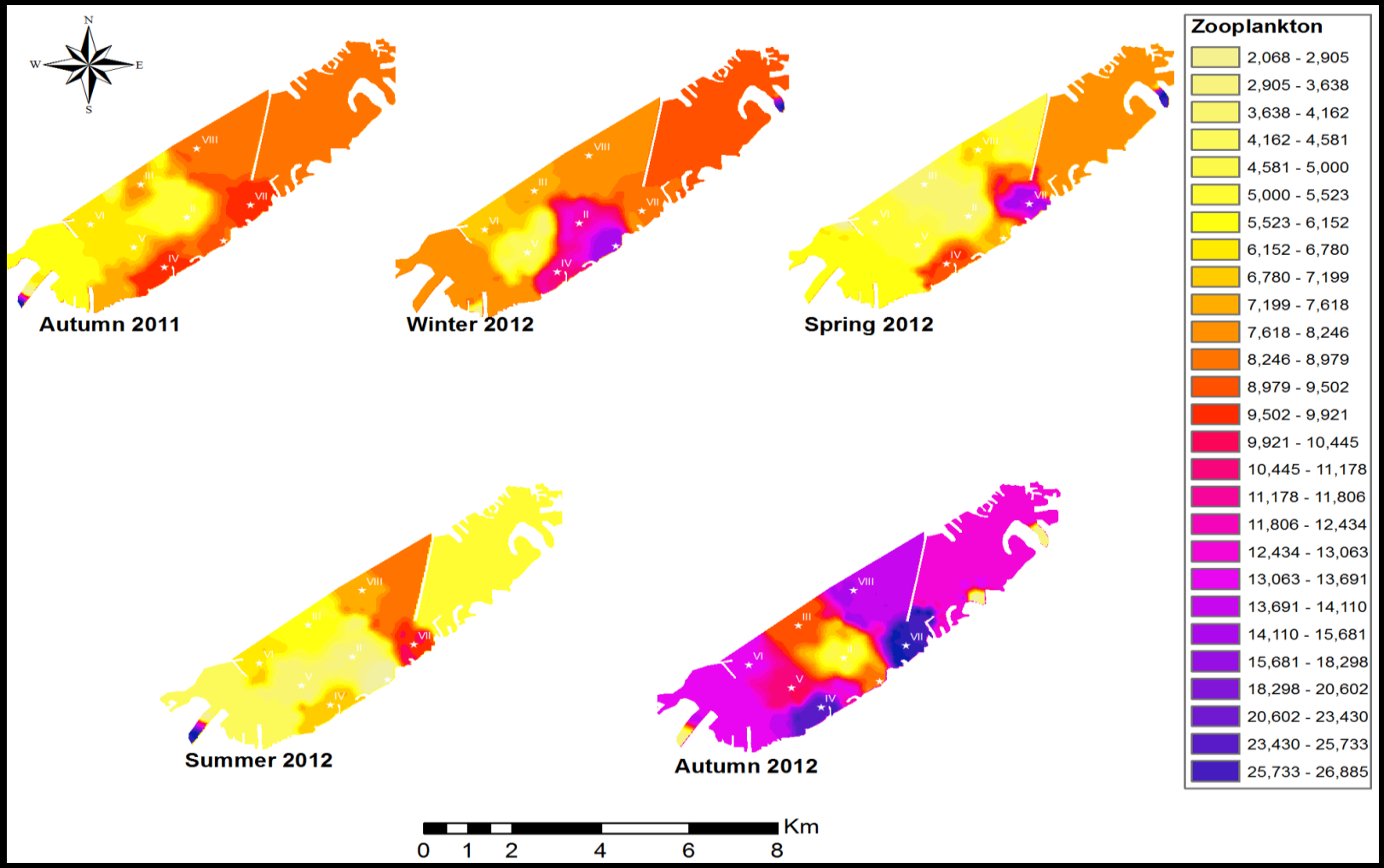


Variations of salinities at different stations during the study period

Productivity of El- Mex Bay

