

**PRESENT SITUATION OF THE FISHING STOCKS IN
NORTH-WEST MEDITERRANEAN (ALICANTE-ELBA).
ECOLOGICAL AND FISHING IMPACT**

CARLOS BAS

*Instituto de Ciencias del Mar
Paseo Nacional, s/n, 08039 Barcelona, Spain*

ABSTRACT

The more important and grave consequence of the fishery activity is related with the distribution of equilibrium in the ecological structure of the North-West Mediterranean. The pelagic species appear to support in good conditions the fishing effort but the demersal stocks are submitted to the strong overfishing. On the other hand the trawl fishing activity disturbs the bionomic structure of the bottom communities. For the correct management it is necessary to develop a new model for evaluation and control adapted to the Mediterranean characteristics. The resources in the Mediterranean Sea are at the lowest level but the exploited species have developed several strategies for self regulation behaviour related with these adaptations to the geomorphological bottom structure and the environmental conditions.

INTRODUCTION

In the whole Mediterranean Basin the zone proposed in this paper is specially interesting for the three following aspects. First, because is the zone with a highest dynamic activity as result of the interactions between currents, eddies, frontal areas, deep water formation, funnels, and relatively high productivity. Second, because the fishery activity has reached the more developed level including a great variety of strategies. Finally the pollution impact is very important as a result of the flow of the Rhone, Ebro and the

other rivers that transport several wastes of the industrial and agricultural activities which are very important in neighbouring land areas.

The zone between Alicante and Elba is considered as a model of the complexity in the dynamic activity of the Mediterranean.

MOST IMPORTANT CHARACTERISTICS OF THE MEDITERRANEAN SEA

The Mediterranean basin is the result of movements and interactions between the different tectonic plates: Euroasiatic and African plaques. Its geological changes reflect the different levels in their activity. In the present time the seismic activity is strong along the Mediterranean central line. It is the result of the tertiary geologic period when the Pyrenees, Alps, Apennines, Balkans and Atlas mountains as well as the desertic zones in southern and eastern part of Algeria, Tunisia, Libya and Egypt were originated. In summary, the morphological structures and the atmospheric characteristics related with them produce a typical climate: the Mediterranean climate. First characteristic of this climate is related with the low level of the rain and on the other hand with the very high evaporation: two factors of the Mediterranean performance. This non compensated hydrodynamic situation originates an important deficit compensated by the entry of the Atlantic water through the Gibraltar Strait. This current goes from Western to Eastern Mediterranean as far as the Levantine area: the Israeli coast. It is the most important current in the Mediterranean oceanographic structure which moves near the African shore; some branches to the Balearic, Tyrrhenian, Adriatic Seas, etc. are detached from the principal current. (Lacombe and Tchernia, 1960; Ovchinnikov, 1966; Font, 1986). Other particular important points of the Mediterranean basin are constituted by the several islands situated in the central-transversal part: Balearic Islands, Corsica-Sardinia, Sicily-Malta, Crete and Cyprus. This situation is very important for the distribution of the subsidiary currents. Other special points of the general characteristics of the Mediterranean are related with the very differentiated features of the Adriatic, Aegean and Black Seas. Certainly other important characteristics are typical of the Mediterranean but its climate and consequently its hydrographic features are the most important in the geomorphological context. On the other hand it is evident the very strong relation between the resources and the environment and it is

impossible to explain the dynamics of the resources independently of the environmental conditions (Fig. 1).

