NOT TO BE CITED WITHOUT PRIOR
REFERENCE TO THE AUTHOR(S)

Northwest Atlantic Fisheries Organization

Serial No. N4528 **NAFO SCR Doc. 01/133**

SCIENTIFIC COUNCIL MEETING – SEPTEMBER 2001
(Deep-sea Fisheries Symposium – Poster)

Spatio-temporal Patterns in a Demersal Fish Assemblage of the Ionian Sea (Eastern Mediterranean)

by

T. Madurell[1] and J.E. Cartes[2]

[1]National Centre for Marine Research, Institute of Marine Biological Resources. Hellinikon, 16604 Athens, Greece
e-mail: tmadurel@ncmr.gr
[2]Institut de Ciències del Mar (C.S.I.C.). Psg. Marítim de la Barceloneta 37-49, 08003 Barcelona, Spain
e-mail: jcartes@cmima.csic.es

Abstract

The present results form part of a study that is being carried out in the Ionian Sea at depths ranging from 470 to 610 m. This is an unexploited area until now, where perspectives of deep-sea crustacean fisheries (i.e. *Aristeus antennatus* and *Aristaeomorpha foliacea*) might be develop. In order to understand the fishing impact and the carrying capacity of fragile ecosystems such as deep-waters, it is important to know the spatio-temporal biomass distribution, and the energetic requirements (food, feeding ecology and daily rations) of the demersal communities. Here, we present first data on the analysis of the demersal fish community in the Ionian Sea. Fish were collected in a total of four 24-h day-night sampling cycles covering the four annual seasons (April 1999; August 1999; November 1999; February 2000). A total of 8136 specimens included in 27 species were collected in 29 hauls performed, being the dominant species *Nezumia sclerorhynchus*, *Hoplostethus mediterraneus*, *Hymenocephalus italicus*, *Chlorophthalmus agassizi Helicolenus dactylopterus Phycis blennoides* and *Coelorhynchus coelorhynchus* (accumulated abundance 84.63 %). Species abundance and biomass are processed according to multivariate techniques (Clustering and MDS) in order to identify possible general trends with the distribution of the fish fauna. Season was the main identified factor influencing the fish distribution with higher abundance in February and August (ANOVA df=28; p<0.01), while no differences were found with depth. Also in August abundance was higher in daytime (Mann-Whitney p< 0.05). The study of fish movements along the slope is important to establish for a posterior reliable determination of daily rations and food dynamics.

Introduction

The Eastern Ionian Sea is an unexploited area until now, where perspectives of deep-sea crustacean fisheries (i.e. *Aristeus antennatus* and *Aristaeomorpha foliacea*) might be develop. In order to understand the fishing impact and the carrying capacity of fragile ecosystems such as deep-waters, it is important to know the spatio-temporal biomass distribution, and the energetic requirements (food, feeding ecology and daily rations) of the demersal communities. Here, we present first data on the analysis of the demersal fish community in the Ionian Sea. The study of fish movements along the slope is important to establish for a posterior reliable determination of daily rations and food dynamics.

OBJECTIVES

1) To describe the structure of the demersal fish assemblage in the upper-middle slope of the Eastern Ionian Sea
2) To establish the dominant pattern (e.g. season, diel cycle) in the abundance and species composition of fish in the Ionian Sea

Materials and Methods

Trawl data and sampling

- samples were taken during four seasonal cruises in April 99, July-August 99, November 99 and February 2000
- the investigation area was the Eastern Ionian Sea (Figure1)
- all surveys were carried out on a hired commercial vessel. Sampling gear was a common otter trawl (twin wrap trawling) used by fishermen in Greek waters. Cod end mesh size of 14 mm; towing speed was 2.5 knots; duration of each haul was approximately 60 min
- 29 hauls were performed over a 24h cycle (8 hauls per season except in November due to bad weather conditions). Fishing depth ranged from 473 to 613 m

