

Catch Per Unit of Effort fluctuations in deep waters in West Coast of Greece (Ionian Sea).

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Abstract

In the framework of the "Deep Water Fisheries" project, twelve monthly sampling cruises took place in Ionian Sea from December 1996 to November 1997. The depth of the stations ranged from 300-750 m. Two depths zones were defined: the first one ranged from 300-500 m and the second one from 500-750 m. The Catch Per Unit of Effort (CPUE) was calculated as Kg/hour of fishing, for the total fish, crustaceans and cephalopods catch and separately for the main fish and crustacean species. In the first depth zone, the CPUE of the fish was higher than the CPUE of the crustaceans during all months. In the second depth zone from January to April the CPUE of fish was approximately equal to the CPUE of crustaceans but from May to September it was higher. The CPUE of cephalopods was in both depth zones very low. *Aristaeomorpha foliacea* was the most abundant crustacean species in both depth zones. The unidentified shrimps were quite abundant in both depth zones and *Aristeus antennatus* in the second one. The CPUE of *Parapenaeus longirostris* and *Nephrops norvegicus* was higher in the first depth zone. In the first depth zone *Chlorophthalmus agassizi* and *Argentina sphyraena* were the most abundant species. *Helicolenus dactylopterus*, *Hoplostethus mediterraneus* and *Chlorophthalmus agassizi* were the most abundant species in the deeper depth zone. *Galeus melastomus* and *Lophius budegassa* were found quite abundant.

Keywords: Deep water fisheries, Catch Per Unit Effort, fish, crustaceans cephalopods, Ionian Sea, Greece, Mediterranean Sea.

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Introduction

Bottom trawl fishery in Greek waters is carried out mainly in depths less than 400 m. Fishing activities in deeper water are very restricted. In some areas (e.g. Central Aegean Sea) there is a fishery targeting to *Nephrops norvegicus* (prawn) and *Merluccius merluccius* (hake) in depths around 400 m. Other worth mentioning fisheries in deep waters are long line fishery for hake (in depths down to 600 m) and gill net fishery for *Pagellus bogaraveo* (in depths down to 550 m). The scientific knowledge about the composition and the quantity of the catches in deep water is very poor, it comes from some tows of bottom trawl fishery projects which took place in various areas in Greece. Generally, the waters deeper than 400 m are not well exploited either by fishermen or scientists.

The geomorphology of the Greek coastline is characterised by steep bottoms and narrow continental shelf. The bottom trawl activities are restricted to a narrow area along the coast and in many cases the stocks are suffering from overexploitation (Papaconstantinou, et al. 1993; 1995, Anon. 1996). The extension of bottom trawl fishing activities in deep waters would take pressure off the shallow water species and would provide the fish market with new products. This could involve the danger of disturbing the deep water ecosystem which is more fragile than the ecosystem in shallow waters. Therefore, knowledge on the biology and on the inter-specific relationships of the deep water species is need in order to plan a reasonable managing design.

In this paper the monthly fluctuation of the Catch Per Unit Effort (CPUE) of the main fish and crustaceans species in the west coast of Greece (Ionian Sea) are examined. The CPUE is calculated in two different depth zones in order to determine bathymetrical differences in the abundance or movements of the species during the year.

Materials and Methods

Sampling took place in the South Ionian Sea in monthly basis from December to November 1997 (Fig. 1). The sampling took place only during day-light. In total 90 valid hauls were carried out. The depth ranged from 300 to 750 m (Fig. 2). The duration of the tows ranged from 30 to 115 minutes according to depth and substrate. In 72% of the tows the duration was 60 minutes, in 14% was less than 60 minutes and in 14% was more than 60 minutes.