If these are the general trends of the whole Mediterranean it is

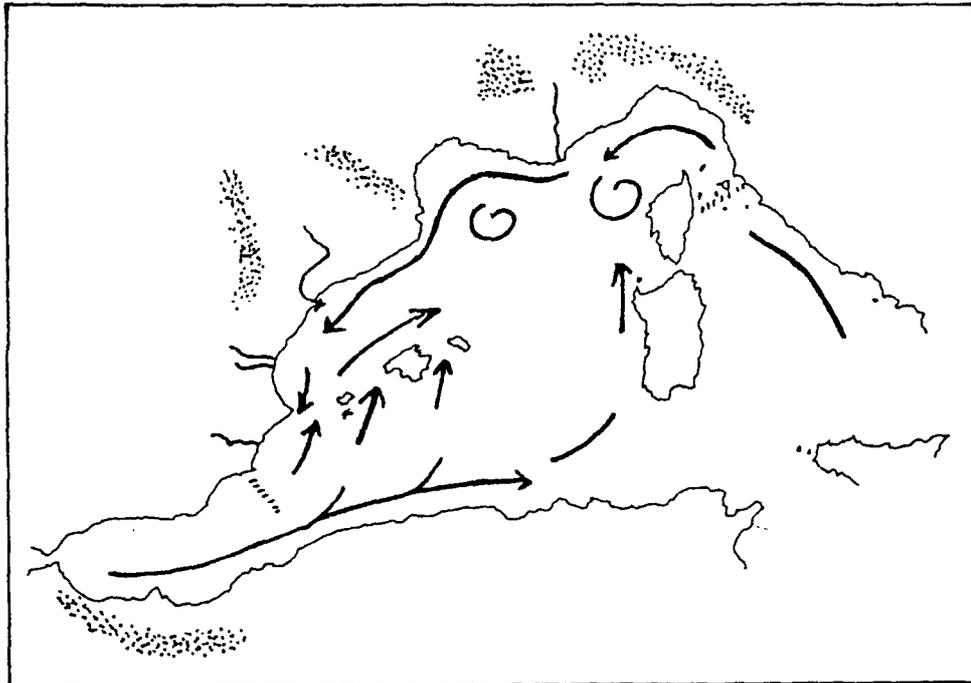


Fig. 1. Western Mediterranean. Mountains, deltas, currents and eddies.

necessary to distinguish some well differentiated zones: Alboran Sea, North-West Mediterranean zone, Algerian zone, Tyrrhenian Sea, Adriatic Sea, Jonian Sea or central zone, Aegean Sea, Levantine area and Black Sea. The differences among them have different level but the geomorphological and oceanographical conditions are the most important aspects for the differentiation.

SPECIFIC FEATURES OF THE NORTH-WEST MEDITERRANEAN

The North-West Mediterranean zone is comprised between the oceanographic frontal area in the Alboran boundary and the Elba island off the

Italian coast. As a result of the different cruises in the area during a long series of years – more than 20 years – are clear the characteristics in order to differentiate its particular features from those of the neighbouring zones: strong influence of the eastern superficial water mass proceeding from the Tyrrhenian Sea. This water is mixed with the important mass of fresh water of the Rhone river. This aspect is more important than fresh waters from Rhone which go along the Gulf of the Lion until the Spanish coast (Epsom, 1976). Similar situation is observed near the mouth of the river Ebro, though the final direction is different. In both cases there is a clear and direct relation with a great concentration of the pilchard. It is possible that the variations in intensity and the situation of the contact zone of the fresh and marine water is important for anchovy distribution.

Other important aspect is the intermediate water proceeding from the Levantine zone. The depth and thickness of the intermediate layer are others of the more important characteristics in the North-West Mediterranean. It is possible that these oceanographic features impact the planktonic distribution and particularly the deeper plankton mass. The general circulation in this part of the Mediterranean produces a number of eddies in the Ligurian Sea and in the southern part of the Gulf of the Lion; the last ones possibly related with the deep water formation. On the other hand, the frontal zone between NE-SW current and the Atlantic branch circulating in the northern part of the Balearic Islands are related with the eddies in the south of the Gulf of the Lion.

Other important characteristic of the North-West Mediterranean is related with the existence of great number of coastal lagoons specially abundant along the French coast of the Gulf of the Lion.

In summary, the boundaries of the area are the Spanish coast from Alboran front, the French coast, the Ligurian Sea, and from Balearic Islands to Corsica and Elba in the southern part. The geographical and oceanographical structures establish the southern boundary.

Geomorphological aspects

The continental shelf is normally very narrow with abundant slope canyons of tectonic origin and others from sedimentary processes during the different changes in the sea level during the last geological times. Two important zones with large continental shelf – Gulf of the Lion and Castellon area – are very important in fishery exploitation and support the great concentration of pelagic

species. The transition zones Alicante–Ibiza, Mallorca–Menorca and Corsica–Italy have very great importance because of the southern Atlantic water branches passing through them into North-West Mediterranean zone. Two great deltas – Rhone and Ebro – with several associated structures, lagoons and marshes (San Feliu, 1975; Folch, 1977), introduce into the area special characteristics not only in oceanographical conditions but also in biological and environmental pathways.

The coastal lagoons Mar Menor, Santa Pola and Albufera de Valencia in Spain and Canet, St. Nazaire, Bourdigou, Salces-Leucate, Lapasme, Bage-Sigean, Thau, Berra, etc. in the French coastal zone are the most important, and Orbetello in Italy, though situated near but in the southern part of the considered zone. In general, these lagoons accept a great quantity of juveniles of the several species of fishes because the food is abundant. Afterwards, these fishes are fished, using different gears and strategies (Amanieu and Lasserre, 1981).

Finally, one very important feature is the strong dynamic activity at the interface level between the land and the coastal marine waters, related with the variable structure of the coast and the environmental changes (Bas and Ninot, 1985).

