

DISTRIBUTION OF SARDINE, *SARDINA PILCHARDUS* (WALB.) EGGS AND LARVAE ALONG THE SOUTH MOROCCAN ATLANTIC COAST (21-26°N)

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Introduction

The sardine is a commercially important fish in Morocco that occurs in high abundance along the margin of the Moroccan Atlantic coast. Its distribution area extends from Cape Blanc (21°N) to Cape Spartel; (35°45'N) with three stocks recognized (Belvèze 1984): the northern stock between El Jadida and Cape Spartel, the central stock from Laayoune to Cape Cantin (Safi) and the southern stock between Cape Blanc and Cape Boujdor. This paper concerns investigations of the spawning grounds and nursery areas of sardine in the southern stock between 21° and 26°N. The exploitation of this stock began in 1968 as a secondary catch to that of mackerel, *Scomber japonicus*, and horse mackerel, *Trachurus trachurus* (Belvèze 1984).

Materials and methods

Sampling for sardine eggs and larvae was carried out along the Moroccan Atlantic coast using the ship the *R/V Russian AtlantNIRO*. The sampling grid was composed of transects spaced 30 nautical miles apart and each comprising 3 to 5 stations. The temporal distribution of sardine eggs and larvae was studied over 1994 and 1995, during winter (January-February) and in summer (July-August). Sampling was carried out using a double Bongo net (20cm diameter) equipped with a flowmeter, hauled obliquely from a maximum of 100m depth to the surface at a speed of approximately two knots. The two nets had different mesh-sizes; that used for ichthyoplankton had a 417µm-mesh whilst the second (168µm) was used for zooplankton. Both nets were assembled on a framework, and each net had a cylindrical part in front of the filtration cone. Samples were preserved immediately after collection in a 5% borax-buffered formalin solution in filtered seawater.

Results

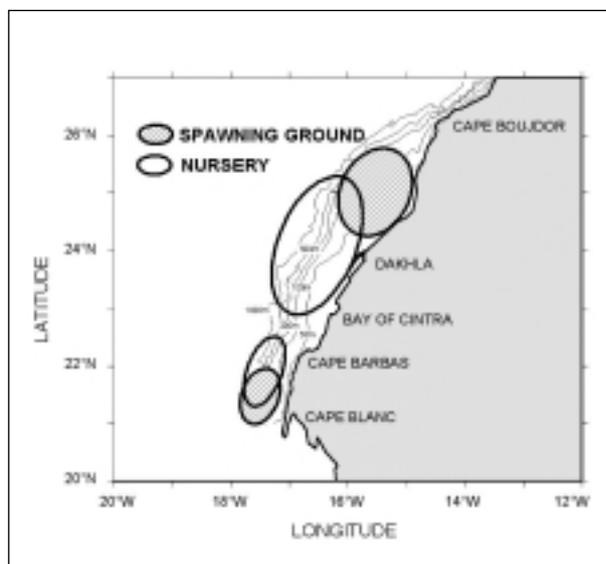


Fig. 1

The distribution of sardine eggs showed two zones of presence during winter 1994; the first was between Cape Boujdor and Dakhla and the second was off Cape Blanc. During the winter 1995, one zone was from Cape Boujdor to Cintra Bay, and a second zone was located near Cape Barbass (Fig. 1). During summer the egg distribution area was less extensive than in winter, and was localized between Cape Boujdor and Dakhla in 1994 and narrower in 1995. The area of maximum egg abundance was located north of Dakhla (24°N), with densities of 10-100 eggs/10m² during both winter and summer 1994, >1000 eggs/10m² during winter 1995, and from 100-1000 eggs/10m² during summer 1995. During winter 1994, a spawning ground was located in the south between Cape Barbass and Cape Blanc, with concentrations of 100-1000 eggs/10m².

The distribution of larvae from Cape Boujdor to Cape Blanc showed some variability from one season to another compared with that of the egg distributions, and the situation in 1994 differed from that in 1995. Larval distribution was wider than that of eggs, and covered the entire coastal region (Cape Boujdor-Cape Blanc) with higher concentrations occurring during the winter and summer of 1994. Maximum densities of larvae (>100 larvae/10m²) were localized at the same place as the eggs between Cape Boujdor and Dakhla, and between Cape Barbas and Cape Blanc. During winter 1995, the sardine larvae were located between Cape Boujdor and Cintra Bay, with the highest concentrations (100-1000 larvae/10m²) in the neighborhood of Dakhla. During summer 1995, the highest larval densities (100-1000 larvae/10m²) were in the Dakhla-Cape Barbas region.