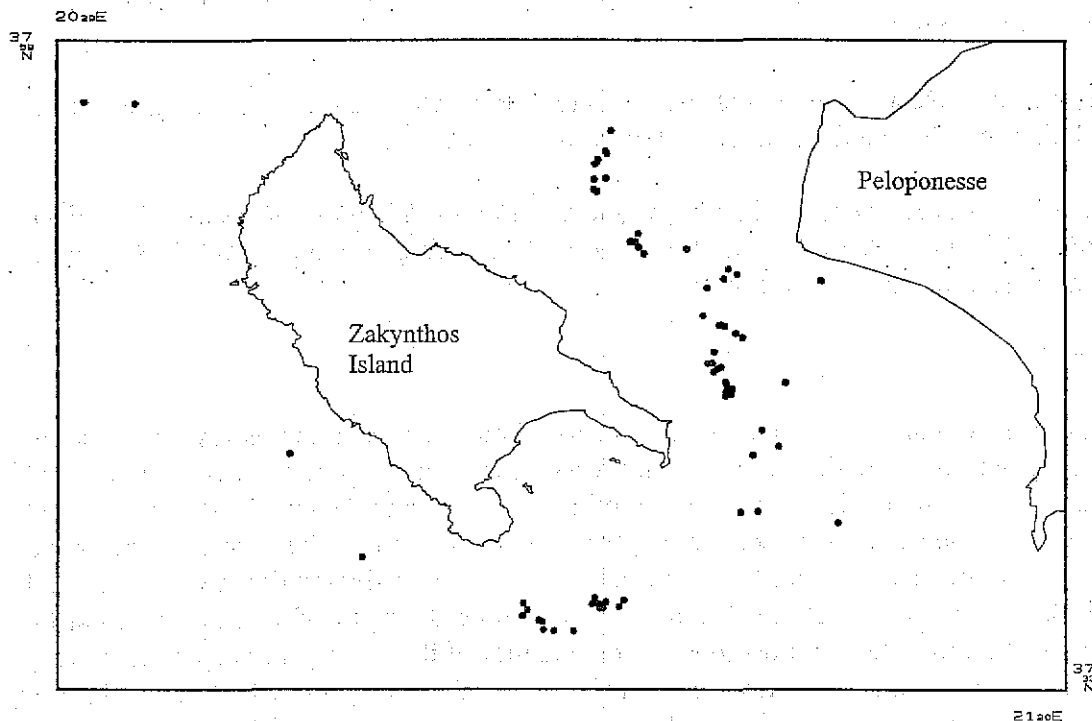


Fig. 1. Map of the sampling area with the fishing stations.

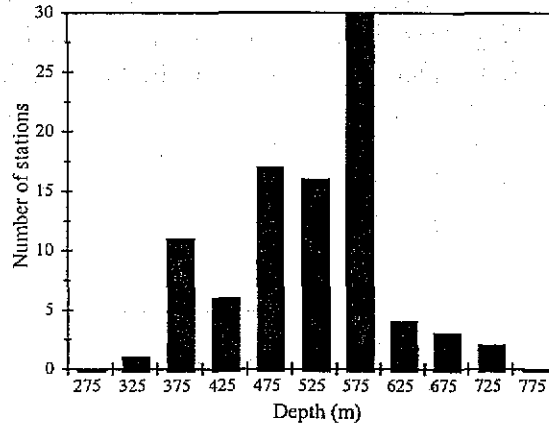


Fig. 2. Number of fishing stations per depth.

All the surveys were performed by means of a hired commercial bottom trawl fishery vessel named "Panagia Faneromeni II". The overall length of the vessel was 26 m, it had an engine with 450 HP and was equipped with 2 radar, geographical plotter with GPS, sonar and a hydraulic winch. The gear used in this project was a common bottom trawl used by the fishermen in Greek waters. The mesh size in the cod end was 14 mm (bar length).

In each station the catch was sorted to species level and the number and weight of specimens per species were recorded. An electronic balance (SCANVAEGT 1026.20) was used to take the weight on board. The lengths of all the species were measured. Biological data (such as sex and maturity stage) and otoliths were taken for the target species. Furthermore, shrimps samples, which were not classified to species level on board, were collected in order to analyse them in the laboratory.

