# INVESTIGATION OF INTERANNUAL DYNAMICS OF SUITABLE SPAWNING HABITAT FOR ANCHOVY (*ENGRAULIS ENCRASICOLUS*) IN THE SOUTHERN BENGUELA USING A 3D HYDRODYNAMIC MODEL

**Claude Roy[1], Pierric Penven[1] and Carl D. van der Lingen[2]**

*[1]Centre IRD de Bretagne, 29280 Plouzané, France.*

*[2]Marine and Coastal Management, Pvt Bag X2 Rogge Bay 8012, South Africa.*

Environmental characterization of the spawning habitat of anchovy in the southern Benguela through single parameter quotient analysis has identified ranges of environmental variables within which this species "prefers" to spawn (Twatwa *et al*., 2004). The objective of this work is to test the potential of using simulations from an hydrodynamic model as a surrogate for direct measurements of the physical environment to explore the interannual variability of the potential anchovy spawning habitat. Once validated, it is thought that this approach could provide a methodology to diagnose the impact of future climate change on anchovy spawning habitat.

A ten year simulation (1991 to 2000) of the physical environment of the southern Benguela has been produced using an hydrodynamic model based on the ROMS numerical code. The model is forced at the surface with realistic weekly wind. Details of the configuration are given by Penven *et al*. (2001) and Blanke *et al*. (2002). The simulation provides modeled fields of temperature, salinity and currents in 3D with a spatial resolution ranging from 9 km inshore to 18 km offshore and with a temporal resolution of two days. The quotient analysis gives the ranges of temperature, salinity, current speed and water depth within which anchovy select to spawn, using observations made during annual cruises conducted in November (the peak anchovy spawning period). At each time step of the simulation, the Boolean combination of temperature, salinity and current speed ranges given by the quotient analysis is compared to surface values of those parameters given by the model over the whole domain, and areas meeting the criteria ranges are identified. Incorporation of the depth range identified by the quotient analysis provides a means of defining the area that is suitable for anchovy spawning. The resulting output is a ten year simulation with a two day time-step of the location and size of suitable anchovy spawning habitat in the southern Benguela. Plate 1 (page xi) presents a snapshot of suitable spawning habitat that corresponds to 18 November 1991.

A validation of the simulated suitable spawning habitat is performed by comparing the number of anchovy eggs collected during November surveys from 1991 to 1998 with the suitable spawning areas calculated by the model (Fig. 1). A positive correlation is found for area A (the west coast) and for the major anchovy spawning ground that corresponds to the combination of areas B+C+D (the

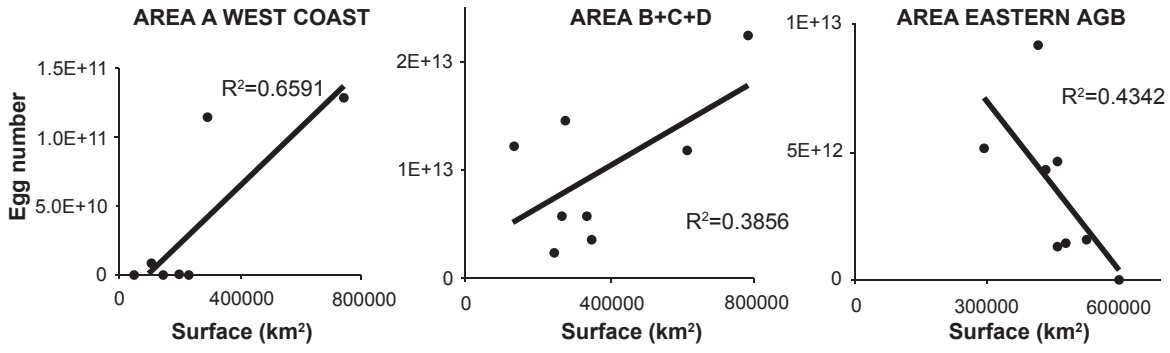



**Figure 1. The relationship between the simulated suitable spawning surface and observed anchovy egg number during the November surveys from 1991 to 1998.**

southwest coast, and western and central Agulhas Bank, respectively). In those areas, an increase in the simulated suitable spawning area corresponds to an increase in the observed abundance of anchovy eggs. An unexplained negative correlation is found on the eastern Agulhas Bank.

Using a simple combination of environmental parameters deduced from data collected during November surveys, the hydrodynamic model is able to partly reproduce the observed interannual variability in the distribution of anchovy spawning. This result gives us some confidence in the ability of such tools to investigate the impact of climate changes on spawning habitats. Future work will include a new configuration of the model with a southward and eastward extension of the oceanic boundary of the south-east corner of the domain. This will allow a better representation of the Agulhas retroflexion and of the influence of the Agulhas current on the Agulhas bank. Further development will include a realistic forcing at the oceanic boundaries in order to integrate the impact of remote events such as ENSO.

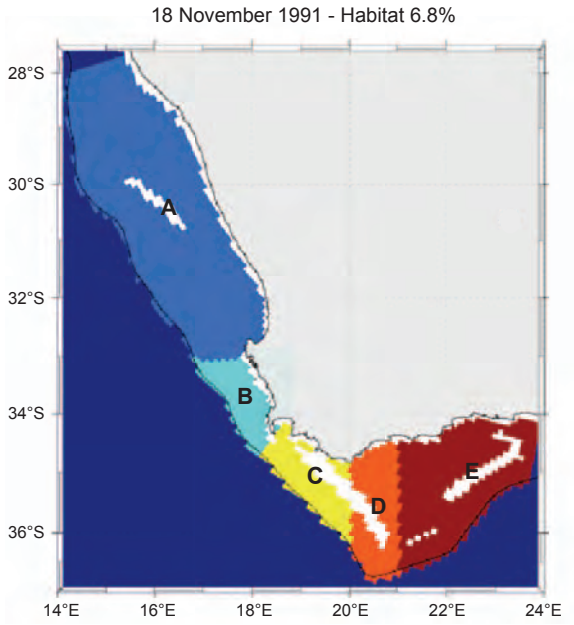
## References

Blanke B., C. Roy, P. Penven, S. Speich, J. McWilliams and G. Nelson. 2002. Linking wind and interannual upwelling variability in a regional model of the southern Benguela, Geophysical Research Letters 29(24): 2188, doi:10.1029/2002GL015718.