Environmental trends

The first point is the strong relation between the hydrographic and atmospheric features both related to the geomorphological structure of the bottom near the coast and the mountains and valleys in the near lands. Other point is the influence of the Ligurian current proceeding off the Tyrrhenian waters and the associated cyclonic areas related with the current branches coming from the Corsica and Sardinia islands and the Algerian basin water mass passing to the Balearic Sea through the straits between the islands. On the general picture with the former features, another one very important remains evident: the central front in the Balearic Sea. It is the contact zone between two associate currents situated in the central part and probably related with a higher productivity in the zone as indicated by a major presence of *Gonostomatidae* and other migratory oceanic fishes. Other structures – slope frontal structures fingers, eddies, etc – increase the dynamic activity in the North-West Mediterranean.

Primary production and plankton

Summarized data: the most characteristic feature is the low productivity, though possibly it is the highest of the Mediterranean Sea, specially during the winter and the spring season. On the contrary the general productivity is at minimum level during the summer according to the stratification of the superficial water (Fig. 2). Special attention will be paid to the following aspects or points: the quick turnover of microplankton production, maximum depth chlorophyll production, increasing productivity in cyclonic areas, influence of the slope canyons favouring punctual higher primary production and the possibility that *Appendicularia*, *Salpa*, *Doliolum* and other gelatinous plankton accumulate a great quantity of particulate organic material (Ibarra, 1981; Estrada, 1985; Margalef, 1985).

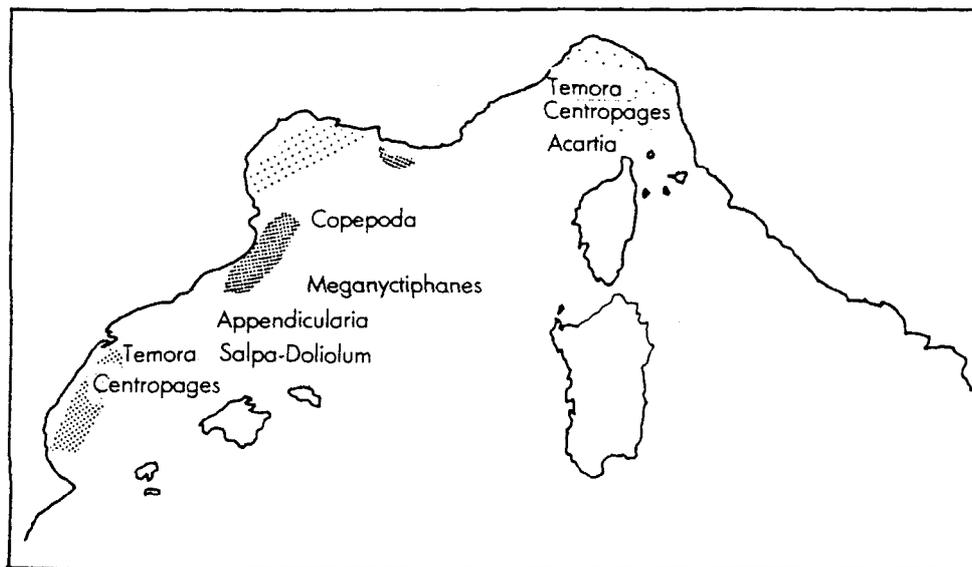


Fig. 2. Zooplankton distribution in the North-West Mediterranean.

Consequently, it is possible to consider two aspects. The first one is that primary production is low in general terms, but on the other hand the production in located areas possibly is much more high than at global level, supporting more abundant fish populations. The zooplankton – Copepoda, Cladocera, Chaetognatha, Euphausiacea, etc – has a very

different distribution in North-West Mediterranean (Razouls, 1975; Vives, 1978). As a very interesting example, *Meganyctiphanes norvegica* – a boreal euphausiacean – is more abundant in the northern than in the southern part where is substituted by other species of same group. The distribution of the zooplankton in space and time has a very important significance for the trophic relations of the ecological system.

PELAGIC SPECIES

The pelagic ecosystem has a great importance in all the Mediterranean but the exploited species can be considered in three important groups. The first group is made of little pelagic species constituted by *Sardina pilchardus* with important biomass concentrations in the areas near the mouth of most important rivers: Rhone, Ebro, Segura, etc (Andreu et al., 1950). *Engraulis encrasicolus* with two most important spawning areas along the coast of Catalonia: one in the northern part of Catalonia, SW of the Gulf of the Lion and the other one in the southern part, near the delta of Ebro (Palomera, 1989). It is possible that major concentrations of this specie are related with the frontal oceanographic zones. It has been ascertained that the larvae live in large areas far off the coast. Finally *Sprattus sprattus* is frequent in the Gulf of the Lion according to its boreal origin and *Sardinella aurita* in more southern area because is a tropical specie; both are two pelagic species with a local fishery interest.

The second group is constituted by the medium-sized pelagic species: *Scomber scombrus*, *Trachurus trachurus trachurus*, *T. t. mediterraneus* and *T. picturatus* (Bas, 1968). The first three live in coastal waters and are intensively exploited, but *Tr. picturatus* is less abundant and prefers oceanic waters.