In order to determine possible vertical movements two depth zones were defined: The first one from 300 m to 500 m and the second one from 500 m to 750 m. The CPUE calculated as Kg/Hour of fishing as follows:

The total weight or weight of the species was standardised to one hour of towsing:

$$W_i = w_i * 60 / t \text{ (where } W_i = \text{standardised weight, } w_i = \text{actual weight, } t = \text{duration of the tow)}$$

The CPUE was estimated as the mean of the standardised weight in the depth zone:

$$CPUE = \sum W_i / N \text{ (where } N = \text{number of hauls in the depth zone).}$$

Results

In the 300-500 m depth zone the CPUE of the fish was higher than the CPUE of crustaceans and cephalopods during all months (Fig. 3). Its minimum value was observed in February (37.8 Kg/hour) and the maximum in March (146.7 Kg/hour). During April to September the CPUE was quite constant (about 80 Kg/hour). The CPUE of the crustaceans was lower and ranged from 0.1 Kg/hour (July) to 16 Kg/hour (February). The CPUE of the cephalopods was low (less than 2.9 Kg/hour).

In the deeper depth zone (500-750 m), the CPUE of the fish and of the crustaceans during December 96 to May 97 and during October to November 97 was almost the same but during June to September 97 the CPUE of the fish was higher. The CPUE of the fish in the 500-750 m depth zone was lower than in the shallower depth zone ranging from 7.2 Kg/hour to 51.5 Kg/hour whereas the CPUE of the crustaceans was higher in deeper depth zone and ranged from 8.1 Kg/hour to 33.7 Kg/hour. The CPUE of the cephalopods was very low (less than 1.2 Kg/hour).

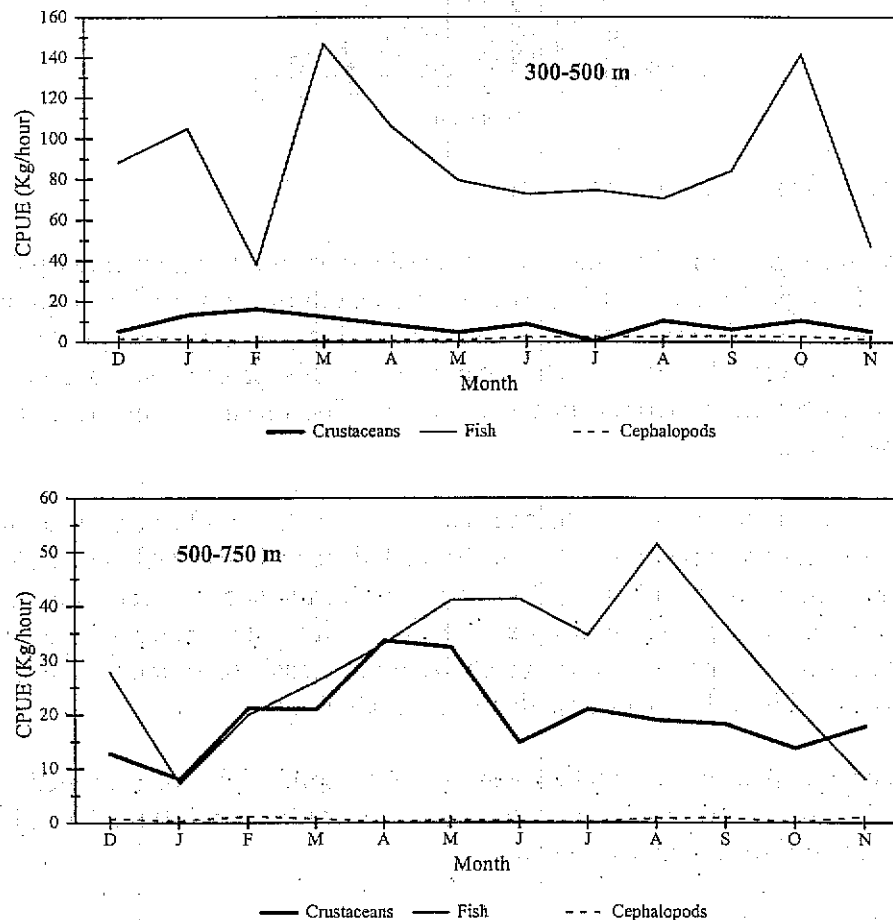


Fig. 3. Fluctuations of the CPUE of fish, crustaceans and cephalopods catch during December 1996-November 1997.