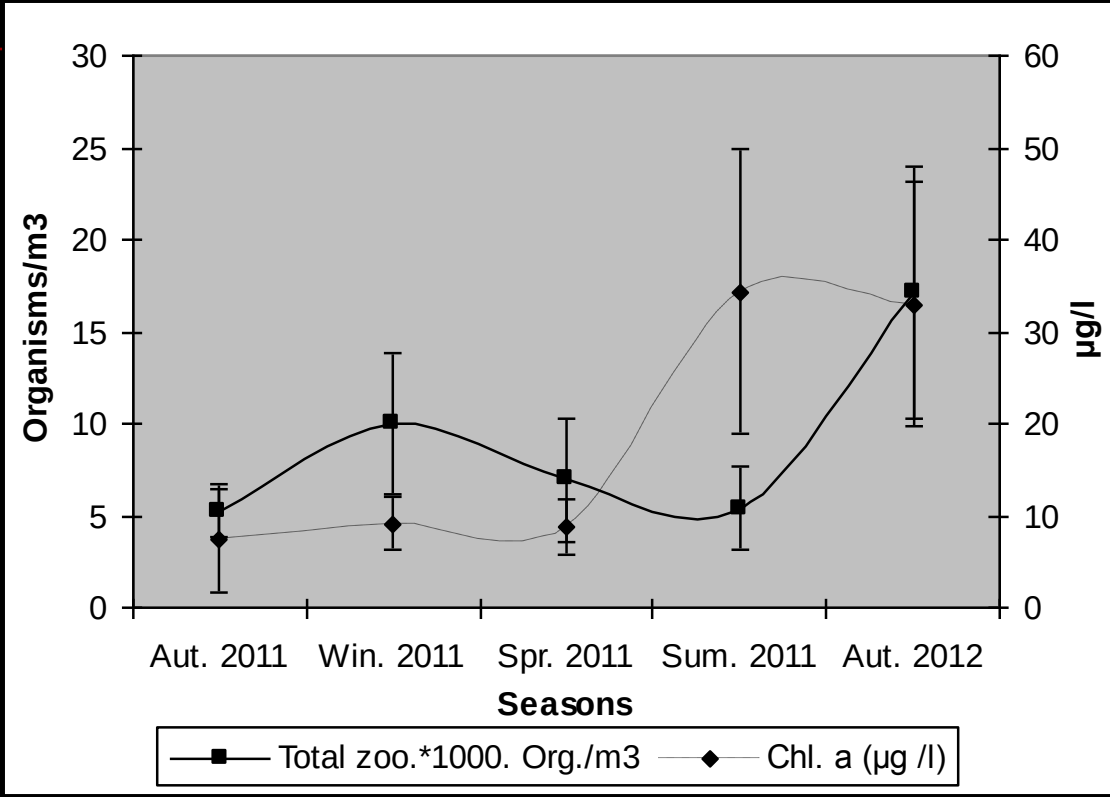


Seasonally variations of chlorophyll-a readings (µg/l) recorded at different stations during the investigated period