Finally the group of the big pelagic species. *Thunnus thynnus*, *Xiphias gladius*, *Coriphaena hyppurus* and several Elasmobranchii, are other important pelagic resources. All members of this pelagic group live exclusively in oceanic waters. A very important question is related with the non super exploitation, in general, of the pelagic species, a interesting situation contrasting with the situation of general fishery resources.

DEMERSAL COMMUNITY

Only few aspects will be considered in this paper. The first example is related with a schematic situation concerning the northern part of delta of Ebro (Fig. 3)

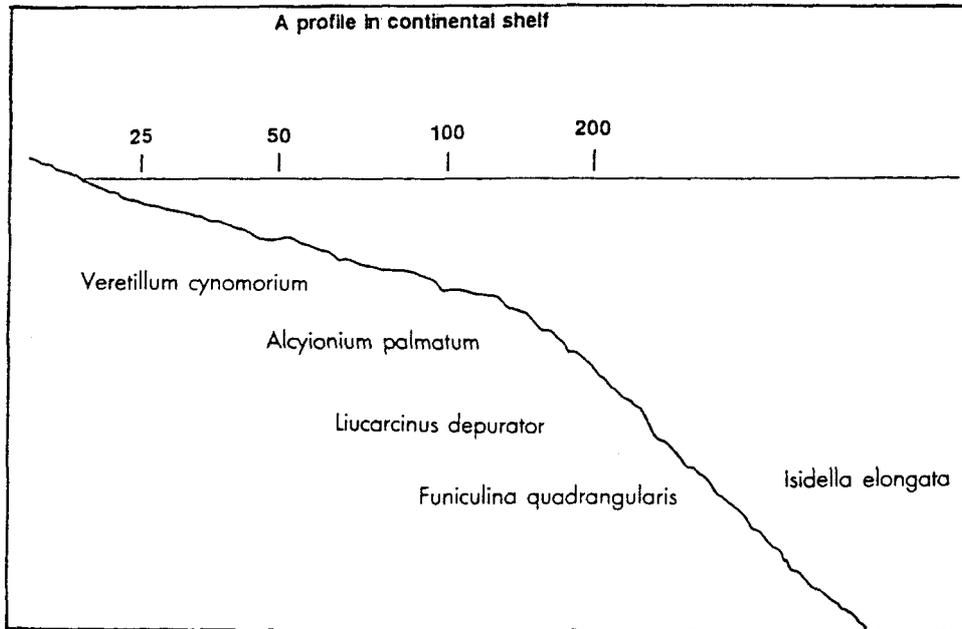


Fig. 3. Bionomic characteristics of a profile in continental shelf.

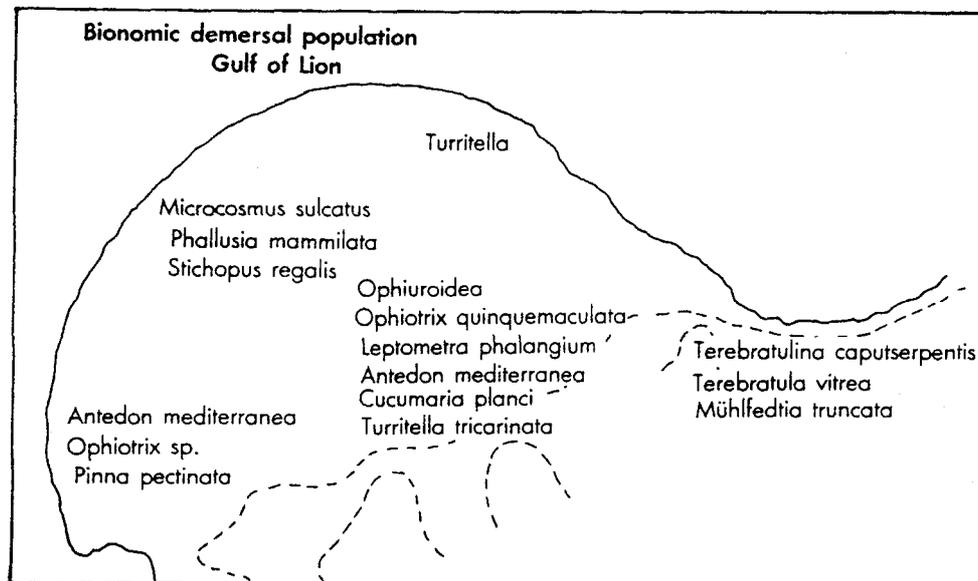


Fig. 4. Demersal communities of the Gulf of the Lion.

