

**SOME CHARACTERISTICS OF THE BIOLOGICAL AND DYNAMICAL
PROPERTIES OF THE FISH SPECIES OF THE DEEP SEA
(MEDITERRANEAN AREA)**

**QUELQUES CARACTÉRISTIQUES DES PROPRIÉTÉS BIOLOGIQUES ET
DYNAMIQUES DES ESPÈCES VIVANT EN EAUX PROFONDES
(ZONE MÉDITERRANÉENE)**

by CARLOS BAS

Laboratory of the Fisheries Research Institute, Blanes, Spain

Abstract

Summary of the biology and dynamics of the fish populations inhabiting the deep sea (Mediterranean area), with a preliminary division into the different types of fisheries.

Résumé

Exposé sommaire de la biologie et de la dynamique des populations de poissons vivant en eaux profondes (zone méditerranéenne) et classement préliminaire des différents types de pêche.

* * *

Along the Catalan Coast (West Mediterranean), the exploitable fish species comprise several well characterized types. These types result from the geographical structure of the sea bottom (Bas, Morales and Rubió, 1955), which creates conditions which favour their various biological characteristics (Bas, 1956 and 1957 (a)), as well as the application of proper fishing techniques. These diverse types are located in four main zones:

- a) the lagoon coastal zone;
- b) the shallow zone with a sandy but never muddy bottom;
- c) the zone comprising most of the continental shelf; and
- d) the slope of the continental shelf.

Each zone has its own marked characteristics, both biological and ecological. A previous study (Bas, 1956), called attention to the influence of the geomorphological structure. The first zone is also found in the *valli* of the Upper Adriatic, the second is of little importance,

the third is the main fishing ground, and the fourth zone supplies most of the fish in the Mediterranean Sea. The coastal lagoons are very important as they are rich in food and yield large crops — according to Professor D'Ancona, 150 kg./ha. in the *valli* and about 40 kg./ha. in the French lagoons. Along the coasts of France, Italy, Yugoslavia, Tunisia, Greece, Spain, etc. there are numerous lagoons. The dynamics and yield of these lagoons are but little investigated. There is very little data for the second zone. The third zone is the best known as it is the one principally exploited, especially the Valencia Gulf, the Adriatic Sea, the Gulf of Gabes, etc. Finally, the fourth zone is inhabited by species — crustacea and fish — whose characteristics are very suitable for commercial exploitation.

The fourth zone is characterized by a more pronounced slope and greater depth as compared with the other zones situated on the continental platform. Here two kinds of species may be distinguished: the permanent inhabitants, such as *Merlangus pouassou*, *Aristeus antennatus*, and *Aristeomorpha foliacea*, and those inhabiting the zone only during the senile part of their life, such as *Merluccius merluccius*, *Phycis blennioides*, etc. It is perhaps interesting to note that these species are bordering the abyssal zone. The *Myctophum*, relatively scarce in the conventional fishing grounds, appears in large quantities in some months of the year in the stomach of the *Merlangus*, whose stomach contents are used to study the biology of the *Myctophum* as well as the early stage of the *Aristeus*, the latter also used as food by *Merlangus*. Similar habitats produced species of different characteristics, due to the conditions of spawning and the early age. The *Merluccius* and *Phycis* are bred in shallow water, which is richer in food and has a wide and flat bottom, and the spawning occurs at the edge of the shelf (see available literature). On the other hand, as the youth of the *Merlangus* and *Aristeus* is short, they live only for a short time in shallow water and adapt themselves to deep water characteristics, that is, quick growth and precocity. The quick growth is shown by the fact that the animals born in February are in December already between 18 and 20 cm. in length. For age determination, the occipital crest (according to Menon with *Gadus minutus*), the opercular bone (Le Creen) and the otoliths are used. In commercial fishing, specimens of 1 to 2 years of age are preferred, which show in certain periods an increase in average length. Specimens of over 35-40 cm. are very uncommon. They spawn at the age of 1 year. Their food is principally *Myctophidae*, *Lampanictus*, *Aristeus*, *Macruridae*, etc. The *Merlangus* vie with the *Aristeus* of the pre-recruit phase. The interference of both species is through predation and not through food competition, because the stomach contents of *Aristeus* (Arté, not published) show an abundance of plates of the sea cucumbers of the *Synapta* group, frequent in the Mediterranean muddy bottom, but scarce in the biological remainders (Pérès). The adaptation of these species, living in deep water, is characterized by their high faculty to transform the available food into increased body weight. The optimum point of the growth curve is of a low location.

After intensive fishing exploitation of the *Merlangus*, it diminished in number, but in spite of the increased fishing rate in 1950, its average size increased. The study of the fishing curves revealed a diminution of the mortality rate in agreement with the increasing size. For the commercial fishery, this species offers the advantage that it is not very vulnerable during its early stage of life because of its living rather dispersed, and inhabiting non-exploited fishing grounds, although the latter are quite scarce in this littoral (see communication from Bas-Rubio). On the other hand, the optimum size and spawning size coincide with the desirable commercial size. Regarding the *Aristeus antennatus* things are different due to

competition between the units of fishing effort, as this shrimp inhabits the narrow valleys where the trawlers are compelled to go one after another and so disperse the *Aristeus* more and more, thus diminishing the possibility of catch for the following trawlers.

