DEMERSAL ASSEMBLAGES ON DEEP WATER TRAWLING GROUNDS OFF THE MALTESE ISLANDS: MANAGEMENT IMPLICATIONS

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Abstract
Data from three consecutive years of trawl surveys were used to characterise the demersal assemblages present on trawling grounds around the Maltese Islands, (Central Mediterranean) in water ranging from 85 to 800 m depth. Five different assemblages were present which seemed related to depth zones that do not coincide with those sampled in existing stock assessment programmes. It is therefore clear that the depth strata sampled in such programmes need to be revised to make them more biologically relevant and to achieve a better sampling representation of each assemblage type.
Keywords : Demersal, Deep Waters, Fisheries, Stock Assessment, Trawl Surveys.

Introduction
The modern trend in the management of fish stocks is 'ecosystem-based fisheries management', where fish stocks are no longer considered in isolation but as one component of an integrated ecosystem [1]. In turn, such an approach requires a good knowledge of the constituents of the system. Bottom trawling is an important component of many Mediterranean fisheries, being responsible for a high share of total catches and, in many cases, yielding the highest earnings among all the fishing sub-sectors. In the Mediterranean, bottoms are trawled for commercial fishing at depths ranging from 50 to 800 m [2]. We studied the spatial distribution of demersal resources on muddy bottoms in the depth range from 80 to 800 m within the General Fisheries Commission for the Mediterranean (GFCM) geographical sub-unit 15, and assessed management implications of our results.

Methods
Samples were collected from trawling grounds off the Maltese islands within the GFCM geographical sub-unit 15 as part of the ongoing MEDITS trawl survey programme. Otter trawl samples were collected in June-July of 2003, 2004 and 2005 from 45 stations located at different depths between 80 and 800 m. Each haul lasted for ca 45 minutes, depending on the depth and substratum type, and trawl speed was ca 3 knots; the gear used was IFREMER GOC 73 [3] and consisted of a 40 m long and 22 m wide trawl net with a 1-2 m vertical opening and a cod end stretched mesh size of 20 mm. The entire faunal component from each haul was sorted, identified, weighed and counted. The data for each station were standardised per square kilometre, and were analysed using classification and ordination techniques. Species whose percentage biomass was less than 0.01% were removed from these analyses. Agglomerative hierarchical clustering followed by non-metric multidimensional scaling (nMDS) ordination was then applied on a similarity matrix constructed from the fourth-root transformed data using the Bray-Curtis similarity measure, using the PRIMER 6 software [4]. Since the biomass data yielded more detailed and clearer results than abundance data, the former is presented in this paper.

Results and discussion
A total of 552,963 live individuals (22,887 kg) comprising 189 different species (26 elasmobranchs, 111 teleosts, 26 decapods and 26 molluscs) were identified, of which teleosts were the largest component in terms of both abundance and biomass.Cluster analysis and nMDS ordination of the species biomass data resulted in five main clusters at a similarity of 46% (Fig.1). These clusters correspond to two sets of outer continental shelf stations, those from the continental shelf slope (140 - 273 m), those from the shelf break (240 - 440 m) and those from the deep slope (466 - 701 m) stations.
In general, the difference in assemblage structure increases with depth, with the transition from one assemblage to the next being more gradual at shallower depths and sharper as the depth increases. The differences between the continental shelf assemblages (Outer shelf A, Outer shelf B, Shelf break) were mainly quantitative, but were both quantitative and qualitative between the outer and shelf break assemblages and the upper slope assemblages, and between the upper slope assemblages and those of the deep slope.

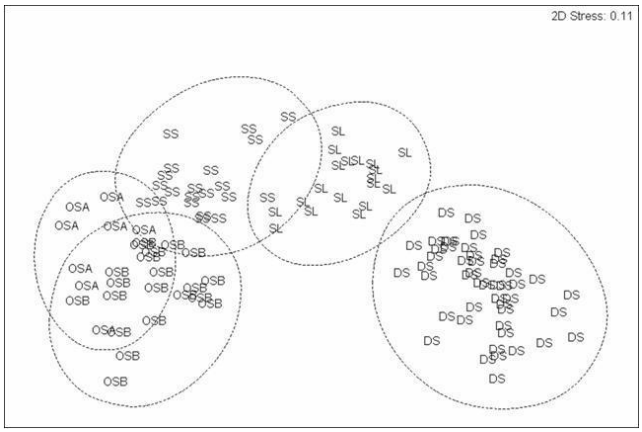

Fig. 1. Non-metric multidimensional scaling (nMDS) plot for the sampling stations for all the three years, based on biomass. The ovals enclose the groups generated by cluster analysis. OSA - Outer shelf A; OSB - Outer shelf B; SS - Shelf break; SL - Shallow slope; DS - Deep slope.

Based on these results the fishery resources of Maltese trawling grounds are stratified in four main depth ranges: 80-160 m (outer continental shelf: two subgroups), 160-270 m (shelf break), 270-440 m (upper slope), and 440-800 m (deep slope). These strata do not coincide with those sampled in existing stock assessment programmes, which were set up without reference to benthic/demersal assemblage structure and its relation to depth. It is therefore clear that the depth strata sampled in such programmes need revision to make them more biologically relevant and in order to have a better sampling representation of each assemblage type. There would be substantial benefit in further regional analyses of assemblage structure to detect the impact of various fishing practices on the benthic/demersal assemblages both spatially and temporally, and if any changes found are related to the spatial and temporal effort of the fishing fleet.

References

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