Discussion and conclusion

The distribution of eggs and larvae of pelagic fish is generally under the influence of oceanographic conditions (temperature, current, wind, availability of food *etc.*) that affect the geographical distribution of adults at the moment of reproduction. The distribution of the densities of sardine eggs and larvae reveals that winter is the main spawning season, with maximum egg abundance located North of Dakhla. Sardine larvae occur along the coast from Cape Blanc to Cape Boujdor with maximum densities between 23° and 25°N.

These results agree with those of Conand (1975) who previously identified a sardine nursery area in the neighborhood of Dakhla. This area is characterized by a large, flat and relatively shallow continental shelf. These characteristics decrease the effects of dispersion towards the deep ocean, and this zone could constitute a favourable place for the retention and development of larvae (Roy 1991, Ettahiri 1996). Vertical movements of turbulence and westward drift in this area are reduced by the wide continental shelf (Roy 1991). This result is also similar to the conclusions of Marchal (1991) on the reproduction sites of other pelagic species along the West African coast; eggs and larvae remain mainly within the area of continental shelf because of the topography of the area. The same phenomenon was demonstrated for the Sidi Ifni-Cape Juby zone, which constitutes the spawning ground and the area of maximum abundance of larvae of the central sardine stock (Ettahiri 1996, 1997).

Blaxter and Hunter (1982) suggest that pelagic fish spawns in areas of substantial biological production to ensure adequate juvenile feeding. An area with such characteristics that acts as the spawning ground and nursery at the same time, and provides retention and concentration, fulfills Bakun's (1996) three conditions for the success of larval development: namely enrichment, concentration, and retention of the larvae in a favourable habitat.

Another important point is the existence of a shift in the location of the maximum densities of the larvae compared to eggs, especially during summer. This shift could result from drift of the larvae as they develop. Drift results from the surface currents that are directed from north to south (Mittestaedt 1991), as well as from active movements of the larvae, probably in relation to the search for adequate food. During the spawning season, the period of maximum egg production varies from year to year according to temperature, salinity, primary production and zooplankton. In the period of this study it is likely that the observations made in winter 1994 correspond to the end of the spawning season whilst those of winter 1995 correspond to the peak of the spawning season.

References

- Bakun, A. 1996. *Patterns in the Ocean: Ocean Progresses and Marine Population Dynamics*. California Sea Grant, San Diego, California, USA, in co-operation with Centro de Investigaciones Biologicas de Noroeste, La Paz, Baja California Sur, Mexico. 323pp.
- Belvèze, H. 1984. Biologie et dynamique des populations de sardine (*Sardina pilchardus*) peuplant les côtes Atlantiques Marocaines et propositions pour un aménagement des pêches. Doc. d'Etat, Université de Bretagne Occidental: 532pp.

- Blaxter, J.H.S. and J.R. Hunter. 1982. The biology of clupeoid fishes. *Adv. Mar. Biol.* 20: 1-223.
- Conand, F. 1975. Distribution et abondance des larves de Clupeïdés au large des côtes du Sénégal et de la Mauritanie en Septembre–Octobre 1972. *Archive. Centre Rech. Oceanogr. Dakar-Thiaoroye* 26: 11pp.
- Ettahiri, O. 1996. *Etude de la phase planctonique de la sardine, Sardina pilchardus, et de l'anchois, Engraulis encrasicolus des côtes Atlantiques Marocaines*. Doc. d'université. Université de Bretagne Occidentale: 262pp.
- Ettahiri, O. 1997. Caractéristiques des frayères et nourriceries de la sardine, *Sardina pilchardus*, des côtes Atlantiques Marocaines (stock central). COPACE/Rapport du Groupe de Travail *ad hoc* sur la sardine, Casablanca, 25-28 Février 1997.
- Marchal, E. 1991. Un essai de caractérisation des populations de poissons pélagiques côtières: cas de *Sardinella aurita* des côtes ouest africaines. In Cury, P. and C. Roy (eds.). *Pêcheries ouest-africaines–variabilité, instabilité et changement*. ORSTOM, Paris: 192-200.
- Mittestaedt E. 1991. The ocean boundary along the northwest African coast: circulation and oceanographic properties at the sea surface. *Prog. Oceanog.* 26: 307-355.
- Peterson, W.T., C.B. Miller and A. Hutchinson. 1979. Zonation and maintenance of copepod populations in the Oregon upwelling zone. *Deep-Sea Res.* 26A: 467-494.
- Roy, C. 1991. *Réponses des stocks de poissons pélagiques à la dynamique des upwellings en Afrique de l'ouest: Analyse et Modélisation*. Doc. d'université. Université de Bretagne Occidentale, Brest, 149pp.

Figure Legends

Figure 1. Spawning grounds and nursery areas of sardine, and bathymetric map of the Atlantic Moroccan south coast.