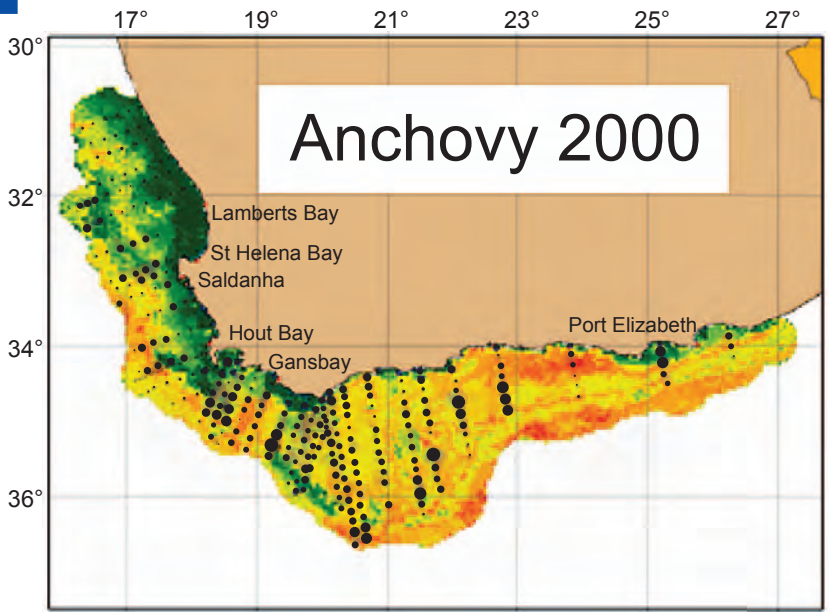
Penven P., C. Roy, G. Brundrit, A. Colin de Verdière, P. Fréon, A. Johnson, J. Lutjeharms and F. Shillington. 2001. A regional hydrodynamic model of the Southern Benguela upwelling. South African Journal of Science 97: 472-475.

Twatwa N.M., C.D. van der Lingen, L. Drapeau, C.L. Moloney and J.G. Field. 2004. Characterizing and comparing the spawning habitats of anchovy (*Engraulis encrasicolus*) and sardine (*Sardinops sagax*) in the southern Benguela upwelling ecosystem. African Journal of Marine Science 27(2): 487-499.

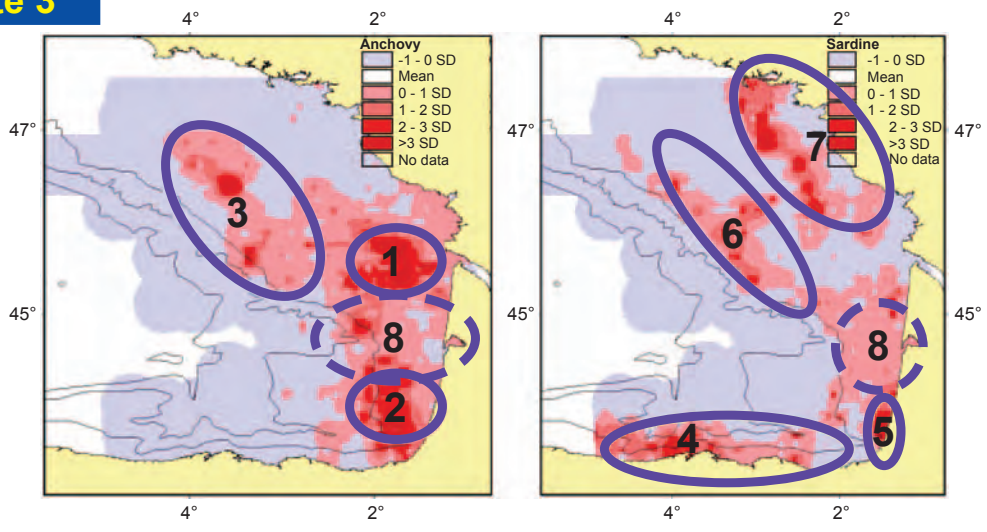
## Plate 1




## Plate 2




## Plate 3



# GLOBAL OCEAN ECOSYSTEM DYNAMICS

## GLOBEC Report No.22

SMALL PELAGIC FISHES AND
CLIMATE CHANGE PROGRAMME

Report of a GLOBEC / SPACC Meeting on
Characterizing and Comparing the Spawning
Habitats of Small Pelagic Fish

14-16 January 2004, Concepción, Chile

GLOBEC

# GLOBAL OCEAN ECOSYSTEM DYNAMICS

## GLOBEC Report No.21

## Report of a GLOBEC / SPACC Workshop on Characterizing and Comparing the Spawning Habitats of Small Pelagic Fish

**(12-13 January 2004, Concepción, Chile)**

## GLOBEC Report No.22

## Report of the SPACC Meeting on Small Pelagic Fish Spawning Habitat Dynamics and the Daily Egg Production Method (DEPM)

**(14-16 January 2004, Concepción, Chile)**

IRD
Institut de recherche pour le développement

IAI

IDYLE
IRD M&CM UCT

Sociedad Chilena de Ciencias del Mar

International Council for Science
Scientific Committee on Oceanic Research

LOTA PROTEIN