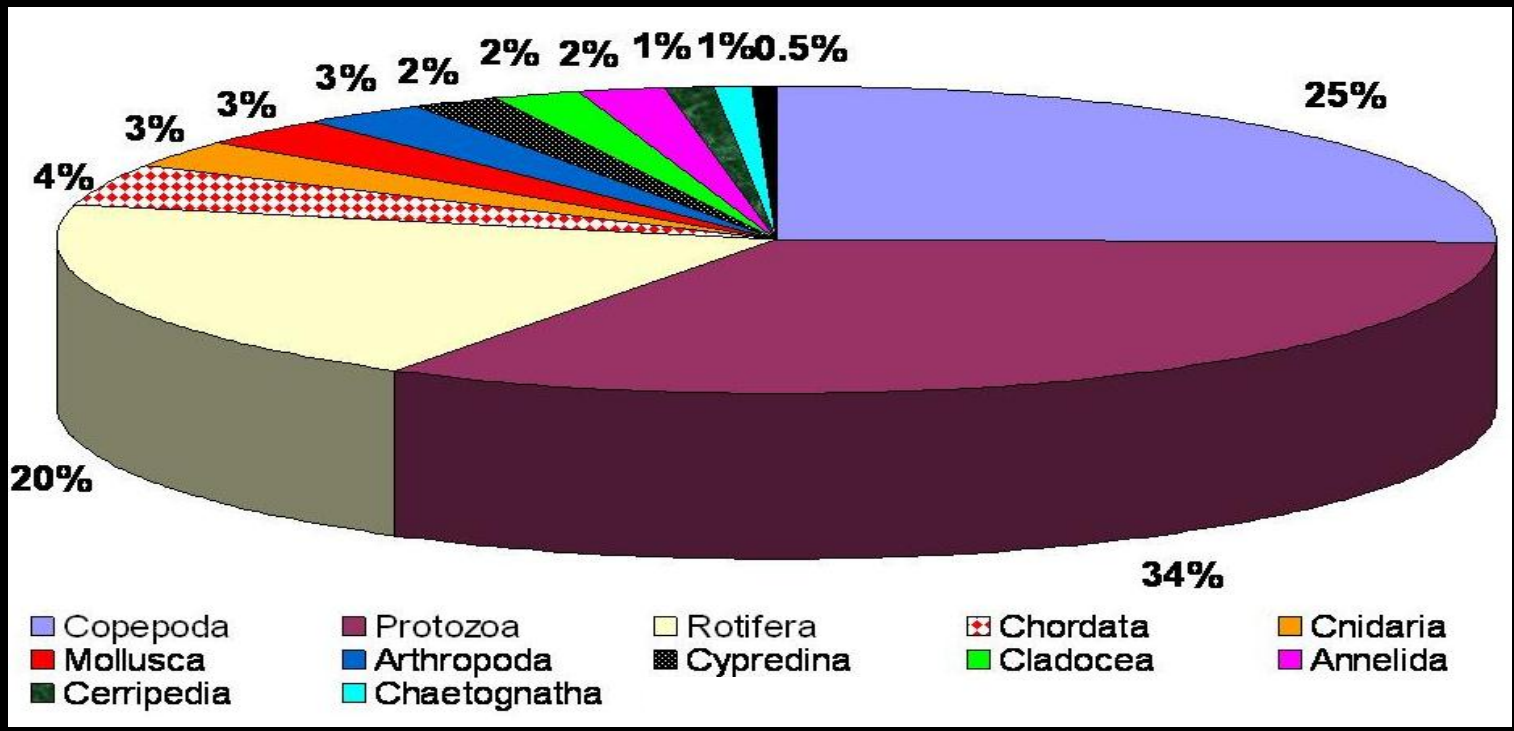
Temporal variations of zooplankton densities during the whole study period

Relation between primary and secondary producers



The intensity of phytoplankton (as chlorophyll-*a*) and zooplankton recorded at El-Mex Bay during the study period

Faunal Composition (Zooplankton Community)



Percentages of different zooplankton groups recorded during the whole study period in El-Mex Bay depending on number of species

Indication of water quality

Protozoa are characterized by many specific structural and functional features, represent an important ecological assemblage in aquatic ecosystem and play a crucial role in the function of microbial food webs in addition to their role as indicators of water quality **(Xuet *et al.*, *2008).***

In the bay, Protozoa occupied the 2nd order of abundance among zooplankton groups in El-Mex Bay contribution 15.6 % of the total zooplankton counts (averaged 1440 organisms/m^3), predominated by ciliates.