Data analysis

- catch values (abundance and biomass) were standardised to 1 hour tow
- species abundance and biomass were processed according to multivariate techniques (Field et al, 1982). Data were previously transformed by log (x+1) to linearize data, minimizing the effects of very abundant or very large species
- cluster analysis was performed using the 1-Pearsons r metric distance since data was standardized and the aggregation algorithm was the unweighted pair-group average (UPMGA)
- a Multidimensional scaling (MDS) was carried out to explain observed similarities or dissimilarities between the groups resulting from the similarity matrix generated by cluster analysis
- three-way analysis of variance (MANOVA) was used to test whether there were or not differences in the mean values of the abundance and biomass between seasons, diel periodicity and depth groups
- Mann-Whitney test for pairs comparisons was applied for day-night data on abundance and biomass for each season

Results

Spatio-temporal changes in the abundance and composition of fish assemblages

- a total of 8136 specimens included in 27 species were collected in 29 hauls performed
- season was the main identified factor influencing the fish distribution (Table 1) with higher abundance and biomass in February and August (Figure 2a, 2b)
- total abundance also differed significantly between day and night (Table 1). Densities of fish were much lower at night during August 99 and February 2000 (Figure 2c)
- in biomass there was a significant two-way interaction between season and depth (Table 1). The significant depth and season interaction was mainly due to the fact that in contrast to the other seasons and depths, the biomass in April was very low (Figure 2b, 2d), especially in the shallow station. When data from April was excluded from the analysis, there was not a season by depth interaction effect
- comparing medians by Mann-Whitney test applied to day-night, season and depth, significant differences in abundance and biomass between day and night were found only in August ($p<0.05$). In April significant differences in biomass with depth were found ($p<0.05$)

Changes in the taxonomic composition

- stations were classified into four groups corresponding to the four seasons (Figure 3). Further sub-divisions in February seemed to be mainly due to some depth variations in the catches
- MDS analysis (Figure 4) showed similar results with that obtained by cluster analysis concerning seasonality (stress 0.19). The second axis seems related to some daily pattern in the distribution of species
- *Hoplostethus mediterraneus* and *Helicolenus dactylopterus* were dominant species in terms of abundance and biomass in all seasons though *H. mediterraneus* was more abundant during summer and autumn. The macrourids *Nezumia sclerorhinchus*, and *Hymenocephalus italicus* were also dominant species in nearly all seasons (except in autumn) in terms of abundance while *Etmopterus spinax* and *Phycis blennoides* also made up an important contribution in nearly all seasons in terms of both abundance and biomass (Table 2)

- the rest of species were abundant only at concrete seasons. Thus, *Lepidorhombus boscii* and *Coelorhynchus coelorhynchus* were important in August and in November whilst *Chloroephthalmus agassizi* presented highest densities in August and in February. The three species were scarce in April (Table 2)

Conclusions

- dominant demersal fish species found on the upper-middle slope in the Ionian Sea: *Nezumia sclerorhynchus, Hymenocephalus italicus Hoplostethus mediterraneus, Helicolenus dactylopterus, Chloroepthalmus agassizi, Etmopterus spinax and Phycis blennoides*.
- season was the main identified factor influencing fish distribution, with maximum densities and biomass of fish observed during summer (August 1999) and winter (February 2001)
- changes might be related to:

  1) reproductive biology (life history) of species, which may show spawning peaks, and movements to spawn, in concrete periods
  2) food availability as has been suggested for decapod shrimps (e.g. *Aristeus antennatus*, Pandalidae) mainly related to zooplankton (e.g. euphausiids) fluctuations in the western Mediterranean (Cartes, 1993; 1994)
  3) changes over a single depth station may be attributable to upward/downward movements along the slope (to reproduce or to feed)

Future research

The 3 possible causes of the temporal changes observed will be related to:

1) the obtained pattern to some basic environmental parameters (surface temperature, PP, food resources available) probably among the explanatory variables of this pattern
2) the size distribution between day-night cycles and seasons for dominant fish species

