CLADOCORA CAESPITOSA CORALS IMPACTED BY EXTREME WINDSTORM GENERATED SWELLS, IN CYPRUS

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Abstract
Cladocora caespitosa, the emblematic endemic coral species of the Mediterranean has been shown to suffer from mortality events, due to temperature rising, for the last two decades. Recent monitoring work on a coral population in the island of Cyprus has identified yet another threat. In January 2015, an unusually strong wind-storm hit the southeast coast of Cyprus, with higher-than-normal wind speeds. The storm generated swells, which caused precarious boulders to drop off cliffs in an area abundant with *C. caespitosa* colonies. As a result, ~7% of the colonies in the area were affected, the first documented impact of an extreme event on *C. caespitosa*.

Keywords: Wind, Cyprus Basin, Erosion, Infralittoral, Cnidaria

Introduction
Cladocora caespitosa is the only endemic colonial zooxanthellate scleractinian coral species in the Mediterranean known to be able to form extensive banks. Highly susceptible to sea-surface temperature increases it has undergone a number of mortality events, in various areas in the Mediterranean, in the last 15 years [1,2]. In contrast to colonies found in the West and Central Mediterranean, colonies of *C. caespitosa* in Cyprus are almost always found at depths shallower than 5m, typically near the coastline. This makes them unequivocally vulnerable to coastal disturbances, such as erosion and sedimentation, which could be results of extreme climatic events and human activities. Effects of extreme events on coral reefs have been documented well in the tropics, but very little is known about the impact of extreme events on rocky benthic communities in the Mediterranean [3].

Methods
"Kryo Nero" field-site (SE Cyprus), holds a population of ~150 colonies within an area of ~100 m^2. Colonies (N=70) permanently tagged are being monitored on a monthly basis, since January 2014, with the use of photographic material. The extent of damage on the colonies was calculated with the use of Photoquad image analysis software. Boulder measurements taken in situ (length, width, height) were used to calculate their weight. Observed winds, from nearby meteorological stations (Meteorological Service of Cyprus), showed speeds fluctuating from 3 to 22 m s^{-1}, over a period of 72 hours (4-6 January, 2015). Operational forecasts (Oceanography Center, University of Cyprus WAM4 wave model) indicated unusually high waves of up to 4.4 m during the storm.

Results
Five (out of 70) of the tagged colonies showed obvious signs of mechanical damage from the storm (Fig. 1). Impacted colonies suffered reductions in live polyps ranging between 10 to 100 per cent. A substantial amount of boulders of various volumes were observed scattered around the locality, with large boulders found lying next to the damaged colonies. Empty sockets in the cliff formations directly above the coral communities indicated their detachment from the vertical walls, presumably by the force of the wind-generated waves from the storm (Wind speed vs Wave height; R^2=0,87, p<0,01). Erratic boulders (N=10) measured in the locality were estimated to vary in volume (MIN: 0,007 m^3, MAX: 0,942 m^3) and weight (MIN: 1 kg, MAX: 1900 kg).

Discussion and Conclusions
Coral communities in Cyprus, recently documented and monitored, are scarce. The naturally oligotrophic and warm waters surrounding the island form an inhospitable environment to sensitive organisms such as corals, yet still hold viable communities of the endemic *C. caespitosa*. Nonetheless, the extreme event of January 2015 had a serious impact on ~7% of the coral population at the monitored site. The storm indisputably left the colonies vulnerable to various potential after-effects, such as succession by macroalgae, exposure to bacterial infections and corallivory, hence the extent of damage could ultimately be much higher. Lack of long-term monitoring data in the Levantine Sea necessitates the need to study the ecological effects of extreme climatic events, which are largely expected to increase in severity on a global scale. Continuous monitoring is expected to identify the extent of the after-effect of the extreme event on the colonies.

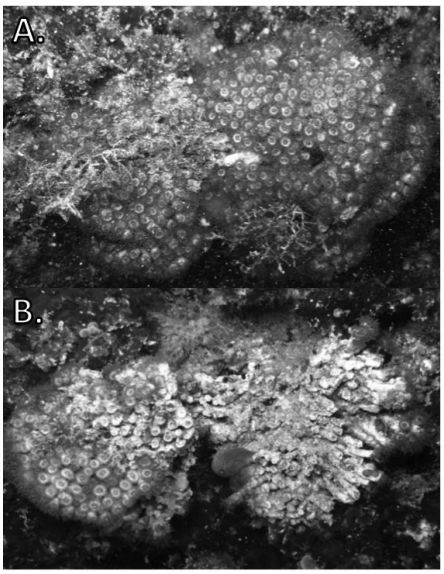

Fig. 1. *C. caespitosa* colony before (A) and after (B) the storm.

References
1 - Rodolfo-Metalpa R., Bianchi C.N., Peirano A., Morri C. 2005. Tissue necrosis and mortality of the temperate coral Cladocora caespitosa. Ital J Zool (Modena) 72:271–276. doi:10.1080/ 11250000509356685
2 - Jiménez C., Hadjioannou L., Petrou A., Nikolaidis A., Evriviadou M. & Lange M. 2014. Mortality of the scleractinian coral *Cladocora caespitosa* during a warming event in the Levantine Sea (Cyprus). *Regional Environmental Change*, doi: 10.1007/s10113-014-0729-2. pp. 1-11.
3 - Teixido´ N., Casas E., Cebria´n E., Linares C., Garrabou J. 2013. Impacts on Coralligenous Outcrop Biodiversity of a Dramatic Coastal Storm. PLoS ONE 8(1): e53742. doi:10.1371/journal.pone.0053742