A model to study the behaviour of sardine in the Portuguese coast

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Introduction

The relations between habitat and fish population dynamics is a very important research area.

In this case we want to study the behaviour of the sardine in the Portuguese coast using an individual-based model.

The activities with more relevance to simulate are spawning, habitat selection (movement), feeding and growth, and mortality. The feeding mechanism will include drift feeding and searching for stationary food. The mortality risks include starvation, aquatic predation, terrestrial predation and temperature.

Some aspects of the sardine behaviour in Portuguese coast

The reproduction rhythm can be controlled by the structure of the population. In this way, the duration of the spawning can be condition by the distinct age group composition of the reproducers that reach the sexual maturation at different times of the year. The ecological factors that control the rhythm of reproduction of the sardine (Clupeidae) aren't still are completely clarified. Various authors state that the temporal evolution of the water temperature, the food availability and photoperiod have a direct influence in reproduction. The water temperature seems to be the most important factor, and consequently determinative of the sardine spawning.

A long the Portuguese coast the sardine spawning extends for almost all year, existing a strong relation between the temperature of the water and the high spawning. The spawning occurs preferential during the Autumn-Winter (November/January) and Spring (April/May), being residual in the Summer. The spawning is more intense during the Autumn and Winter in the region occidental, north of the Portuguese coast. In the

south region higher spawning occurs during the Spring. The existence of two periods of high reproduction intensity long the Portuguese coast is probably related with the age group structure of the population.

The sardine presents stages of development, egg, larvae, juvenile and adult. The larvae are dependent of the reserves of the egg, in the locals where the food availability is low, the size of the egg is important for survival of larvae, until they start to find food, predation, (juveniles).

The dimensions of the capsule and the oil drop of eggs of Sardina pilchardus vary in a cyclical way, presenting maximum dimensions in the Winter months and minimum in the Spring months**.** The explanation for this phenomenon could be associate with the age group structure of the population, in such way that the individuals of more advanced age produce eggs of bigger dimensions, while the individuals that reach the sexual maturation for the first time produce eggs of minor dimensions.

Some authors state that photoperiod seems to have a direct influence in the spawning process the time when the eggs in first stadiums of development are captured in plâncton (timer of spawning) can vary consonant the season of the year. Ré et al. (1988a) had verified that the sardine reproduces long the Portuguese coast, in the Spring in first hours of the nocturne period (21:00/23:00 T.U.C).

The existence of migrations in sardine long the Portuguese coast in the South-North direction, allied to the fact of its reproduction to be more intense in the region NW during the months of Autumn and Winter and in the South region during the months of the Spring (Ré, 1984a, 1986a) seems to indicate that:

i) The spawning register in the NW coast is due mainly to the (2/3 years) age groups. In this region the sardine reach the sexual maturation sooner, and this individuals are not, in a general way captured in the South region.

ii) The spawning registered in the South region is due basically to individuals that reach the sexual maturation for the first time (1º year).

The relation between the food availability and the spawning intensity can be explained in part by the energetic needs of the adult and also by the fact that appropriated areas for the feeding of the adults are also appropriate for the development of the stages larvae.

The sardine presents also vertical migrations. Results seem to suggest that the stage larvae can be found mainly between the surface and 30m depth during a day/night cycle. During the day the maximum abundance will be found between10 and 25m, and during night the larvae are found closer to the surface, in the first 5 - 10m. The dynamics of the vertical distribution of the larvae stage of the Clupeidae in general, seems to follow an identical standard. The larvae are found predominantly closer to 20m depth during the day. During the night a trend to perform vertical migrations in direction to the surface can be observed. This kind of movement can perform be related with food availability. The vertical migrations occurring in some zooplankton species serve as food for sardine larvae can explain the vertical displacement of these. Hindering from predators can also be a explanation to this behaviour.

Aplication of the DEB theory

The DEB model computes population dynamics considering that the population is composed by individuals differ from each other by one or more characteristics, such as age which affect feeding, survival or reproduction, (structured populations).

Some point of view in DEB theory have a particular concern in analyse the behaviour of populations like the relations between age distribution and the survivor probability of the individuals, the volume distribution related with growth of dividing individual, the mass transformation .

My research interest is to in an imposed environment to predict the behaviour of the sardine population in the Portuguese coast based on DEB individual model.

The environmental conditions will be supplied by Hydrodynamic/Water Quality model Mohid (www.mohid.com).

The sardine model will be implemented in mohid as a lagrangian tracers. model.

References

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