Ciliated Protozoa are considered as bio-indicators from two ways:

1- The absence of these organisms:

indicates the presence of toxic substances, such as phenols, cyanides, and heavy metals.

2- The presence of these organisms:

- indicates oxygen deficiency.
- system overload.
- putrefaction.
- An increased number of several different bacteria.
- The presence of Cyanophyta, Zooflagellata, and **Ciliata**, is an indication of water overloaded with organic matter, i.e. an indication of polysaprobic processes and oxygen deficiency **(Németh-Katona, 2008)**.
- Some **Protozoan** species are considered as indicator of the pollution with sewage pathogens such as the genera ***Euplotes***, ***Centropyxis*** *and* ***Difflugia****.*

Indication of Eutrophication problem:

With increasing phytoplankton biomass, herbivorous zooplankton species increases (Shiganova et al., 1998).

Due to pollution and eutrophication the copepod *Acartia clausi* was favored, while rare species became extinct during the season of phytoplankton flourishing, this was agree with (Isinibilir *et al.,* 2008 and Zhenbin *et al.,* 2008) whom reported that zooplankton community structure changed from eutrophic-indicator genera (*Brachionus, Polyarthra and Keratella)* to genera more characteristic of oligotrophic conditions (*Tintinnopsis and Acanthocyclops)*.

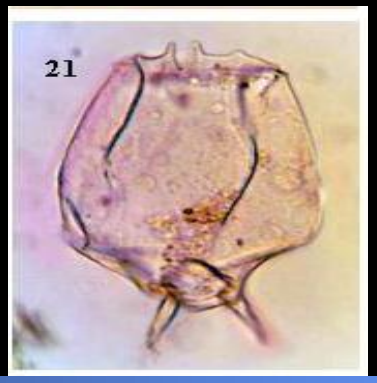
Acartia clausi

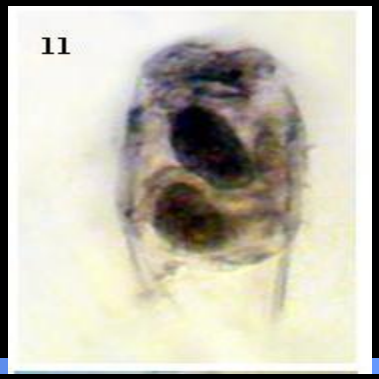
Acartia bispinosa

- The ecological study of rotifer assemblages in different world regions indicated that some rotifers have the ability to exist and flourished in polluted waters species **(Klimowicz, 1961, Aboul Ezz *et al.*, 1996, Abo-Taleb, 2010, Abdel Aziz, *et al.*, 2011, Pejler, 1957, El-Bassat, 1995 and Arora, 1966)** and are considered as:

1- pollution bio-indicators.

Ex.: *Brachionus and Polyarthra* and *Filinia longiseta.*





- **Indicators of trophic nature of the environment.**
  The presence of *Brachionus* and *Keratella* species, especially *Keratella cochlearis and Filinia* species in any water body is an indicator of eutrophy.

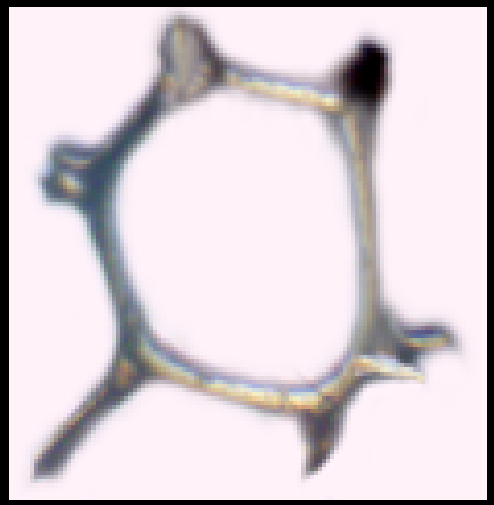
All the species mentioned above were found and dominant in El- Mex Bay during the present study, thus confirming that the bay classified as highly eutrophic and polluted waters.

