# SPATIAL SPAWNING STRATEGY OF JACK MACKEREL (*TRACHURUS SYMMETRICUS MURPHYI*) OFF THE CENTRAL-SOUTH REGION OF CHILE

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Jack mackerel is a middle-sized pelagic species that inhabits the southern Pacific Ocean. This species performs a seasonal migration that would explain its availability along the Chilean coast, this seasonal migration has been related to feeding and spawning processes, with an offshore migration for spring spawning in oceanic waters, and an onshore migration during end summer-autumn for feeding.

From 1997 until 2001 acoustic surveys are performed during spring in order to study the spawning zone of jack mackerel. From 1997 until 2001 acoustic surveys are performed during spring, in order to study the spawning zone of jack mackerel, *Trachurus symmetricus murphyi*, off the Central South region of Chile. Knowing that the spawning of jack mackerel is related to sea surface temperature (SST), the survey area is located between the shore and up to 800 nautical miles from the coastline.

A specific survey design, called “Rastrillo” was conceived and Rastrillo surveys were held in November in 1997, 2000 and 2001, and December 1998 and 1999. These surveys are performed using a set of fisheries vessels achieving simultaneous E-W parallel (linear or zigzag) transects. Each vessel performs two transects from the coastline up to 800 nautical miles offshore. Eggs and larvae are collected during plankton stations each 15 nautical miles using a WP2 plankton net; an acoustic survey is performed using the fleet echo sounders, *i.e.* only relative values (occurrence of aggregation echo types) can be recorded. They are classified according to their abundance (high: >200t, medium: 20-200t, low: <20t) and their type (defined during ECOS Project C97B06: dense schools, dense layers, dispersed layers and small schools). From these results a series of density and distribution indexes are calculated, such as the occupation surface index (OSI) (nb of positive ESDU over total nb of ESDU), for the whole detection and for each class of echo type. Similarly a series of indexes are calculated for the eggs (4 classes: “no eggs”; “low”: 1-249 eggs/10 $m^2$; “medium”: 250-499; “high”: >500 eggs/10 $m^2$) and abundance index.

In 1997 and 1999, the occupied surface indices (OSI) were high (15% and 15.5% respectively) and the egg abundance index (EAI) low (4.3 and 14.8%). In 1998, 2000 and 2001, OSIs were low (2, 4 and 4.3%) while EAIs were high (21.5, 36.8 and 39.4%). During all surveys, the highest abundance of eggs and the highest abundance of fish school echoes were located in different areas. Figure 1 describes the distribution of eggs and fish during the 2000 survey. It can be noted that high abundance of eggs occurs in the low fish abundance area, and vice versa. Geostatistical variograms were calculated on both egg and fish distributions. In the case of jack mackerel, 47.7% of variance is due to a nugget effect (76.4% for egg distribution); jack mackerel distribution presents spatial structures of 4.8 and 14.4 nautical miles. For egg distribution, the spatial structure is much wider, and above 42 nautical miles.

Lorenz curves were calculated on eggs and fish data. They describe the distribution heterogeneity in the surveyed area. Results show that the egg distribution is much more homogeneous than fish distribution. Moreover, they present an opposite tendency: the egg distribution is the most homogeneous when the fish distribution is the most heterogeneous.

