DISTRIBUTION AND ABUNDANCE OF PELAGIC SHARKS IN THE EASTERN MEDITERRANEAN SEA

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During the period 1998-2001, a survey to study the incidence of the drifting longline fishery on shark populations was carried out in the Eastern Mediterranean Sea.

A total of 8 different pelagic shark species were recorded in the catches of the Greek swordfish and albacore longline fisheries. Among them, the big-eyed thresher shark, *Alopias superciliosus* and bigeyed sixgill shark, *Hexanchus vitulus*, were reported for the first time in the area while the blue shark, *Prionace glauca*, was the most common species in the catches.

Shark catches were remarkable in the swordfish fishery reaching a 3.8% in number and 3.6% in biomass. Higher abundance indices observed in the Levantine basin however, catches per unit effort never exceeded one shark/1000 hooks. Catches showed an increase in areas where the sea surface temperature was under 18° C and over 26° C, while catches by moon phase were higher during the full moon period.

Size distributions indicated that catches in the area consisted of much larger specimens than those of Central and Western Mediterranean Sea. Sex ratio was in favour of males (2:1). Most of sharks brought on board were alive and 22% of them were discarded.

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ABSTRACT

During 1998-2001, a total of 8 different pelagic shark species were recorded in the catches of Greek swordfish and albacore long line fisheries. Bigeyed sixgill shark, *Hexanchus vitulus,* was reported for the first time in the area while blue shark, *Prionace glauca*, was the most common by-catch. Shark catches in the swordfish fishery reached a 3.8% in number and 3.6% in biomass. Higher abundance indices observed in the Levantine basin however, CPUE never exceeded one shark/1000 hooks. Catches showed an increase in sea surface temperatures under 18° C and over 26° C, while catches by moon phase were higher during the full moon. Size distributions indicated that catches in the area consisted of much larger specimens than those of Central and Western Mediterranean Sea. Sex ratio was in favor of males (2:1). Most of sharks brought on board were alive and 5.4% of them were discarded.

INTRODUCTION

Among marine fauna, sharks are one of the less well-known groups both in terms of their biology and stock assessment. They are slow-growing species with long reproductive cycles and there is concern that depleted populations cannot sustain heavy fishing mortality over many years. The main goal of this study was to improve our knowledge on distribution and abundance of pelagic shark species caught in the Eastern Mediterranean Sea and to study the relationships between catches and various environmental factors.

MATERIALS AND METHODS

A 4-year survey (1998-2001) monitoring Greek swordfish and albacore long line fleets was performed since up to date, no shark directed fishery exists in the Eastern Mediterranean Sea. A network of sampling ports throughout the Ionian Sea, Aegean Sea and Levantine basin was developed and the catches were sampled at landing and on board. Catch data series concerned: geographical coordinates of each fishing set, number and weight of sharks by species, fishing effort in number of hooks per fishing day and type of fishing gear (American type of swordfish long line SWO-LL$_A$, Traditional swordfish long line SWO-LL$_T$ and albacore long line ALB-LL). Length measurements in cm, dressed weight in kg and sex of sharks were recorded. Health status of specimens brought on board vessels was estimated and


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discards were recorded. Relative abundance of sharks was calculated as Catch per Unit Effort (CPUE) both in number of fish / 1000 hooks and kg of fish / 1000 hooks. To study the influence of environmental factors on shark distribution CPUE were related to Sea surface temperatures (SST), obtained indirectly from satellite-derived estimates. Moreover, CPUE were related to four time periods of 7-8 days representing the moon phases (full moon, waning moon, new moon, crescent moon).