(Vives et al., 1967) with the following successive order, considering only most representative species (Fig. 3):

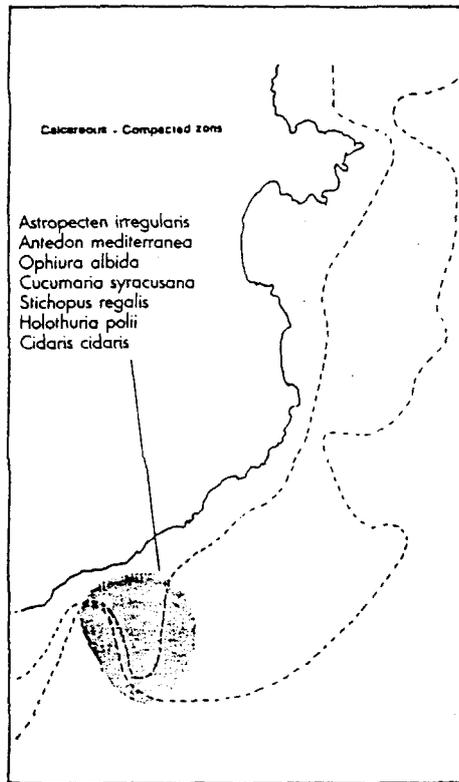


Fig. 5. Demersal communities in a compacted calcareous zone of Costa Brava (Catalonia).

Veretillum cynomorium, 25–50 m; *Alcyonium palmatum* with *Liocarcinus depurator*, 50–100 m; *Funiculina quadrangularis*, 100–200 m and *Isidella elongata* at more than 200 m depth (Maurin, 1968; Gili et al., 1987). In the second example, very characteristic bottom communities are related with the important zones of the Gulf of the Lion: *Antedon mediterranea*, *Terebratula caputserpentis*, *T. vitrea*, *Cidaris cidaris*, *Hyalinoecia tubicola*, *Ophiothrix quinquemaculata* and *Leptometra phalangium* (Fig. 4). In the costa Brava shelf, the more characteristic species related with calcareous compacted areas (Catalonian coast) are: *Astropecten irregularis*, *Cucumaria syracusana*, *Antedon mediterranea*, *Echinus acutus*, *Stichopus regalis*, *Holothuria polii*, *Cidaris cidaris*, *Ophiura albida*, practically all of the Echinodermata group (Fig. 5).

CONTINENTAL AND SLOPE SHELF EXPLOITED SPECIES

The principal characteristic is the relative uniformity from the taxonomic point of view of the bionomic composition of the bottom exploited resources and also the non exploited species (Bas et al., 1955; Demestre et al., 1988). Changes are only related with the relative abundance of some species in different zones. That is specially clear comparing the narrow and the large shelves. This situation is very clear in the *Mullus* sp. In the large shelves the more abundant is *M. barbatus* on the mud bottom; on the contrary in the narrow and rough continental shelf the more abundant is *M. surmuletus*.

Coastal species

The more typical species in the coastal zones are the following: *Octopus vulgaris*, *Epinephelus guaza* in the rock zones, *Sepia officinalis*, *Atherina boyeri*, *Ammodytes cicerellus* in the sand and mud bottom with several members of the *Blenniidae* and *Gobiidae* families and *Serranus cabrilla*, *Coris julis*, *Squilla mantis*, etc. A number of marine species visits the interface water and the coastal lagoons during the juvenile period: *Mugil* sp., *Dicentrarchus labrax*, *Sparus aurata*, with particular importance in the lagoons of the Gulf of the Lion, Ebro delta and Mar Menor (Arnal et al., 1976; Arte et al., 1981).

Continental shelf bionomic structure

It is characterized by the great number of different species but the only ones important in the ecological context and specially for their fishery interest are considered. In the Gulf of the Lion the following are worth mentioning: *Mullus barbatus*, *M. surmuletus*, *Scorpaena* sp., *Trachinus* sp., *Uranoscopus scaber*, *Gobius quadrimaculatus*, *Dicentrarchus labrax*, little specimens of *Merluccius merluccius* and *Phycis blennioides*, *Labridae* and *Sparidae*, etc. Of different origin are *Diplodus cervinus*, a very interesting tropical specie, and *Platyichthys flesus* a specie on the contrary of rare cold water origin, very strongly related with the presence of fresh water. The typical mediterranean species are: *Spicara maena*, *S. smaris*, *Trigla gurnardus*, *T. pini* and *T. lyra*, considered very important from the fishery point of view.

The narrow and large shelves along the spanish coast of the Mediterranean Sea have the same species but the relative population changes according to the shelf structure. Finally in the eastern French coast the bottom population is very limited and the fishery exploitation practically does not exist.

Slope continental community

The most important and characteristic species in the continental slope are: *Micromesistius poutassou*, *Nephrops norvegicus*, *Aristeus antennatus*, *Aristeomorpha foliacea*, *Polycheles typhlops*, *Geryon tridens*, *Notacanthus*

bonapartei, *Etmopterus spinax*, *Trachyrhynchus scabrus*, *Alepocephalus rostratus*, and big specimens of *Merluccius merluccius* and *Phycis blennioides*.

