DEPTH DISTRIBUTION OF *CIDARIS CIDARIS* (LINNAEUS, 1758) AND *STYLOCIDARIS AFFINIS* (PHILIPPI, 1845) (ECHINODERMATA, ECHINOIDEA) AROUND THE MALTESE ISLANDS.

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Abstract
The sea urchins *Stylocidaris affinis* and *Cidaris cidaris* (family Cidaridae) are abundant on circalittoral and deeper bottoms off the Maltese Islands. Different authors quote different depth ranges for the two species. The depth distribution in Maltese waters was studied based on material from MEDITS surveys. *S. affinis* was found at depths of 50-550m with the highest relative abundance between 50m and 150m, predominantly on maerl or coarse sedimentary substrata. *C. cidaris* was found from ca. 50m to depths greater than 550m, mostly on sandy-mud.

Keywords: Deep sea ecology, Deep waters, Echinodermata, Sicily Channel

Introduction
Stylocidaris affinis and *Cidaris cidaris* are the most common sea urchins on circalittoral and deeper sedimentary bottoms around the Maltese islands. There is general agreement between authors that these species have different but overlapping bathymetric ranges; *S. affinis* is more commonly found in shallower waters than *C. cidaris*, which has a wider depth range. However, different authors give different depth ranges. For example, Tortonese [1] gives a bathymetrical range of 30-1000m and 50-2000m for *S. affinis* and *C. cidaris* respectively, while correspondingly, Koehler [2] gives 30-150m and 50-400m, and Koukouras *et al.* [3] give 5-180m and 20-250m.

Material and Methods
Samples were collected in 2009, 2010 and 2011 using the MEDITS trawling gear [4] during MEDITS (Mediterranean International Trawl Survey) surveys carried out in the General Fisheries Commission for the Mediterranean's Geographical Sub-Area 15, which includes the Malta 25 nautical mile Fisheries Management Zone. Cidarids were sorted from the by-catch, preserved and transferred to the laboratory where they were identified and counted. Although the two species differ in coloration (normally, *S. affinis* has a reddish coloration and *C. cidaris* is greenish), each individual was identified on the basis of the structure of the large globiferous pedicellariae, which have well defined terminal teeth in *C. cidaris*, but which lack terminal teeth in *S. affinis* [5]. Abundance was standardised to N^o/km^2 of seabed trawled. The grain-size distribution of sediment collected by grab from each station was determined using standard granulometric analysis and sediments were classified following the Udden-Wentworth scale.

Results
The samples from stations in the 51m to 200m depth range had a more or less similar abundance of *C. cidaris* and *S. affinis*, however the relative abundance of *C. cidaris* increased in the deeper stations (Figure 1).

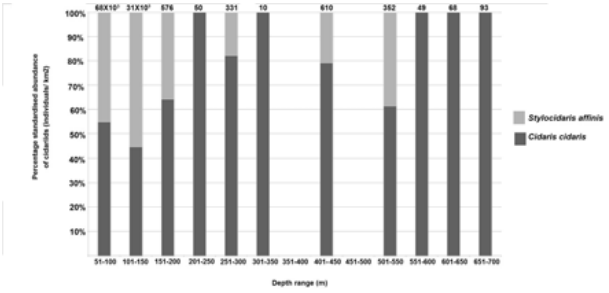

Fig. 1. Stacked bar graph showing the relative abundance of cidarids at different depth ranges around the Maltese Islands, based on MEDITS samples. The figures above each bar are the total number of individuals collected per km^2 from that depth range. No samples were collected from the 351-400m and 451-500m ranges.

Granulometric analysis showed that stations >100m in depth all had sandy-mud bottoms, while stations <100m in depth had bottoms of gravelly sandy-mud, most of which were maerl habitat.

Discussion
In Maltese waters, the two cidarids have a considerable bathymetric distribution, extending from ca. 50m to ca. 700m. At the shallower end (50m - 200m), there is total overlap in distribution with all stations having relative abundances of 45 - 65% and 35 - 55% for *C. cidaris* and *S. affinis*, respectively. The highest relative abundance of *S. affinis* recorded was 55% from the 101-150m range, which suggests an affinity of *S. affinis* for upper circalittoral depths where the bottom is predominantly maerl, or gravelly sandy-mud with rhodoliths. The relative abundance of *S. affinis* with respect to *C. cidaris* decreases with depth such that between 251m and 550m the abundance of *S. affinis* ranges from 17% to 39%. Only *C. cidaris* was present at depths greater than 550m where the bottom is muddy, implying an affinity of *C.cidaris* for fine sediment in the lower circalittoral and upper bathyal.

All the shallower stations where *C. cidaris* was the sole cidarid (200-250m and 300-350m) had fine sediment bottoms. Conversely, where *S. affinis* occurred at large depths (400-450m and 500-550m) the surficial sediment was relatively coarse due to large quantities of empty molluscan shells and shell fragments. This shows that the distribution of the two cidarids is not determined by depth alone, but that the nature of the bottom may be more important. Both species co-occur on rhodolith bottoms at the shallow end of their bathymetric range, however, *S. affinis* can only occur in deep water if there are coarse inclusions, such as shell fragments, in the sediment.

Where both species co-occur, it is crucial to identify each individual on morphological characters, since coloration alone is not diagnostic (some *C. cidaris* individuals in the present study had an orange colour whereas some *S. affinis* had a reticulated coloration rather than the normal overall reddish coloration). Misidentification may be one of the reasons contributing to the variance in depth records of the two species in the literature.

Acknowledgements
This project is part of an ongoing collaboration between the Marine Ecology Research Group of the Department of Biology of the University of Malta and the Fisheries Control Directorate at the Agriculture and Fisheries Regulation Department, Government of Malta. We acknowledge the kindness of the staff of both institutions for their assistance during the course of the project.

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