RESULTS

A total of 166 sharks were reported from 650 fishing days-530 observations at landing and 120 on board. They were the most important by-catch following the target species in all fishing gears ranging from 2.2% to 4.0% in number and 0.9% to 4.0% in kg. Eight shark species were identified, blue shark, *Prionace glauca*, being the most common catch in all areas and gears studied (71.1%). Other species observed in order of abundance were: Tope shark, *Galeorhinus galeus,* shortfin mako, *Isurus oxyrinchus*, common thresher shark, *Alopias vulpinus,* bigeyed thresher shark, *Alopias superciliosus*, great white shark, *Carcharodon carcharias*, sharpnose sevengill shark, *Heptranchias perlo* and bigeyed sixgill shark, *Hexanchus vitulus*. The Levantine basin showed the higher percentages of shark by-catches (4.6%), followed by the Ionian (4.2%) and the Aegean Sea (2.6%). Average weight of sharks caught was higher in Levantine (33.7 kg) and smaller in Ionian (12.4 kg). Shark catches were
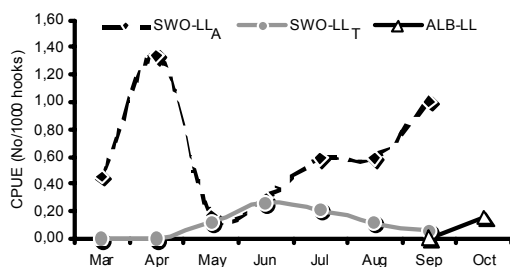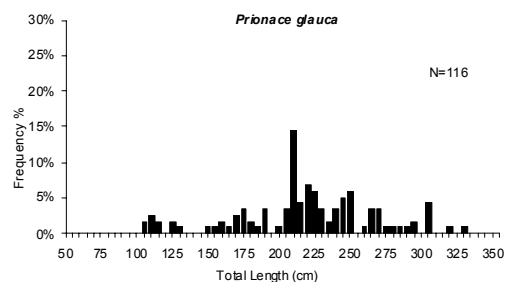
Figure 1. Seasonal variation of sharks CPUE (fish/1000 hooks) by fishing gear
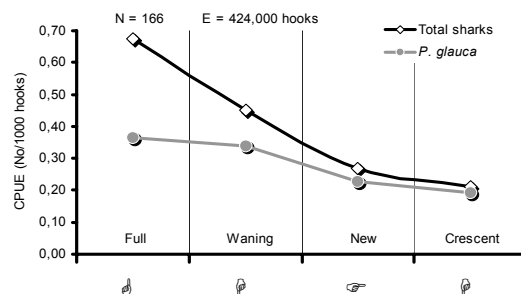
Figure 2. Sharks CPUE (fish/1000 hooks) by moon phase
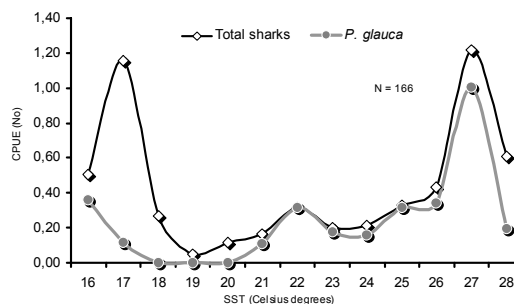
Figure 3. Sharks CPUE (fish/1000 hooks) by sea surface temperature

Figure 4. Total length frequency distribution for blue shark. *Prionace glauca*

more numerous in the SWO-LL$_A$ (4.0% in number and in kg) and with the higher average weight (31.3 kg). ALB-LL catches were minor (0.9% in biomass). Abundance indices expressed in means of catch rates were lower than 1 shark/1000 hooks. SWO-LL$_A$ showed the highest CPUE values while ALB-LL the lowest (Fig. 1). Sharks were more abundant in the Levantine basin area. Catches between the four lunar phases showed statistically significant differences (*Kruskall-Wallis test*; *P<0.05*) being higher during full moon (Figure 2).

Shark catches were higher in surface temperatures of 17 and 27° C with a secondary preference at 22 ^{o} C. (Figure 3). Health status of 41 sharks brought on board was excellent, only 1 reported dead (2.4%). 9 out of 166 sharks were discarded at sea (5.4%). Blue shark, *Prionace glauca*, distribution by size varied significantly by area and fishing gear (*Kruskall-Wallis test*; *P<0.05*), larger fish caught in the Levantine basin by SWO-LL$_A$. Mean total length was 216.4 cm (Fig. 4). Males were predominant in blue shark catches (males/females = 2.3:1), while the rest of the species were few to make significant assertions.

