DISTRIBUTION OF DEMERSAL FISHES IN THE NORTH AEGEAN SEA, GREECE

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Abstract
The summer demersal fish density was assessed at 64 stations in the northern Aegean Sea sampled using a bottom trawl (1996-2001). Five high density regions were observed with the biomass density presenting a north/south and an inshore/offshore gradient. The biomass variability was explained by the mixing of the prevailing water masses, the water circulation of the northern Aegean Sea and the upwelling systems.
Keywords : Aegean Sea, Demersal, Fishes, Crustacea.

Introduction
The northern Aegean Sea is an area of complex bathymetry with an extended continental shelf. Although the landings are dominated by small pelagic fish, some demersal fish species (e.g. the European hake, *Merluccius merluccius*) constitute a significant part of the commercial catch in the area. The overall biomass of demersal fishes in the northern Aegean Sea has never been evaluated. The aim of the present work is to assess the demersal fish distribution and their biomass in the northern Aegean Sea and to explain the parameters that may are responsible for such variability.

Materials and methods
The summer fish species density was calculated using the swept area method based on data from 64 stations of the northern Aegean Sea. Sampling was performed using a bottom trawl during the Mediterranean International Trawling Survey (MEDITS) program between 1996 and 2001 [1]. The duration of each haul was 30 or 60 min, depending on the sampling depth and the vessel speed was kept constant during hauling (at 3 knots). The gear used was the same for each haul (GOC 73) with a codend stretched mesh size of 20 mm and a vertical mouth opening of about 2 m. The swept area method is based on the analogy between the sampled area (estimated by the trawl opening, the speed and the duration of each haul) and the entire stock area [2]. The fish density was estimated by simply dividing the weight (kg) of fish caught in each haul by the sampled area (km^2). No error estimates are available for these calculations.
Sea surface and bottom temperatures (°C) were recorded *in situ*. MapInfo Professional 8.0 was used to show the fish biomass in the area and principal component analysis (PCA) to determine the factors (sea surface and bottom temperature, depth, longitude, latitude, cephalopod and crustacean biomass) that better explained the fish distribution variability.

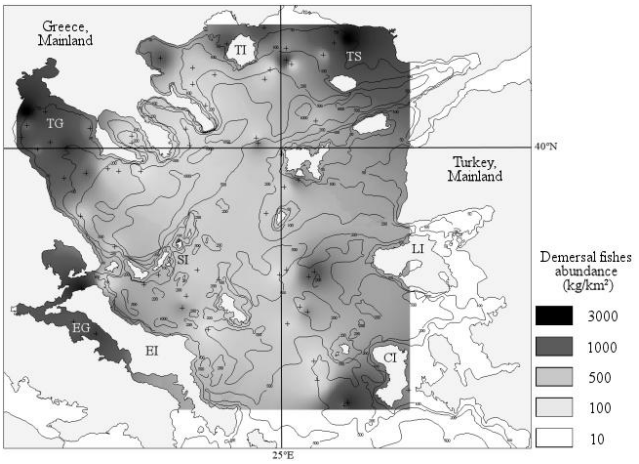

Fig. 1. Average demersal fishes density in the North Aegean showing demersal resources high density spots (MEDITS 1996-2001 data). TS : Thracian Sea, TG : Thermaikos Gulf, EG : Evoikos Gulf, TI : Thassos Island, SI : Sporades Islands, EI : Evoia Island, LI : Lesvos Island, CI : Chios Island.

Results
The biomass density presented a north/south and an inshore/offshore gradient with the coastal regions being richer in terms of biomass than the open sea ones, as it has been previously pointed out for zooplankton [3]. We observed 5 high-density regions persistent over the 5 years (Fig. 1): Thracian Sea (TS), Thermaikos Gulf (TG), South of Chios Island (CI), Evoikos Gulf (EG) and the area 25 km west of Lesvos Island (LI).
The PCA showed that there was a correlation between fish biomass and crustacean biomass, explaining 30.14% of the system's variance. No other correlations were found.

Discussion
Three main areas were previously distinguished in the northern Aegean Sea based on their particular environmental conditions [4]: TG, TS and central Aegean Sea. These areas are also highlighted in this study, with TG and TS being biomass-rich areas. TG and TS are shallow areas influenced by the less saline and nutrient-rich riverine input and the Black Sea water [5]. These water and nutrients fluxes tend to explain the biomass abundance and the north/south gradient. EG is a particularly deep (about 500 m) with the lowest bottom water temperature in the entire northern Aegean Sea. Yet, it is a productive area, exhibiting high fish biomass which remains unexplained.
The zone located to the west of LI belongs to the generally biomass-poor central Aegean and yet shows a high fish biomass. An upwelling/downwelling system [6] that brings nutrient-rich water offshore may explain this phenomenon. The west CI high density area may be also due to Ekman transport leading to water mixing [6]. The Ekman transport and the subsequent upwelling/downwelling is greatly related to the northerly winds blowing during the summer in the Aegean Sea and, to a large extent, is seasonally confined. Hence, the overall demersal fish distribution pattern refers to summer conditions only.

References
1 - Bertrand J., 1995. Manuel des protocoles. *In:* J. Bertrand (ed.), Campagnes internationales de chalutage démersal en Mediterranée. Campagne 1994. Rapport de Contrat EC-IFREMER-IEO-SIBM-NCMR (MED93: 020-018 006004)
2 - King M., 1995. Fisheries biology, assessment and management. Fishing News Books, Oxford. 341 pp.
3 - Ramfos A., Somarakis S., Koutsikopoulos C. and Fragopoulu N., 2005. Summer mesozooplankton distribution in coastal waters of central Greece (eastern Mediterranean). I. Hydrology and group composition. *J. Mar. Biol. Assoc. UK.*, 85: 755-764.
4 - Kallianiotis A., Vidoris P. and Sylaios G., 2004. Fish species assemblages and geographical sub-areas in the North Aegean Sea, Greece. *Fish. Res.,* 68: 171-187.
5 - Yüce H., 1995. Northern Aegean water masses. *Estuar., Coast. Shelf Sci.,* 41: 325-343.
6 - Bakun A. and Agostini V.N., 2000. Seasonal patterns of wind-induced upwelling/downwelling in the Mediterranean Sea. *Sci. Mar.,* 65: 243-257.