The CPUE of *Aristaeomorpha foliacea* in the 300-500 m depth zone was maximum in January 97 (8.1 Kg/hour), during the following months it showed a reduction until May 97 when the CPUE reached the minimum value (0.5 Kg/hour) (Fig.4). On the other hand, in the deeper depth zone (500-750 m) the CPUE was increasing until April 97 (20.12 Kg/hour), during May and June it was decreasing and during the following months the CPUE was quite constant (9.1 Kg/hour to 14.8 Kg/hour).

Aristeus antennatus was caught only during January to March 97 in the 300-500 m depth zone (Fig.4). The higher CPUE value in this depth zone was observed in February (2.4 Kg/hour). In the deeper depth zone (500-750 m) the CPUE was increasing from December 96 (0.8 Kg/hour) to May 97 (7.7Kg/hour). During the following months the CPUE was lower and ranged from 0.5 Kg/hour (June 97) to 3.7 Kg/hour (July 97).

Nephrops norvegicus and *Parapenaeus longirostris* were more abundant in the shallower depth zone (300-500 m) (Fig.4). The CPUE of *N. norvegicus* in the 300-500 depth zone ranged from 0-1.3 Kg/hour and in the deeper depth zone from 0-0.9 Kg/hour. The CPUE of *P. longirostris* ranged from 0 to 2.4 Kg/hour in the 300-500 m depth zone and from 0.1 to 1.2 Kg/hour in the 500-750 m depth zone.

The CPUE of the unidentified shrimps (shrimps which were not classified to species level on board) was higher during summer in the deeper depth zone and during winter in the shallower depth zone (Fig.4). In the shallower depth zone the CPUE ranged from 0.1 to 3.9 Kg/hour and in the deeper depth zone it ranged from 1-5.3 Kg/hour.

