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ASSESSMENT OF THE IMPACT OF ENVIRONMENTAL CHANGE ON PLANKTON DYNAMICS IN THE EASTERN LEVANTINE BASIN **(EMEDZOO)**

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Introduction

EMEDZOO focuses on an important component of the eastern Levantine Basin ecosystem, zooplankton (Fig. 1), to help address major uncertainties in the future of sustainable Cypriot marine resources. Zooplankton are sensitive indicators of climate impacts on marine ecosystems because their growth rates are tightly coupled to environmental perturbations, and changes in zooplankton biomass cascade through the food web to both higher and lower trophic levels. Thus a better understanding of zooplankton in this region will allow us to understand how the pelagic marine ecosystem could respond to environmental variability and changes in the climate of the eastern Levantine Basin.

Objectives

The objective of EMEDZOO is to describe the zooplankton community in Cyprus waters for the first time. Specifically,

EMEDZOO aims to:

- Conduct spatial surveys of zooplankton
- Link changes in zooplankton populations to variability in the environment
- Compare EMEDZOO findings with historical data on zooplankton in the Eastern Mediterranean

Methods

Zooplankton were collected in Cyprus waters using 200-um and 60-um mesh plankton nets. The nets were deployed off ships of opportunity.
For each plankton tow, the net was lowered vertically to 100 meters depth, and raised back up. A temperature logger was deployed above the net for each tow.

Plankton sampling periods were targeted to capture the maximum variability in environmental parameters (Fig. 2). Variability in sea surface temperatures (SST) and sea surface chlorophyll (SSChl) were investigated using the University of Cyprus Oceanography Center's CYCOFOS system (Cyprus Coastal Ocean Forecasting and Observing System). Sampling periods were chosen in the winter (March) when SST was < 17°C and SSChl was > 0.2 mg m^{-3}, and in the summer (August – September) when SST was > 29°C and SSChl was < 0.2 mg m^{-3}. Field sites were also chosen to capture the maximum szpatial variability in plankton communities, with sampling stations located in Agia Napa, Larnaca, Limassol, Paphos and Pomos.

After net collections, plankton were preserved in formalin for later microscope-based analyses of abundance and taxa composition. Plankton were also filtered onto mesh filters and frozen for later drying and weighing to determine plankton biomass.

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Figure 1: Zooplankton commonly found in Cyprus waters:
(a, b) copepods, (c) cladoceran, (d) ostracod, (e) salp,
(f) pteropod mollusc, (g) chaetognath, (h) appendicularian.

Figure 4: Satellite-determined sea surface chlorophyll in the Eastern Mediterranean and Black Seas.
www.visibleearth.nasa.gov.

Results and Discussion

During EMEDZOO, a total of 194 plankton tows were conducted off the coast of Cyprus. Zooplankton biomass from the 200-um net collections ranged from 0.6 – 10.6 mg dry weight (DW) m^{-3}, and numbers of zooplankton ranged from 150 – 583 individuals m^{-3}.

Spatial patterns were observed in zooplankton populations that differed with season. During winter, zooplankton biomass and abundance were highest at Pomos (5.2 mg DW m^{-3} and 532 individuals m^{-3}) and were lower at southern stations (Agia Napa and Limassol: 2.1 – 2.6 mg DW m^{-3} and 306 – 343 individuals m^{-3}; Fig. 2).

During summer, this pattern was reversed. Zooplankton biomass and abundance were lowest at northern and western stations (Paphos and Pomos: 0.8 – 1.3 mg DW m^{-3} and 211 – 267 individuals m^{-3}), and were higher at southern stations (Agia Napa, Larnaca, Limassol: 1.8 – 2.2 mg DW m^{-3} and 421 – 497 individuals m^{-3}; Fig. 2).

The taxa composition was dominated by copepods, which comprised approximately 80% of the total zooplankton (Fig. 3). These copepods were primarily small individuals from the Families Clausocalanidae, Paracalanidae, Oithonidae, and Oncaeidae.

Other taxa contributed to zooplankton communities around the island of Cyprus (Fig. 3). Significant seasonal patterns were noted for some groups. Cyclopoid copepods were a larger component of the total zooplankton community in summer (24 – 44%) as compared to winter (13 – 26%). Cladocerans were never observed in samples collected around Cyprus in winter, but were an important component of the total zooplankton in summer (0.8 – 16% of the populations).

In terms of spatial variability, appendicularians were observed to contribute significantly to zooplankton populations at southern stations (Agia Napa, Limassol, Larnaca: 32 – 53 individuals m-3), but were less important at northern stations (Pomos, Paphos: 3 – 5 individuals m-3) during all seasons.

To link Cyprus environmental conditions with zooplankton populations measured in EMEDZOO, zooplankton biomass and abundance was correlated with satellite-measured SST and SSChl from the NASA GIOVANNI web application for Ocean Color Radiometry Online Visualization and Analysis (Fig. 4.). Significant correlations were found between zooplankton biomass and satellite-based environmental indicators.
At high SST, zooplankton biomass decreased (Kendall's tau b = -0.61, p = 0.02). Zooplankton biomass was also positively correlated with SSChl (Kendall's tau b = 0.56, p = 0.04), thus was higher when more phytoplankton food resources were available.

Zooplankton biomass and abundance in Cyprus waters were most similar to values found at oligotrophic coastal or offshore locations in the Eastern Mediterranean, for example off the coast of Rhodes and in the southern Aegean Sea.
Zooplankton numbers were higher in inshore waters of the Eastern Mediterranean, for example in Saronikos Bay in Greece, and populations were also greater in the Northeastern Aegean Sea under the influence of the Dardanelles Strait.

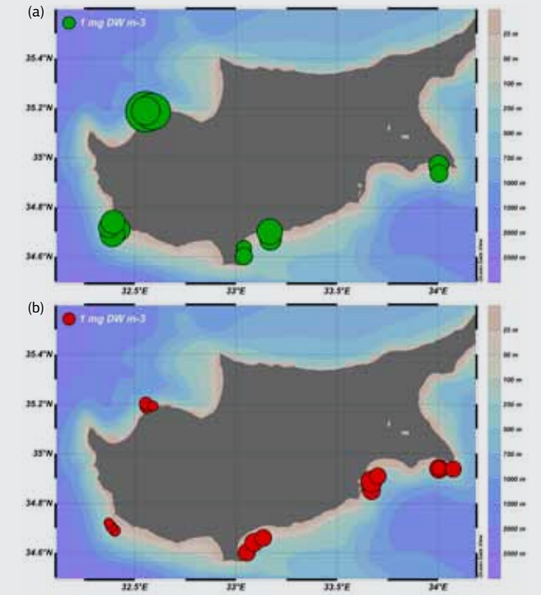

Figure 2: Zooplankton biomass from different locations around Cyprus:
(a) March 2010, (b) September 2010.

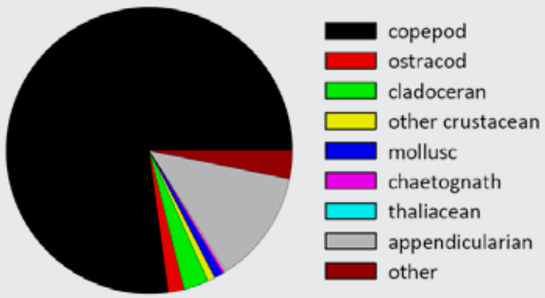

Figure 3: Taxa composition of zooplankton collected off of Limassol in September 2010.