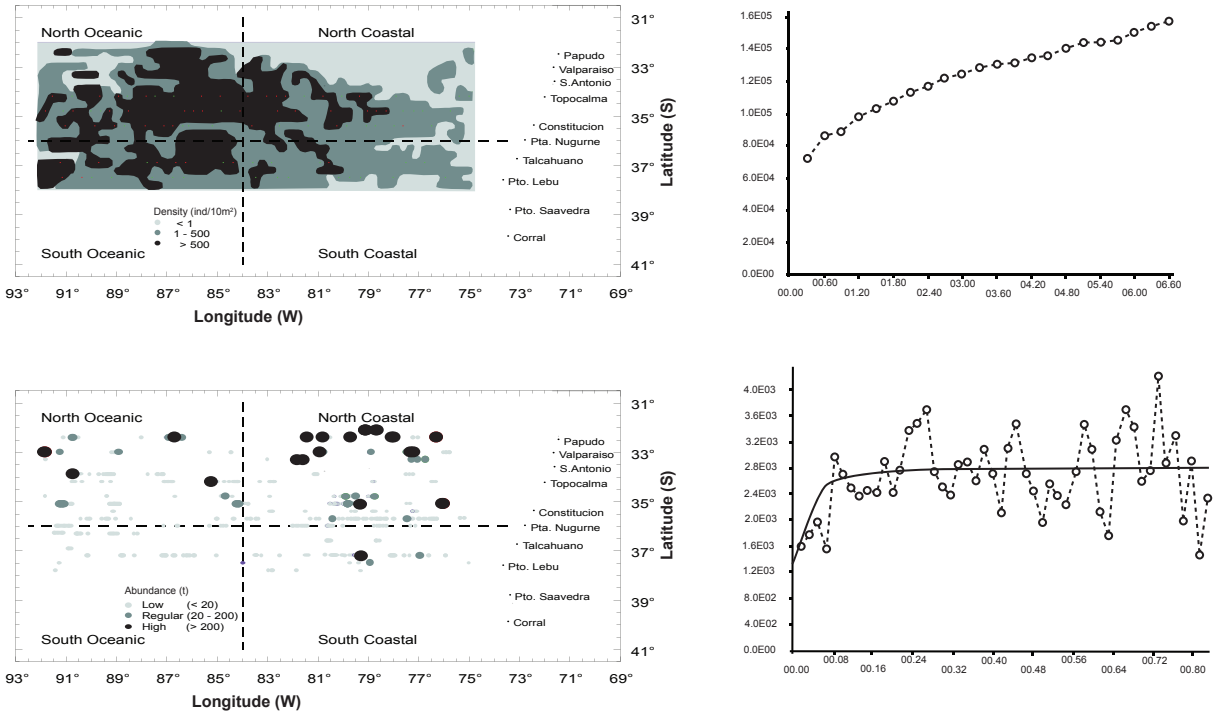


**Figure 1. Description of eggs (above) and jack mackerel (below) distributions during year 2000. Scales present relative concentrations from high (black) to low-null (light grey). The respective spatial distribution variograms are presented on the right of the figure. Note that eggs are concentrated on the centre and west of the surveyed area, and fish on the east and north. The highest concentration of schools is present in area of lowest egg concentrations. Geostatistical variogram of egg distribution shows a long range model (above 3 degrees) while the fish distribution model has a range of less than 10 nautical miles.**

From these results a series of hypothesis are drawn, the principal one being that in the spawning area, jack mackerels do not maintain compact aggregation and stays scattered, which make them invisible to the fleet echo sounders. A behavioural strategy of spawning jack mackerel is described: contrarily to many pelagic fish, this species favour a high dispersion of eggs by developing a highly scattered spawning behaviour, in ultra-oligotrophic areas (72.3ng/l). We hypothesize that the ecological implications of such spawning behavior are: reduced risks of predation on larvae and eggs (low abundance of predators); reduced intraspecific competition (dimension of the spawning area); and low interspecific competition for food during larval stages.