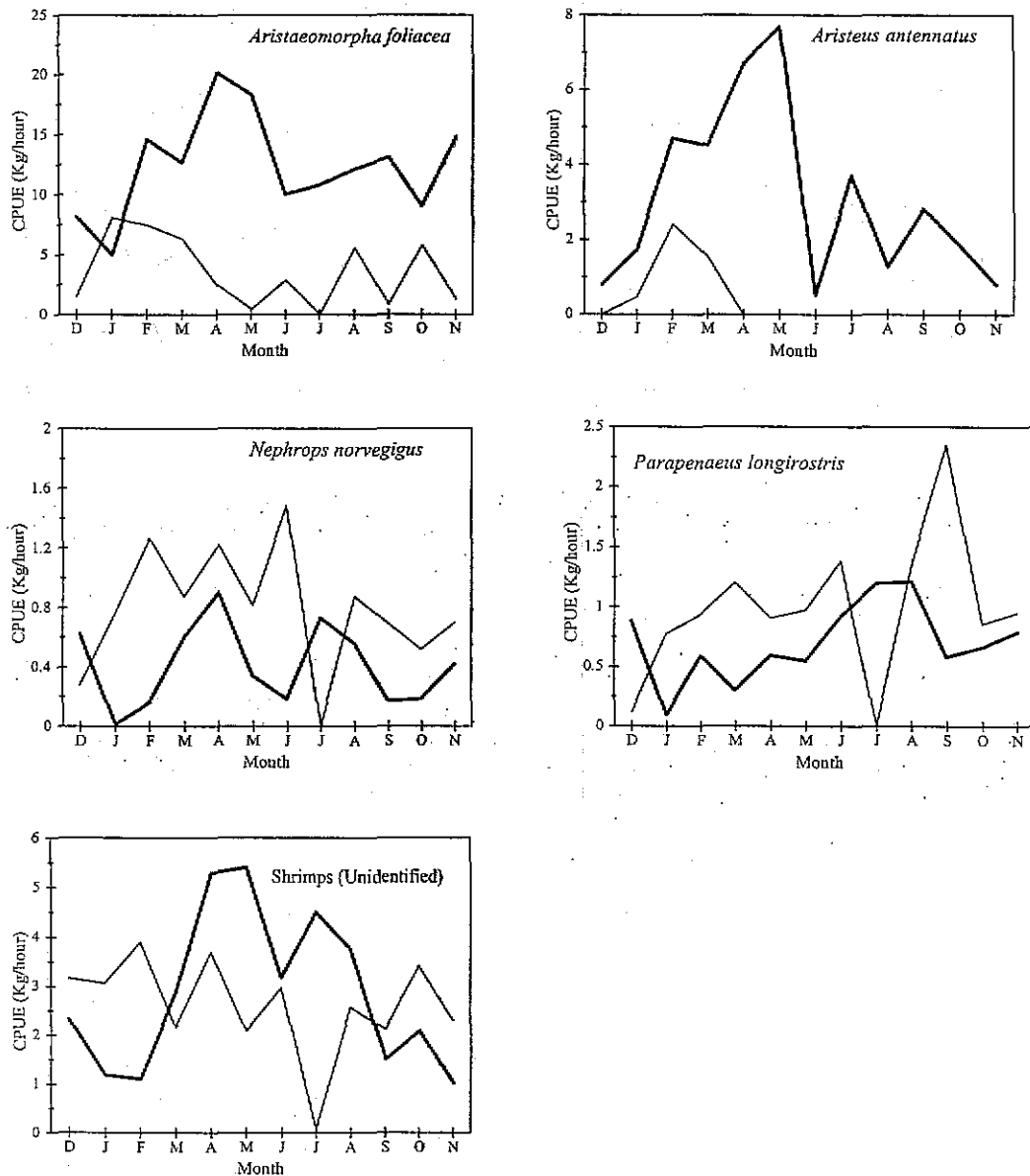


Fig. 4. Fluctuations of the CPUE of the main crustaceans species during December 1996-November 1997 (thin line=300-500 m, thick line 500-750 m).

The CPUE of *Helicolenus dactylopterus* was higher in the 500-750 m depth zone during March to September (Fig. 5). The higher value in the 500-750 m depth zone was observed during March (6.4 Kg/hour) and in the 300-500 m depth zone during April (4.6 Kg/hour). The CPUE of *Hoplostethus mediterraneus* was generally higher in the 300-500 m depth zone except during summer months. The higher value in the shallower depth zone was observed during April (8.7 Kg/hour) and in the deeper depth zone during June (7.3 Kg/hour).

Chlorophthalmus agassizi was more abundant in the shallower depth zone, only during August it was more abundant in the deeper one (Fig. 5). In January, March and October the CPUE of the 300-500 m depth zone was higher than 50 Kg/hour. In the 300-500 m depth zone the CPUE was maximum in August (17.2 Kg/hour).