In summary, the distribution of the different characteristic species of the continental bottom – coastal bottom, continental shelf and slope – is correlated with the geomorphological features of the bottom which consequently determine the demersal fishery strategy.

FISHERY STRATEGY

The fishery activities and developed strategies are the result of the following biological and ecological features of the more important exploited species (Andreu and Rodriguez-Roda, 1951; Bas et al., 1955). These features are summarized in the following lines: the more important catches are of *Sardina pilchardus* whose growth and spawning are very favoured by oceanographic conditions at the mouth zone of Rhone, Ebro and Segura rivers; *Engraulis encrasicolus* presents a big concentration in the western part of the Gulf of the Lion and the northern part of Catalonia (Astudillo et al., 1980). Its quick turnover of the life cycle is a favourable condition. *Trachurus* sp. and *Scomber scombrus* are supporting an intensive fishery because of the great movement capacity and more diversified feeding. Tonnidae and *Xiphias gladius* form a big stock in the oceanic waters and their fishery has developed in recent times. The exploitation of a great number of demersal fishes (trawling) on the continental shelf is stimulated by the economic value. Diversity and economic impact are the principal stimulus for this activity. The species with little growth capacity are in a decreasing situation.

Fishery exploitation on the continental slope has the highest stability in all the North-West Mediterranean. Special attention will be paid to the changes in accessibility of *Aristeus antennatus* (Bas, 1965; Relini Orsi and Pestarino, 1981; Sarda, 1988). The new use of longline has produced new important captures of the big specimens of the *Merluccius merluccius* living in deep sea water (800 – 1000 m) responsables of the recruitment in the shelf areas.

Several species living in the coastal waters are fished using little gears with particular design and high fishing power. In summary, the more important effect of fishery activity is concerned with the changes in the bionomic composition and the low equilibrium level.

The characteristics of the fishery activity result in a little increasing of the total catch until the last years. This situation is the result of the several important strategies: 1) High importance of the little pelagic fish

populations, *Sardina pilchardus* and *Engraulis encrasicolus*; 2) Increasing pressure of the fishing effort in coastal waters on the species – fishes and molluscs – living in this zones; 3) Considerable reproduction level of the several species with special attention for *Mullus* sp. and *Trisopterus minutus capelanus*; 4) Geomorphological bottom structures favouring the life of the several species: *Mullus* sp. and the others; 5) Ecological capacity of *Micromesistius poutassou* to support the fishing whose juvenile stages live in the benthic-pelagic waters at a great distance from the coast where are not accessible for fishing (Bas and Calderon, 1989); 6) The special distribution of the *Aristeus antennatus* with the juvenile specimens non accessible to fishing makes difficult the total extinction of this specie; 7) The particular behaviour of the *Merluccius merluccius* and the *Phycis blennioides* according to previous explanation (Relini Orsi and Franciulli, 1981).

FISHERY MANAGEMENT

The correct management of the Mediterranean fishery is very difficult because the application of the current models used in general fisheries presents heavy distortion for the Mediterranean stock control (Suau, 1969; Garcia, 1984; Caddy, 1980; 1986). The principal problems are related with: 1) A great quantity of the exploited species are fished in the juvenile stages or at prerecruitment level; 2) The changes in natural mortality are important and not evaluated; 3) The geomorphological and hydrobiological variations are very important and represent supplemental difficulties for the correct management of the Mediterranean fisheries; 4) The application of different fishery strategies on the same stock represents a new difficulty for the correct use of the traditional models; 5) As matter of fact, the Mediterranean fishery is a pseudo-multispecific fishery: fishery effort changes continuously for several species or one particular specie, influenced by non-clear controlled conditions or purposes; 6) The q factor – accessibility – is very important and changes strongly; 7) In the present situation practically all species are in the overfishing situation; only the little pelagic possibly are not in this situation; 8) The economic impact is very important and it is the cause of a strong stimulus for the fishery activity and 9) The fishery is today situated in a minimum level but the economic input is very high.

RECOMMENDATIONS

- 1) Stability of the fishery in the continental shelf and particularly in the slope.
- 2) Progressive and better employment of selective gears – artisanal gears – in the continental shelf exploitation.
- 3) Special attention to the coastal lagoons exploitation.
- 4) Agreement between research and management programs of the scientific community of the Mediterranean countries.
- 5) Coordinated policy in the management.
- 6) It is necessary to promote a new research strategy with appropriate models in accord with the Mediterranean fishery exploitation attending the particular characteristics of the resources stocks.