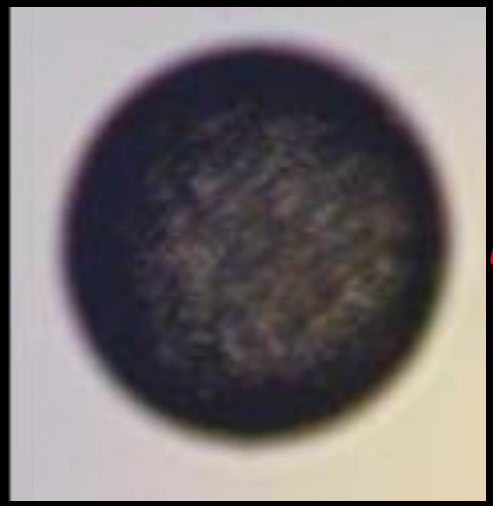
Role of ballast water in species transmission

- Some species known to be characterize the clear open deep water like Archiriscus hertwigi, Myxosphaera coerulea, these two species were encountered at the bay during this study and doesn't recorded before from the shallow water of Egyptian Mediterranean Coast.

- After investigations, there is only one reason supposed to discuss this phenomena, it is the mechanical transmission through the ballast water.

Archiriscus hertwigi





Myxosphaera coerulea

Water acidification Problem and bio-indicators

- The absence of pteropod organisms from any marine water system considered a strong signal on water acidification. The results indicated that pteropods organisms correlated positively with pH values.

- the prevailing acidic conditions in the bay stand as a barrier against abundance, diversity and dispersal of this organisms which recorded in lower densities and diversity (two species only, **Creseis aciculate** and **Limacina inflate**).

- Pteropods are likely to be the plankton organism highly sensitive to environmental condition change in pH (Russell, 1935), because the composition of their shells which mainly of aragonite, will be subject to the increased dissolution under more acidic conditions

Conclusion

Conclusion

1. El-Mex Bay is located under stress condition due to the discharge of untreated domestic, industrial and agricultural effluents,

beside the effect of ships movements from and to the harbors. Therefore, the condition at this bay is eutrophic and completely differe from the open sea water.

These are expected to continue and added to climatic influence of increasing temperature and rising sea level in the future.

Conclusion

2

As a consequence of rapid population growth, industrial development, untreated or poorly treated industrial waste, domestic sewage and agricultural runoff have moved to and through *Mariut Lake* south of the city and then released into The sea. This lake has also received a large loading of agricultural runoff through canals and drains. El- Mex Bay subjected to severe environmental conditions.

These compounds also have corrosion effects on the vessels structure, and consequently increases the economic costs for individuals and governments.

Continue.....

3

Rotifer and other zooplankton species sensitivity to some physical and chemical conditions allow using them as bio-indicators of aquatic ecosystem. Being rather tolerant to different environmental conditions, many rotifer species are good indicators of water quality and can be used for the ecological monitoring of water bodies.

Continue.....

4

All copepod organisms observed in El- Mex waters are eurythermic and euryhaline forms living under a range of water temperature between 14.39- 30.68 °C and water salinity between 10.82- 28.53 ‰.

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5

Plankton abundance is primarily controlled by fluctuations in physical environment and nutrient concentrations, which cause high seasonality among samples.

Due to pollution and eutrophication many species were favored, while rare species became extinct.

Recommendations

Recommendations

1. All Coastal projects at Alexandria should require an environmental impact assessment study (ETA).

2. Establishment of Information System that stores all previous data to help the future development, management and restoration of the coastal areas.

3. Improvement water quality of the discharges by controlling and treatment the different types and sources of pollution and forcing applying of law.

4. It is clear that for a better understanding of the marine ecosystem problems, we should enhances the using of biological components and their relation with the environmental parameters (Bio-Indication).

Thank You

Hamdy