References

Field J.G., K.R. Clarke, and R.M. Warwick. 1982. A Practical strategy for analysing multispecies distribution patterns. Mar. Ecol. Prog. Ser., **8**: 37-52

Cartes J.E. 1993. Diets of deep-water pandalid shrimps on the Western Mediterranean slope. Mar. Ecol. Prog. Ser., **96 (1)**: 49-61

Cartes J.E. 1994. Influence of depth and season on the diet of the deep-water aristeid *Aristeus antennatus* along the continental slope (400 to 2300 m) in the Catalan Sea (western Mediterranean). Mar. Biol., **120 (4)**: 639-648

Acknowledgments

This work was funded by the EU, under the FAIR-GT-1376 contract. Thanks are due to Dr. M. Labropoulou for her comments and suggestions.

Table 1. Three-way ANOVA of abundance and biomass of fishes caught in the upper slope of the Eastern Ionian Sea. (* P<0.05; ns= no significant).

Factor	Abundance	Biomass
Season	*	*
Diel	*	ns
Depth	ns	ns
Season-Diel	ns	*
Season-Depth	ns	ns
Diel-Depth	ns	ns
Season-Diel-Depth	ns	ns

* P<0.05

ns no significant

Table 2. Seasonal abundance and biomass of dominant species that account for more than 5% to the total cacht.

	Abundance				Biomass			
Species name	April	August	November	February	April	August	November	February
Chimaera monstrosa					*	*	*	
Chlorophthalmus agassizi		***		*		*		*
Coelorhynchus coelorhynchus		*	*	*				
Conger conger					***			*
Etmopterus spinax	**		**		*		***	*
Galeus melastomus					*			*
Helicolenus dactylopterus	**	*	*	*	****	****	***	****
Hoplostethus mediterraneus	*	****	****	*	*	****	***	***
Hymenocephalus italicus	**	***		****				
Lepidorhombus boscii			*			*	*	
Nezumia sclerorhynchus	****	***	*	****	*			*
Phycis blennoides			**	*		*	**	*

(**** > 20% of total catch, *** 15-20%, ** 10-15%, * 5-10%)