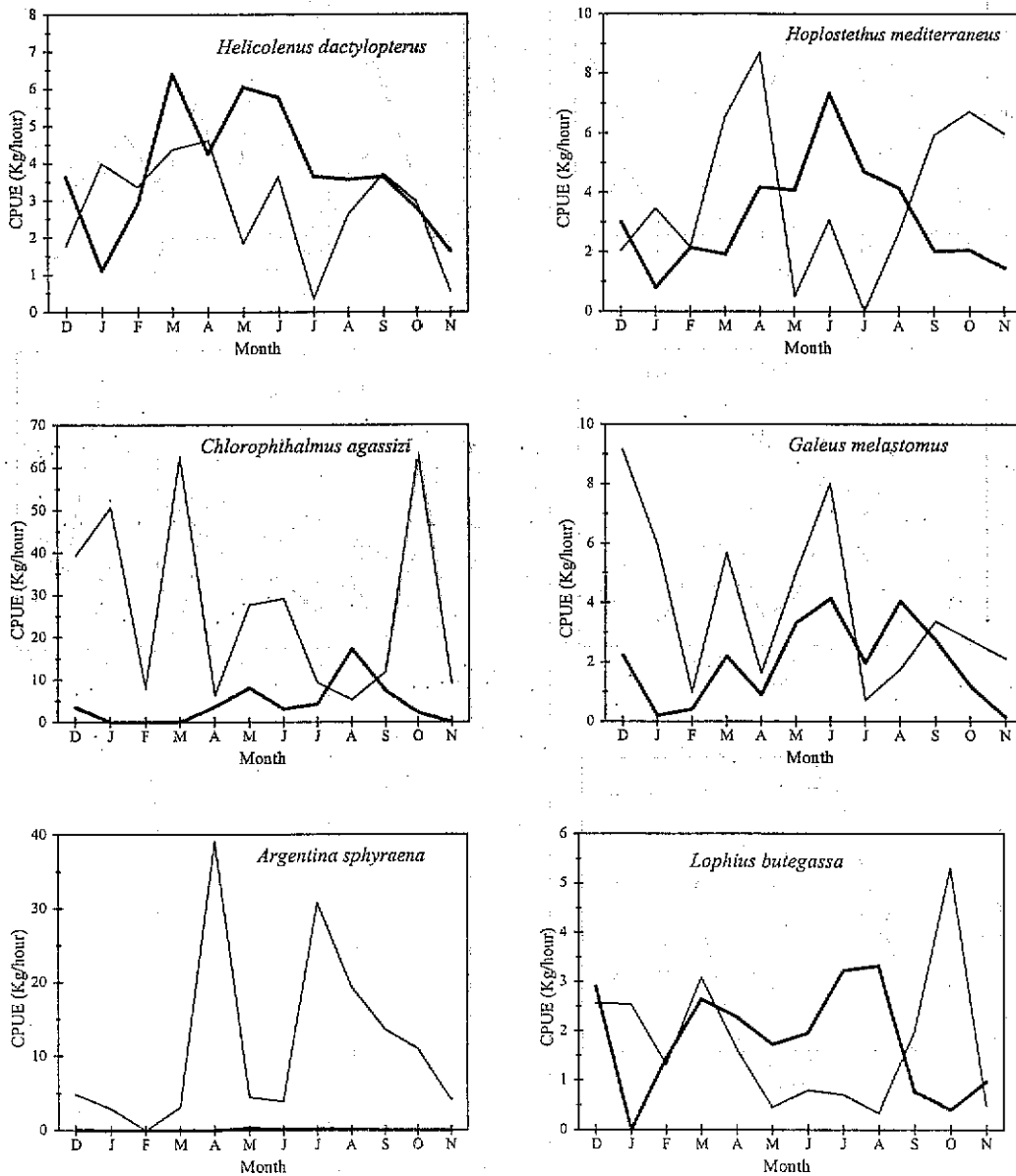


Fig. 5. Fluctuations of the CPUE of the main fish species during December 1996- November 1997 (thin line=300-500 m, thick line 500-750 m).

Galeus melastomus was caught in higher abundance in the shallower depth zone. The higher value was observed in the 300-500 m depth zone in December (9.2 Kg/hour) and in the 500-750 m depth zone in June (4.1 Kg/hour). *Argentina sphyraena* was caught in abundance in the 300-500 m depth zone. Higher values were observed in April and in July (39 and 30.8 Kg/hour, respectively). The higher CPUE of *Lophius budegassa* in the 300-500 m depth zone was observed in October (5.3 Kg/hour) and in the 500-750 m depth zone in August 3.3 (Kg/hour).

Discussion

More tows per month and per depth zone are needed in order to extract more accurate conclusions about the abundance of these species in the two studied depth zones (300-500 m and 500-750 m). The CPUE fluctuations that have been observed, in one degree reflect changes in the abundance of the species but they also could be attributed to the sampling procedure (gear performance, aggregation of the fish, etc.). Some of the differences observed in the CPUE (for example of *Argentina sphyraena*) are mainly due to sampling performance and therefore they do not reflect changes in the abundance of the species.

