

Climate Change

B- ASSESSING CLIMATE CHANGE IMPACTS AND ADAPTATION ON MARINE ECOSYSTEMS

13B.1 GOALS AND OBJECTIVES

Sea-level rise and water temperature increasing due to climatic changes are expected to have a pronounced impact on the offshore marine ecosystems on low-lying coast all over the world. The coastal area in Lebanon is expected to be affected by sea level rise (partly enondation of terrasses and erosion, changes of coastal ecosystems and loss of land and productivity) which will necessarily induce loss of urban areas and socioeconomic changes over the whole Lebanese coastal zone. Fishery rессources will also be affected directly or indirectly due to declining and ultimate disappearance of coastal biotops or ecosystems.

13B.2 SCOPE

The Exposure unit is the Marine Ecosystems in coastal zones which we can divide into two parts:

- Benthic:
 - sandy coast
 - rocky coast
- Pelagic: -plankton: primary production,..
 - nekton: fisheries,..
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By global warming, the former will be affected particularly by sea level rise and the later by water temperature increasing.

The study area is a natural region situated in the central part of Lebanese coast: **Jounieh bay** and another one in **Batroun Bay**.

The timeframe for impact studies is at different intervals 2020 and subsequently at 30 years intervals for the period 2050 to 2080. Normal climatic period from 1940 to 1970.

The availability of data on climatic and hydrographic parameters is not consistant and is a limitation in this study; hence, the collection of new data is an important element. The major data required for the exposure units are: Meteorological data (trend of annual atmospheric temperature and precipitation), Hydrologic data (Water surface temperature , Salinity and Relative Rise in Sea level (RRSL), Topographic maps, preferably with at least-3m contour intervals, Bathymetric maps, particularly of the nearshore areas (less than 10m of water)

Historical records indicative of previous sand of sea level will be important to study benthic ecosystem especially submerged marine terrasses.

13B.3 SOME REMARKS SHOULD BE DONE CONCERNING AVAILABLE DATA

- 1- Data available were collected during special projects in special places and times and it were stopped with the end of project. This is true for water temperature, salinity, planktonic populations which will be directly affected by atmospheric temperature increasing. No regular data available for a long period to help to put a trend line.
- 2- Data of fish product, which also can be affected by water temperature rise, are available only in FAO reports which were given by the Ministry of Agriculture (Bureau de pêche) and are approximately the same every year and are not exact because a large quantity of fish are directly buy by fishermen to the consumers without any indication to the Ministry; also fish collected by amateurs and illegal methods are not mentioned there.
- 3- Data on benthic populations especially in the intertidal zones, which will be directly affected by sea level rise and will be a good indicator, are very scarce.

For all these reasons we did a choice for some parameters trying to estimate the effect of climate change: Water temperature, Phytoplanktonic populations, Total product of fish and total product of Clupeidae.

These parameters were chosen because phytoplankton populations constitute the autotrophic primary producers in the pelagic food chains in marine waters and it is well known that their annual cycle is affected by many physical features that affect nutrient levels; these include fronts characterized by large horizontal gradients in variable such as **temperature**. Concerning the third parameters, Clupeidae which are very sensitive to temperatures change and are represented in our country by sardines (*Alosa fallax*, *Sardinella aurita*, *S. maderensis* and *Sprattus sprattus* which are planktivores and so directly affected by these populations. In Lebanese coastal waters, *Sardinella* are the most important pelagic fish and they play an important role in the local fishing ; abundant in spring and early summer in inshore waters.

13B.4 VULNERABILITY IMPACT ASSESSEMENT

The increasing of water temperature is based on the increasing of air temperature after GCM. In Jounieh Bay, for example, in January, actual water T° is 17.79°C, in 2020 the projection of water temperature is 19.02°C and 19.59°C in 2050 and 20.67°C in 2080 and so on in every month. In Batroun Bay, Basing in a sketch map of Lebanon's coastline showing geoidal elevation (G.E.) and geographic distribution of risk potential areas, we conclude that the region of Batroun bay is situated in the category of *less critical zone* (geoidal elevation > 2.5m) and G.E. is 3.8m in this region. Terraces, which are partially submerged and partially immersed, will be gradually immersed. Algae will receive different qualitative and quantitative light and this will affect their distribution and in consequence the distribution of fauna.

Concerning pelagic ecosystem, phytoplankton populations in Jounieh bay, species responsible for bloom at late winter and at the beginning of spring like *skeletonema costatum*, *Nitzschia* spp., *Leptocylindrus danicus* and *L. minimus* and others could start earlier, because features of temperate marine planktonic ecosystems are not only sensitive to annual variations in weather, but also any trends that might result from greenhouse warming or other factors that affect the climate system and both density and timing of spring blooms will be altered in some regions. Also, the taxonomic compositions of the phyto- and zooplankton may change influenced by the change of ocean structure.

Clupeidae which is very sensitive to the gradient of temperature will reproduce also earlier in our country. Concerning species, maybe thermophile species will increase in density replacing the biota of others species preferring cooler waters.

In case of increasing water temperature we can expect: advance in spawning for these species, abundance for other species of clupeidae such as *Sardina* and finally the abundance of thermophilic species and decreasing of xerophilic species.

13B.5 Recommendation

The following conclusion and recommendations can be drawn:

1. Coastal systems in the country are under high potential threat from development and urgently need a coastal management for a sustainable development
2. Most data concerning coastal zone are not sufficient.
3. Appropriate programmes and selected marine environmental factors should start properly on a regular basis and for a long term to help the determination of trend of climate change.
4. Studies concerning ecosystems should focusing on the studies of species not only groups or families.
5. Importance of coordination between research Centers working in environmental programmes to collect the maximum of data and maximum of parameters.