REFERENCES

- Amanieu, M., and G. Lasserre, 1981. Niveaux de production des lagunes littorales méditerranéennes et contribution des lagunes à l'enrichissement des pêches demersales, Aménagement des ressources vivantes dans la zone littorale de la Méditerranée, *Etud.Rev.C.G.P.M.*, 58, 81–93.
- Andreu, B., and J. Rodriguez-Roda, 1951. La pesca marítima en Castellon. Rendimiento por unidad de esfuerzo (1945–1949) y consideraciones biométricas de las especies de interés comercial, *P. Inst. Biol. Apl.*, VIII, 223–227.
- Andreu, B., Rodriguez-Roda J., and M. Gomez Larrañeta, 1950. Contribucion al estudio de la talla, edad y crecimiento de la sardina (*Sardina pilchardus* Walb.) de las costas españolas de levante (noviembre 1949 – mayo 1950). *P. Inst. Biol. Apl.*, VII, 159–189.
- Arnal, J.I., Garcia A., and A. Ortega, 1976. Observaciones sobre el crecimiento de la dorada (*Sparus aurata* L.) en el mar Menor (Murcia), *Bol. I.E.O.*, 221, 17 p.
- Arte, P., Alcaraz M., Arias E., Camp J., Estrada M., Suau P., and F. Vives, 1981. Exemples locaux d'aménagement des ressources biologiques marines dans le delta de l'Ebre, *Etud. Rev. C.G.P.M.*, 58, 95–100.
- Astudillo, A., Bruno J., Oliver P., Crespo J., and J. Pastor, 1980. Nuevas aportaciones al conocimiento del estado de explotación de las pesquerías demersales del Mediterráneo español, *FAO Rapp. Pêches*, 227, 131–147.
- Bas, C., Morales E., and M. Rubio, 1955. *La pesca en España. I. Cataluña*. Inst. Invest. Pesq., Barcelona, 468 p.

- Bas, C., 1965. Note préliminaire sur la crevette rouge *Aristeus antennatus*, *FAO Débats et Doc. Tech. C.G.P.M.*, 8.
- Bas, C., 1968. La pesca de los escómbridos en el litoral mediterráneo español, *Symposium of scombroid fishes*, Madras.
- Bas, C., and E. Calderon, 1989. Effects of anthropogenic and environmental factors on the blue whiting *Micromesistius poutassou* of the catalonian coast, 1950–1982, *Mar. Ecol. Progr. Ser.*, 54, 221–228.
- Bas, C., and J. Ninot, 1985. Els recursos de la franja litoral i la seva explotació, *Trab. Soc. Cat. Biol.*, 37 (Editores).
- Caddy, J.F., 1980. Perspectives sur les activités futures en matière d'évaluation des stocks dans la Méditerranée occidentale, *FAO Rapp. Pêches*, 227, 149–154.
- Caddy, J.F., 1986. Broad perspectives and approaches analysis of small scale fisheries data for fisheries management purposes, *FAO Rapp. Pêches*, 362, 99–125.
- Demestre, M., Lleonart J., et al., 1988. La pesca en Catalunya, *FAO Rapp. Pêches*, 395, 101–108.
- Doumenge, F., 1981. Problèmes de l'aménagement intégré du litoral Méditerranéen, *Etud. Rev. C.G.P.M.*, 58, 343–364.
- Estrada, M., 1985. Deep phytoplankton and chlorophyll maxima in Western Mediterranean, in *Mediterranean Marine Ecosystems*, edited by M. Moraitou-Apostolopoulou and V. Kiortsis, 247–277, Plenum Press, New York & London.
- Ephsom, O.C., 1976. Extension des eaux fluviales dans le golfe de Lion, *An. Hydrog. 5^e Sér.*, 4, 31–42.
- Folch, R., 1977. Els sistemes naturals del delta de l'Ebre, *Traballs de l'ICHN*, 8, 321 p.
- Font, J., 1986. La circulació general a la mar catalana, *Tesis Universitat Barcelona*.
- Garcia, S., 1984. Un exemple d'utilization des modèles de production composites en Méditerranée espagnole. *FAO Fish. Rep.*, 305.
- Gili, J. M.; Ros J.D., and F. Pages, 1987. Types of bottoms and benthonic cnidaria from the trawling grounds (litoral and bathyal) of Catalonian (N.E. Spain), *Vie et Milieu*, 37, 85–98.
- Ibarra, O. S., 1981. Contributions relatives du micro et du macroplankton a la production primaire dans una zone côtière du Méditerranée nord-occidental, *Vie et Milieu*, 31, 119–128.
- Lacombe, H., and P. Tchernia, 1960. Quelques traits généraux de l'hydrologie Méditerranée, *Cah. Océanogr.*, 12, 527–547.