Even though the results are affected by the sampling, some conclusions can be made about the abundance of the species from the available data. The CPUE of the fish was higher in the 300-500 m depth zone during all the sampling cruises. The main fish species in this depth zone were *Chlorophthalmus agassizi*, and *Argentina sphyraena*. On the other hand the CPUE of the crustaceans was higher in the deeper depth zone (500-750 m) and from December to April and from October to November was approximately the same as the CPUE of fish. The CPUE of cephalopods in both depth zones was not important.

The CPUE of the fish showed a decreasing trend during summer months in the 300-500 m depth zone. At the same time, in the 500-750 m depth zone, the CPUE of the fish, increased. A movement of some species from shallower to deeper waters during summer is very possible. Furthermore, the CPUE fluctuation of *H. dactylopterus*, *H. mediterraneus*, *C. agassizi* and *L. budegassa* supports this conclusion.

The CPUE fluctuation of *A. foliacea* from December to April showed a movement from the 300-500 m depth zone to the deeper zone (500-750 m). During May-June the CPUE in the 500-750 m depth zone declined progressively without an increase in the 300-500 m depth zone. The same pattern is valid for *A. antennatus* since after March it was not present in the catch of the 300-500 m depth zone and after May the abundance in the 500-750 m depth zone was very low. The reduction in the 500-750 m depth zone could be attributed to a migration to deeper waters or to a migration toward areas where we did not have stations. According to Sarda *et al.*, (1994) the distribution of the species extended to 2.200 m in the western Mediterranean and is related to the topography and submarine canyons.

The CPUE of *N. norvegicus* and *P. longirostris* did not show the above mentioned migration pattern. The great majority of the unidentified shrimps were species belonging to the genus of *Plesionika* (Politou, unpublished data). The CPUE of these shrimps in the deeper depth zone increased during summer but the reduction of the CPUE in the shallower depth zone was not clear.

H. dactylopterus, *H. mediterraneus*, *C. agassizi* and *L. budegassa* showed this movement to deeper water during summer months. It is difficult to attribute these movements to a specific behaviour since the biology of these species in the area is unknown.

During 1990-1992 seasonal bottom trawl surveys took place in Aegean Sea in depths down to 500 m (Papaconstantinou et al. 1993). Comparing the CPUE results of the *N. norvegicus* in the Aegean Sea at 200-500 m depth zone with the results obtained in the Ionian Sea surveys, it can be seen that *N. norvegicus* was more abundant in the Aegean Sea. The CPUE in the west part of the Aegean Sea ranged from 1.5 to 7 Kg/hour where as in the east part of the Aegean Sea ranged from 3 to 14 Kg/hour. The CPUE of *L. budegassa* in Ionian Sea during 1996-1997 was similar to the CPUE in the Aegean sea in the 200-500 m depth zone during 1990-1992 (0.5 to 5 Kg/hour). The abundance distribution of *L. budegassa* is low but it appears in a wide range of depths. The CPUE of *A. sphyraena* in the Aegean Sea during 1990-1992 ranged from 1-8 Kg/hour and it was lower than the CPUE in the Ionian Sea. This difference could be due to the higher abundance of the species in the Ionian Sea but could also be result of the vessel and/or a depth effect since the sampling in Ionian Sea took place in deeper zones than in the Aegean Sea. There are no available data on the CPUE of the other species in the Aegean Sea.

A. foliacea was the most abundant crustaceans species in both depth zones in the Greek coasts of the Ionian Sea. The unidentified shrimps followed in the 300-500 m depth zone and *A. antennatus* in the 500-750 m depth zone. The situation is different in the Italian coasts where in surveys which took place in similar depths *A. antennatus* and *P. longirostris* were more abundant species (Anon. 1997). Concerning the fish catch in the Greek coasts *H. dactylopterus* was more abundant than *H. mediterraneus* whereas in the Italian coasts the number of *H. mediterraneus* was more than 10 times the number of *H. dactylopterus*.

These differences between the east and west coast of the Ionian Sea could be attributed to the exploitation status of the two areas. In the west coast there is a fishery operating for many years whereas the east coast is almost unexploited. Therefore a managing design is needed in order to exploit the east coast of the Ionian Sea which would avoid as much as possible the impact of the fishing on the ecosystem.

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