

CORAL MASS MORTALITY ASSOCIATED TO SEAWATER TEMPERATURE ANOMALIES IN THE LEVANTINE (CYPRUS) AND ADRIATIC (CROATIA) SEAS

C. Jimenez ^{1*}, A. Petrou ², I. Cvitkovic ³, M. Despalatovic ³, M. Evriviadou ¹, L. Hadjioanou ² and M. A. Lange ¹

¹ Energy, Environment, Water Research Centre (EEWRC), The Cyprus Institute, P.O. Box 2121, 1645 Cyprus. - c.jimenez@cyi.ac.cy

² Enalia Physis Environmental Research Centre (EPEC), Acropoleos 2, Aglantzia 2101, P.O. Box 26728, 1647 Cyprus.

³ Institute of Oceanography and Fisheries, Šet. I. Meštrovica 63, 21000 Split, Croatia.

Abstract

Marine ecosystems are experiencing rapid changes due to natural and anthropogenic disturbances. If proper management strategies are to be enforced, these changes on the structure and functioning of the ecosystems need to be documented. In this paper, we describe coral mortality events along the coast of Cyprus and Croatia, including sites with intense land-based human activities (e.g. agriculture). Two recent mass mortality events (2010, 2012) seem to have been induced by prolonged seawater temperature increases during a period of several weeks. Using image-analysis software, *Cladocora caespitosa* colonies were evaluated (% affected area). At nutrient-affected sites, macroalgae and filter feeder organisms compete with corals for space, resulting in higher partial-tissue mortality (>90%) exacerbating thus the effects of the warming event.

Keywords: Cnidaria, Levantine Basin, North Adriatic Sea, Mortality, Temperature

Introduction

The island of Cyprus, located in the high-oligotrophic region of the eastern Mediterranean, provides an appealing ground for the study of coastal ecosystems under limiting and contrasting environmental conditions. Such comparative ecological studies are valuable since responses to disturbances from the same habitat/species can be investigated in relation to the local environment. If proper management strategies are to be enforced, the changes on the structure and functioning of marine ecosystems in response to natural and anthropogenic disturbances need to be considered. In this paper, we describe the 2012 coral mortality event along the coast of Cyprus and compare it to a similar event in Croatia, including selected sites where land-based human activities are likely to have a direct impact on coral habitats.

Material and methods

Using image-analysis software, *Cladocora caespitosa* colonies were evaluated by calculating and comparing the area-percentage of healthy tissue, affected tissue (bleached and freshly necrotic) and bare skeleton (recent, old mortality). The photographic record was acquired during and one to two months after the warming event through systematic diving transects at the eastern coast of Cyprus (two localities, 2-6m depth) and in Croatia (Ciovo Island, depth ranges 5-10m, 10-15m, 15-20m).

Results

On average, *C. caespitosa* colonies in Cyprus (Fig. 1A) had less than 15% of pigmented tissue, almost 20% of the colony area affected (bleaching and/or incipient necrosis) and around 15% with recent partial mortality associated to the 2012 warming event. One locality (Krio Nero) had a higher percentage of old mortality ($p < 0.001$) which can be related to the 2010 warming event. Macroalgae covered significant areas of the coral colonies in Cyprus (30-40%). At the Croatian island of Ciovo (Fig. 1B), corals in general were less affected and had more pigmented areas than in Cyprus. However, the few sampled shallow water colonies in Croatia had the highest percentages (over 40%, $p < 0.05$) of affected tissue.

Discussion and conclusions

The 2012 event seems to have been induced by prolonged seawater temperature increases during a period of several weeks in Summer (in August and September), representing the highest warming event of the last 30 years in Cyprus. Seawater temperature in the Levantine basin in general, has increased during the Summer months since at least the '90s [1]. At the nutrient-affected sites, macroalgae and other filter feeder organisms compete with corals for space, resulting in higher partial tissue mortality. Despite this fact, coral colonies are more abundant in those sites, which might be explained by the anthropogenic change of naturally limiting conditions (oligotrophy) of Cypriot waters and the physiology of the particular coral species (auto- vs. heterotrophy). Our results suggest that corals under artificially induced conditions (more commonly found elsewhere in the Mediterranean) respond to environmental disturbances impaired by the macroalgae-dominated community.

Monitoring of the coral colonies and the water quality at the studied sites will continue on a seasonal basis, in order to better understand these altered ecosystems and to contribute to the definition of management strategies.

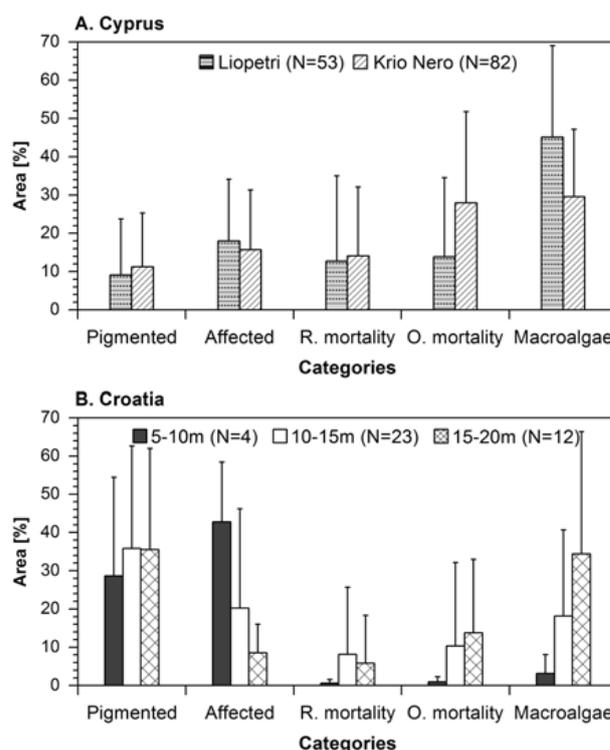


Fig. 1. Mean area-percentage (+1 SD) of tissue condition of *Cladocora caespitosa* colonies and macroalgae at two study sites in eastern Cyprus (A) and at three different depths in Ciovo Island, Croatia (B). Tissue mortality categorized as recent (R) and old (O). N= number of colonies.

References

1 - Samuel-Rhoads Y., Iona S., Zodiatis G., Stylianou S., Hayes D. and Georgiou G., 2010. Sea surface temperature and salinity rise in the Levantine Basin. Rapp. Comm. Int. Mer Médit. 39:177.