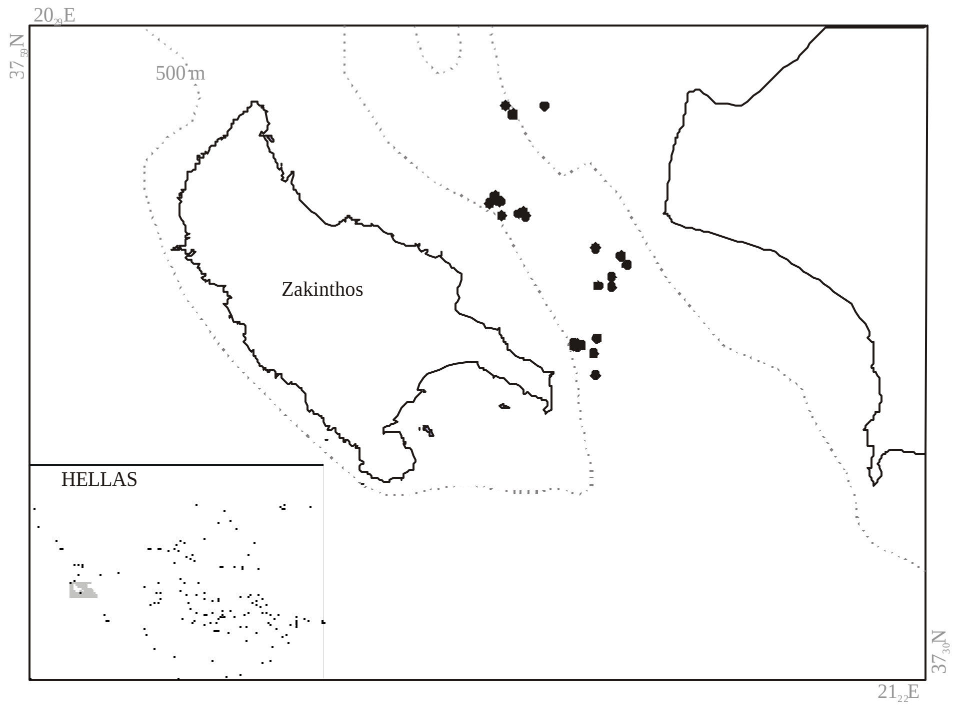

Fig. 1. Sampling area with location of the 29 trawl samples collected on the upper slope of the Eastern Ionian Sea. 500 m depth contour is shown.

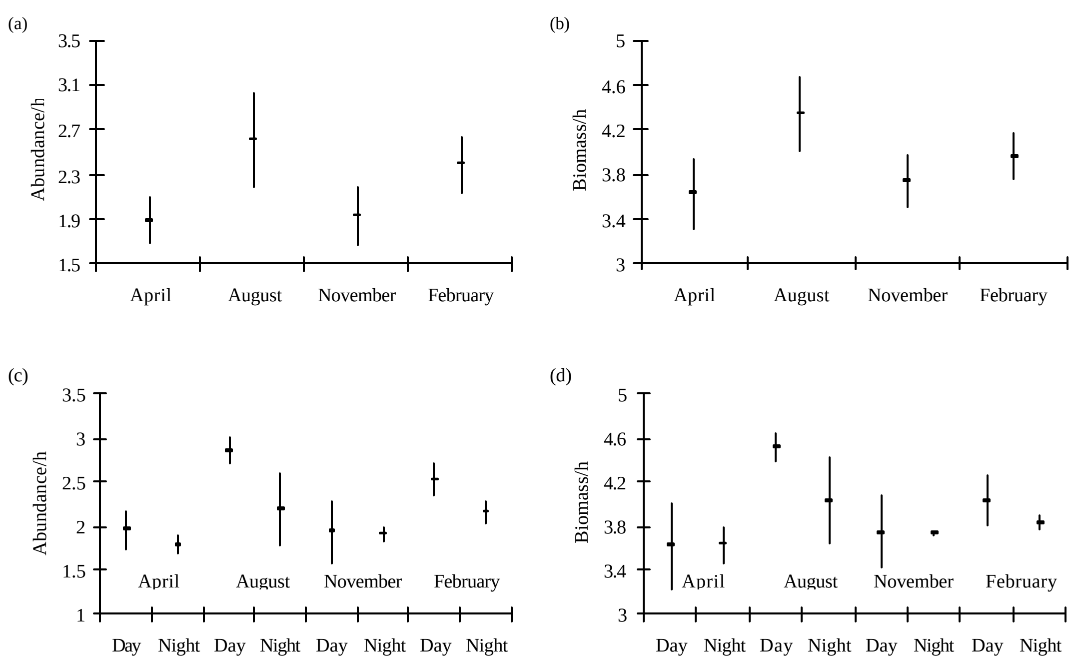

Fig. 2. Mean abundance and biomass (±SD) for fish on the upper slope of the Eastern Ionian Sea (a) mean abundance by season; (b) mean biomass by season; (c) mean abundance by season and day-night periodicity and (d) mean biomass by seasons and day-night periodicity.