## Acknowledgements

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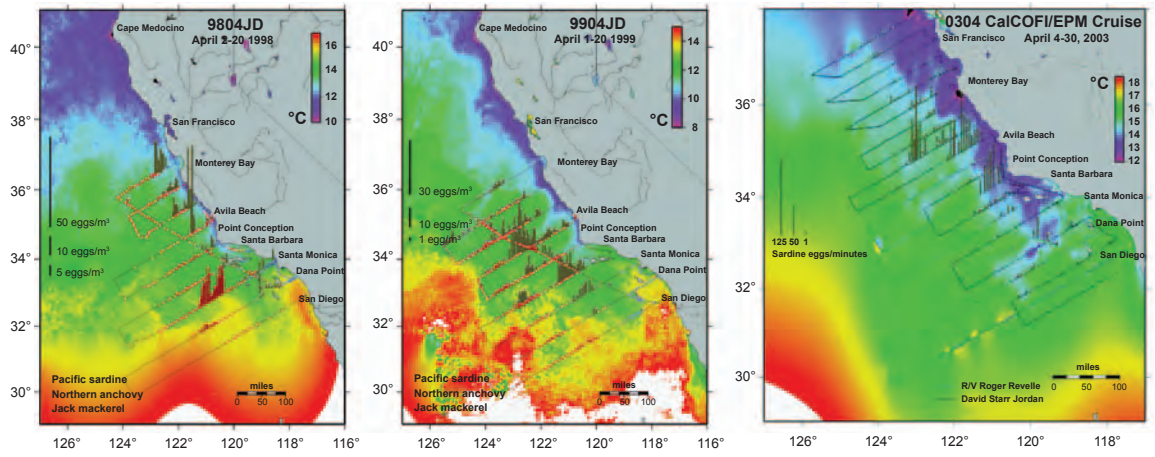
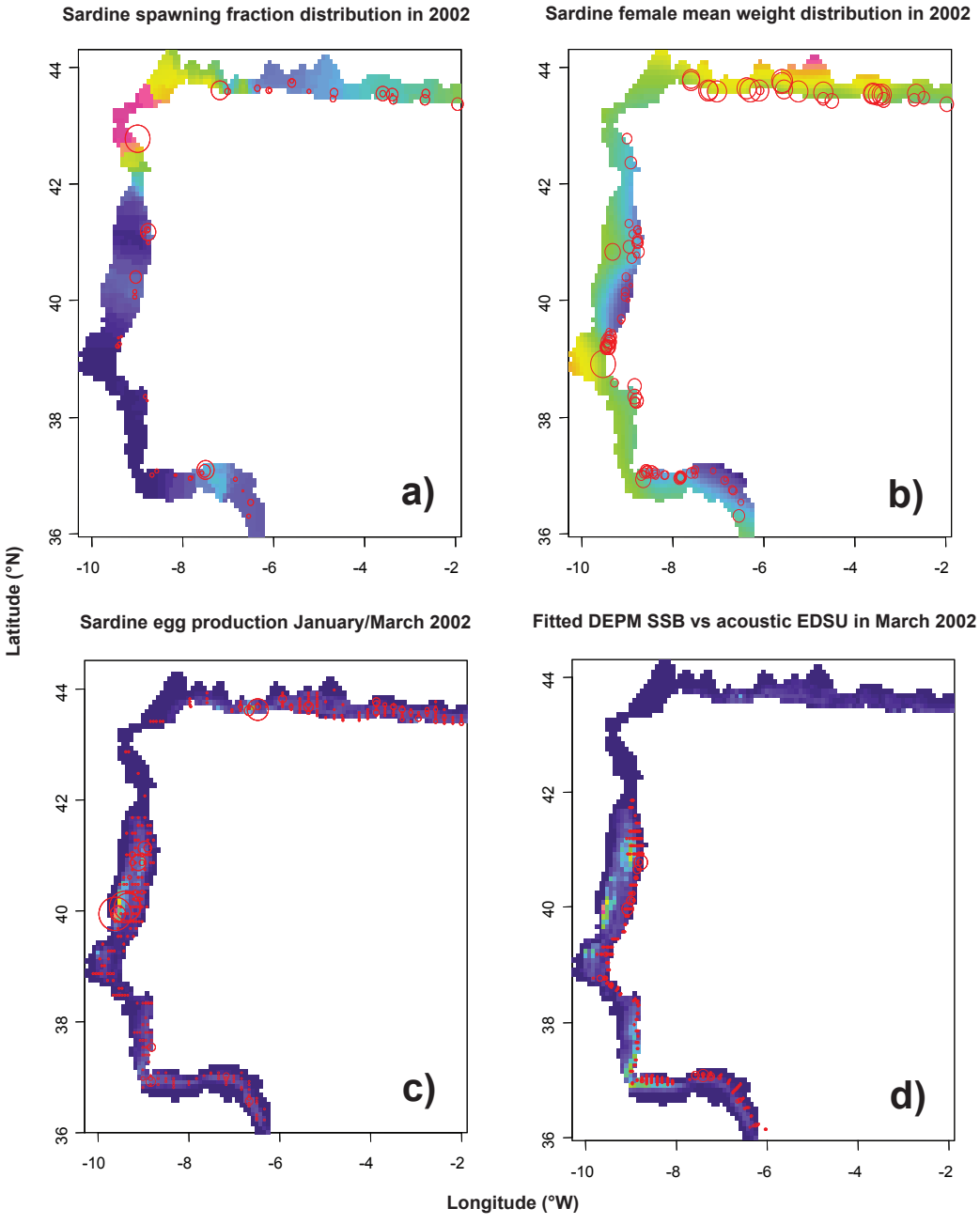
## Plate 9




## Plate 10



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