DISCUSSION

Bigeyed thresher shark, *Alopias superciliosus* (Lowe, 1839) was reported for the first time in the Aegean Sea, while bigeyed sixgill shark, *Hexanchus vitulus* (Springer and Waller, 1969) for the first time in Eastern Mediterranean. Catch rates were some of the lowest ever reported. Swordfish long line CPUE values ranged from 0.9–3.0 sharks/1000 hooks for N. Ionian Sea (De Metrio *et al.*, 1984; Filanti *et al.*, 1986), up to 24.2 sharks/1000 hooks for the Strait of Gibraltar (Buencuerpo *et al.*, 1998). These low catch rates could be the result of differential geographic distribution by size and/or sex, which is the norm for highly migratory sharks (Strasburg, 1958; Nakano, 1994) or the configuration-effectiveness of long line in some areas (Kotas *et al.* 2000). Also, in tropical and subtropical areas sharks shift to deeper, cooler water masses and in these depths they are less vulnerable to surface long lining, reflecting in lower catch rates (Strasburg, 1958; Carey & Scharold, 1990; Nakano, 1994; Bigelow *et al.*, 1999). Sharks abundance during the full moon period, may be a sign of vision playing an important role in sharks feeding habits. Other shark researchers so far reported no significant relation (Bigelow *et al.,* 1998; Walsh *et al.*, 2000). Sharks sea surface temperature (SST) preferences, were analogous with results obtained for blue sharks by Bigelow *et al.* (1998) and Walsh *et al.* (2000) in the Pacific Ocean. The high survival rate of sharks captured could be of great importance in the adoption of conservation measures in the future, to reduce the incidence of shark by-catches in long lining. The low value of shark meat in Greek bulk market (2 €/kg), make fishermen reluctant to keep them aboard and therefore frequently discard them. The average size of most pelagic shark species in Eastern Mediterranean indicated that it is

inhabited from large individuals. Previous works in the Mediterranean waters report averages ranging from 160.0 to 270.0 cm (De Metrio *et al.,*1984; Buencuerpo *et al.,*1998; Megalofonou *et al.,* 2000). Size variation by fishing gear was an expected result and has been documented in the past (De Metrio *et al.*, 1984; Buencuerpo *et al.*, 1998, Megalofonou *et al.*, 2000). Although our results show male domination suggesting sexual segregation, the sample size is inadequate to lead us to significant conclusions.

LITERATURE CITED

Bigelow, K.A., Boggs, C.H., He, X. (1999). Environmental effects on swordfish and blue shark catch rates in the US North Pacific longline fishery. Fisheries Oceanography 8(3):178-198.

Buencuerpo, V., Rios, S., Morón, J. (1998). Pelagic sharks associated with the swordfish, *Xiphias gladius*, fishery in the eastern North Atlantic Ocean and the Strait of Gibraltar. Fishery Bulletin 96:667-685.

Carey, F.G. and Scharold, J. (1990). Movements of blue sharks (*Prionace glauca)* in depth and course. Marine Biology 106:329-342.

De Metrio, G., Petrosino, G., Montanaro, C., Matarrese, A., Lenti M., Cecere E., (1984). Survey on summer-autumn population of *Prionace glauca* L. (PISCES, CHONDRICTHYES) during the four year period 1978-1981 and its incidence on swordfish (*Xiphias gladius* L.) and albacore (*Thunnus alalunga* (Bonn)) fishing. Oebalia 10:105-116.

Filanti, T., Megalofonou, P., Petrosino, G., De Metrio, G. (1986). Incidenza dei Selaci nella pesca del Pesce Spada con long-line nel golfo di Taranto. Nova Thalassia 8(3): 667-669.

Kotas, J.E., Santos dos, S., Azevedo de, V.G., Lima de, J.H.M., Neto, J.D., Lin, C.F. (2000). Observations on shark by-catch in the monofilament long line fishery off southern Brazil and the National ban on finning. IBAMA – REVIZEE research. Copyright : www.wildaid.org :8p

Megalofonou, P., Damalas, D., Yannopoulos, C., De Metrio, G., Deflorio, M., Serna de la, J.M., Macias, D. (2000). By-catches and discards of sharks in the large pelagic fisheries in the Mediterranean Sea. Final Report of the Project No 97/50 DG XIV/C1. Commission of the European Communities:336p.

Nakano, H. (1994). Age, reproduction and migration of blue shark in the North Pacific Ocean. Bulletin of National Research Institute of Far Seas Fisheries 31:141-219

Strasburg, D.W. (1958). Distribution, abundance, and habits of pelagic sharks in the central Pacific Fishery Bulletin 58:335-361

Walsh, W.A. and Kleiber, P. (2001). Generalized additive model and regression tree analyses of blue shark (*Prionace glauca*) catch rates by the Hawaii-based commercial long line fishery. Fisheries Research 53:115-131.