- Le Guen, J. Cl., and R. Chevalier, 1982. Etude des pêcheries. Reflexions sur le environnement et la gestion multispécifique, *Rev. Trav. Inst. Pêche Marit.*, 46, 9–70.
- Margalef, R., 1985. *Western Mediterranean*, Pergamon Press, Oxford, 363 p.
- Margalef, R., 1986. Fluctuaciones de varios años de periodo medio en la producción de fitoplancton en el Mediterraneo nordoccidental, *Colectanea Bot.*, VII.
- Massuti, M., and C. Masso, 1975. La pesca selectiva en el talud continental. Banco de pesca. I. El banco de Cabo de Palos, *Bol. I.E.O.*, 183, 26.
- Maurin, Cl., 1968. Ecologie ichthyologique des fonds chalutables atlantiques (de la baie ibéro-marocaine à la Mauritanie) et de la Méditerranée occidentale, *1^e Thèse Université Nancy*.
- Ovchinnikov, I. M., 1966. Circulation in the surface and intermediate layers of the Mediterranean, *Oceanology*, 6, 48–59.
- Palomera, I., 1989. Primeras fases del desarrollo de la anchoa (*Engraulis encrasicolus*) en la costa catalana, *Tesis Universidad Barcelona*, 274 p.
- Pérès, J. M., and J. Picard, 1958. Manuel de bionomie benthique, *Rec. Trav. Sta. Mar. Endoume*, (Suppl. 14), 23, 7–122.
- Razouls, C., 1975. Estimation de la production globale des copépodes planctoniques dans la province neritique du golf du Lion (Banyuls-sur-mer). II. Variation annuelle de la biomasse et calcul de la production, *Vie et Milieu*, SB, 25, 99–122.
- Relini Orsi, L., and G. Franciulli, 1981. Biologia di *Phycis blennioides*: distribuzione e alimentazione sul fondo di pesca batiale del mar Ligure, *Quad. Lab. Tecn. Pesca*, 3 (Suppl.), 135–144.
- Relini Orsi, L., and M. Pestarino, 1981. Riproduzione e distribuzione di *Aristeus antennatus* (Risso 1816) sui fondi batiali liguri. Nota preliminare. *Quad. Lab. Tecn. Pesca*, 3 (Suppl.), 123–133.
- San Feliu, J. M., 1975. Influencia de los aportes del río Ebro sobre la producción pesquera de la zona, *Publ. Téc., Junta Est. Pesca*, 11, 263–278.
- Sarda, F., 1988. Progresos realizados en el conocimiento de la biología pesquera de la gamba *Aristeus antennatus* (Risso 1816). Ensayo de la evaluación de bancos en el Mediterráneo occidental, *FAO Rapp. Pêches*, 395, 76–83.
- Suau, P., 1969. Evolución de la pesquería de arrastre de Castellón después del Plan Experimental, *Publ. Téc., Junta Est. Pesca*, 8, 69–74.
- Vives, F., Bas C., Lopez J.J., and E. Morales, 1967. La pescade arrastre en la provincia de Tarragona en 1966, *Publ. Téc., Junta Est. Pesca*, 6, 149–161.
- Vives, F., 1978. Distribución de la población de copépodos en el Mediterráneo occidental, *Tesis Universidad Barcelona*, 287 p.

DORMAN: Questions and comments, please.

SKJOLDAL: I have two questions concerning the river input to the area. You started by saying something that the fresh water input was related to the atmospheric and mediterranean climate. Can you explain a little bit more ... what is in that. And the second question is: you showed that was a west going coastal current along this north western Mediterranean. Is that a coastal current that also contains the fresh water run off and it is separated by a front from the more blu mediterranean waters ?

BAS: *Between Balearic area and the coastal area?*

SKJOLDAL: Yes.

BAS: First point. The wind blows in the Valley of Rhone. It is not possible other flow because the mountains, very high mountains, enforce the wind in this direction. The other line is the Valley of Ebro. Two winds in this area produce a very strong perturbation of the atmospheric situation and in this moment, ... (poor recording) ... The other point is the current. This current does not only exist from the oceanographic point of view. Larrañeta has studied the relation between this current and the abundance of sardine in this platform in the shelf ... (poor recording)

DORMAN: Thank you. Yes?

SHERMAN: Doctor Bas, that was a most interesting presentation. In some of your early slides you indicated that the Mediterranean is not to be considered as one large system but rather composed of several smaller systems; how many countries would be involved in this North-West System with regard to management of pollution problems and fishery problems, and are you optimistic that it may be possible to address ecological questions of ecosystem management based on a kind of information at your presenting? Thank you.

BAS: The countries are Italy, France and Spain.

DORMAN: Additional questions? Thank you. We are leaving the current Mediterranean and moving slightly to the West and talk will be presented by Doctor Hernández-Avila, who is the Director of the Sea Grant Program at the University of Puerto Rico: Overview of coastal management and development problems in the Caribbean.