The grounds in the platform however are flat and extensive, permitting an easy dragging and an intensive exploitation which can hardly be increased, because the species here are of a greater ecological distribution and their adaptation to the relative poverty of food, proper to the Mediterranean, results in a slower growth and a lesser survival. *Mullus surmuletus*, *Mullus barbatus*, *Merluccius merluccius* and *Gadus capellanus* are the most important species, but with a relatively slower growth compared to that of the *Merlangus*. There are also other circumstances which impair fishing and contribute to their depauperation. Especially their tendency to move slowly towards the deeper water. Where the bottom is rough, there may be a new factor causing difficulty in the calculation of the different parameters for the study of the yield. Having begun an exploitation, the yield seems to diminish faster than the fishing and the natural mortality would theoretically warrant. Thereafter, it increases also faster, due to the specimens sheltering among the rocks of the bottom, thus diminishing their availability in spite of the increased fishing effort. Nevertheless, the difficulty to trawl freely means that the unit of fishing effort is not quite proportional to the density of the population, unless the latter refers to profitable fishing grounds, which is rather difficult, as present knowledge of the topography of the sea bottom is scarce. This results in increased competition between the different fishing units.

In the shallow water with sandy bottom another kind of fishing has developed; that of species of even slower growth, characterized by sedentary habits and hiding from ambush; needing therefore a large animal territory in order to be able to survive. In this case, the food is not obtained by wandering from place to place but covered from the stock available in a large territory. Although in some parts of the Gulf of Lyons this kind of fishing takes place, we know practically nothing of the biology and dynamics of these populations.

The brackish lagoons in the littoral have a rather high yield, permitting the species, which spawn in the sea, an intense growth, in consequence of the nutritive possibilities existing there, but the variability of the physical conditions does not allow for successful reproduction.

The dynamics of the four populations can therefore be characterized by: (a) an adaptation in form of a great metabolism; (b) and (c) slow development and growth, and (d) a high capacity to transform food into increased body weight.

The geographical diversity and the particular biological characteristics, especially of the feeding habits, prove the exactitude of the division of the fishing exploitation in the Mediterranean Sea into the four zones. Each division permits a subdivision, e. g. the glens of the *Aristeus* and the rocks of the *Phycis phycis* and the *Mullus surmuletus*. Morphologic differences seem to support this point of view (Bas 1957 (b)).

With regard to global studies, with a view to measuring the capacity of the populations of the Mediterranean, two points should be noted, which perhaps will complicate Beverton's and Holt's excellent arguments: (a) in some cases there is an interfering depredate action among the different species which live together, fighting for space and existence; (b) there is the importance of the competition between the different units of effort and the various degrees of availability of the exploited species.

We are now composing a fishery chart, including bathymetry, bionosis, and the evaluation of the populations of the exploited species. In our opinion — in accordance with

Kesteven, Rosa and Holt — each area should be considered as an eco-system, of which not only the commercial elements form a part but also the non-utilized ones, as well as those of the environment (Bas 1957 (c)). Fishery regulations and the determination of equilibrium conditions should take into account all the integral factors. On the other hand, the consideration of an eco-system — as it is a vital unit of a superior order — supplies us with elements for the research based on parameters describing the real structure, like those in Bertalanffy's growth studies.

BIBLIOGRAPHY

- BAS, C. 1956. La géographie du fond et l'état actuel de la pêche des espèces d'intérêt industriel. C.G.P.M. Débats et documents techniques, No. 4, Rome 1957.
- BAS, C. 1957 (a). Consideraciones sobre el crecimiento diferencial de la cabeza de los peces. III Reunión sobre Productividad y pesquerías. Instituto de Investigaciones Pesqueras. 92-97.
- BAS, C. 1957 (b). Algunos problemas de la pesca al arrastre en los caladeros profundos. III Reunión sobre Productividad y Pesquerías. Instituto de Investigaciones Pesqueras, 61-64.
- BAS, C. 1957 (c). Barcelona y la Pesca Catalana. Cátedra Ciudad de Barcelona. Universidad de Barcelona.
- BAS, C., MORALES, E., RUBIO, M. 1955. La pesca en España. I Cataluña, Barcelona.
- BERTELANFFY, V. 1949. Problems of organic growth. Nature 163, 156-158.
- BEVERTON, R. J. and HOLT, S. J. 1957. On the dynamics of exploited fish populations. Fishery Investigations, S. II, V: XIX.
- D'ANCONA, U. 1956. Etangs et lagunes saumâtres du littoral italien et leur exploitation piscicole. C.G.P.M. Documents de Travail.
- SUAU, P. and VIVES, F. 1957. Contribución al estudio del salmoneto de fango *Mullus barbatus* del Mediterráneo Occidental. Investigación Pesquera, V. IX, 97-119.
- VIVES, F. and SUAU, P. 1956. Sobre la biología de la mollera *Gadus capellanus*. Investigación Pesquera, V. V., 3-12.