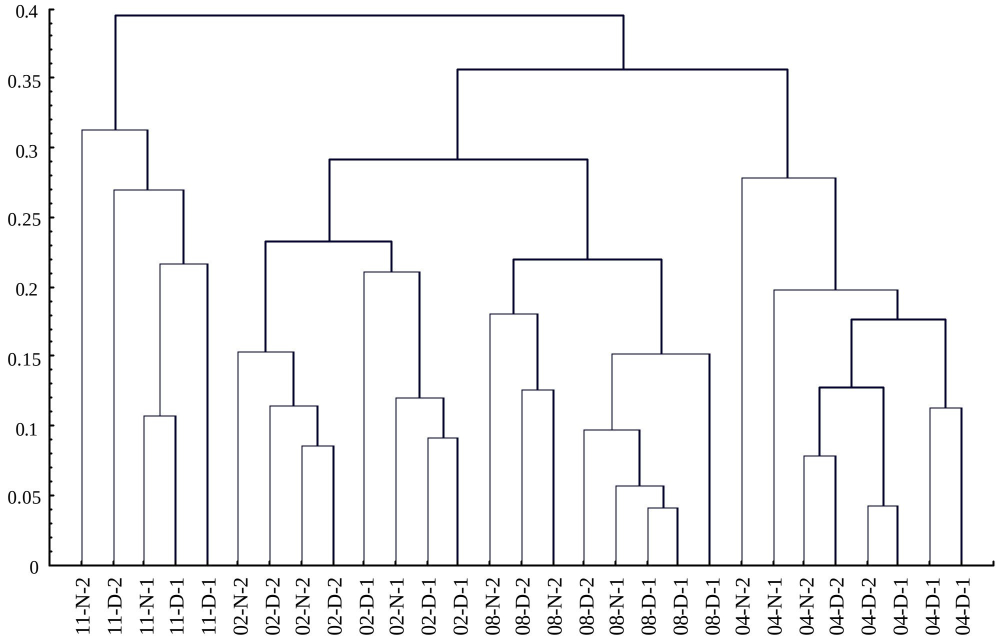

Fig. 3. Classification of sampling stations based on species abundance. 04 (April 99); 08 (August 99); 11 (November 99); 02 (February 2000); D (day); N (night); 1 (shallow); 2 (deep)

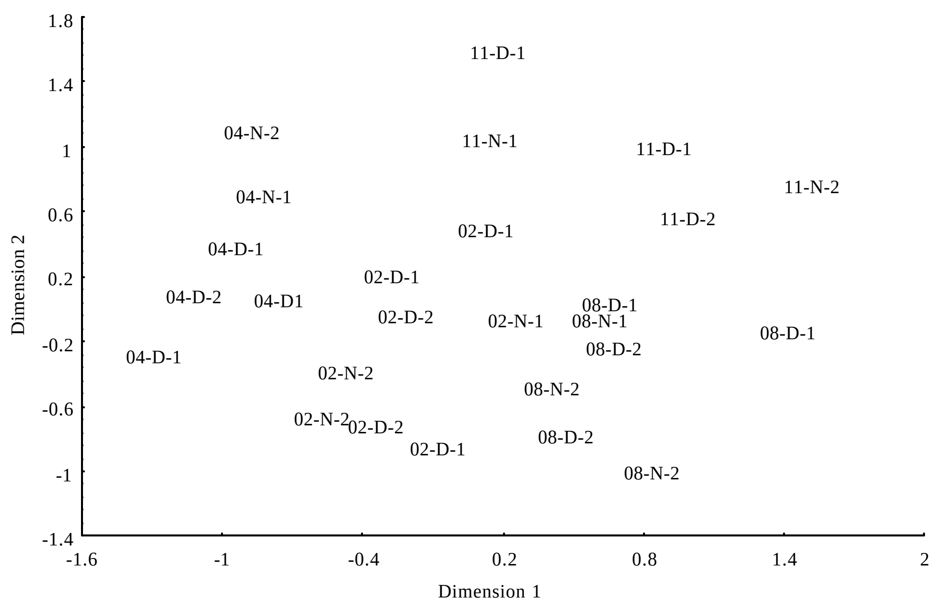

Fig. 4. Ordination (MDS) of sampling stations based on species abundance. 04 (April 99); 08 (August 99); 11 (November 99); 02 (February 2000); D (day); N (night); 1 (shallow); 2 (deep)