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ANALYSIS OF THE TRAWL FLEET SPATIAL DISTRIBUTION DURING AND POST PRESTIGE OIL SPILL BY GIS SIMULATIONS AND REAL DATA

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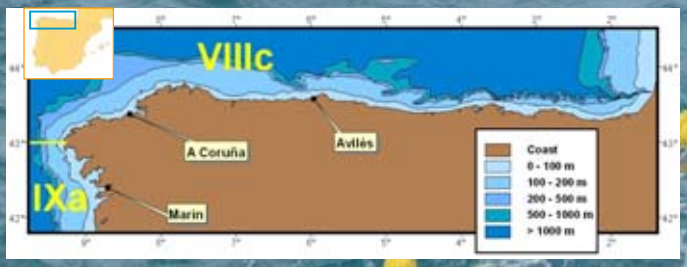


INTRODUCTION

During and after the *Prestige* oil spill (13 November 2002), the Spanish Government adopted a series of fisheries management measures in North Atlantic waters of the Iberian Peninsula (ICES Divisions VIIIc and IXa North). The limitations were fishing closure areas, with absolute banning for fishing, and restrictions for fleet types and gears. The Program of observers on board commercial vessels of the Instituto Español de Oceanografía resumed as soon as management measures allowed it. These restrictions could have affected the use of the traditional fishing grounds, specially the spatial fishing effort distribution. The ban could have a similar effect like the produced by the Marine Protected Areas, in terms of transfers to other fishing grounds and changes in the exploitation pattern (Pastoors *et al.*, 2000 and Rijnsdorp *et al.*, 2001), as an indirect result of the management (Dipper and Chua, 1997).

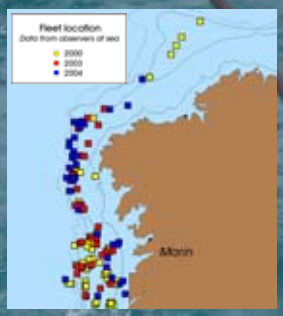
The aims of this work are to determine these possible changes on spatial effort distribution derived by the oil spill as well as to explore and test "simulations module FAST" in this kind of analysis.

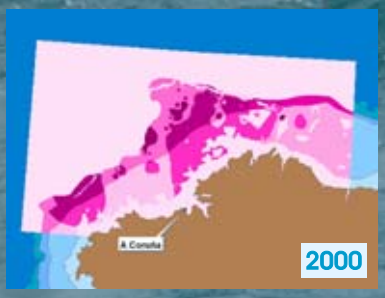
MATERIAL AND METHODS

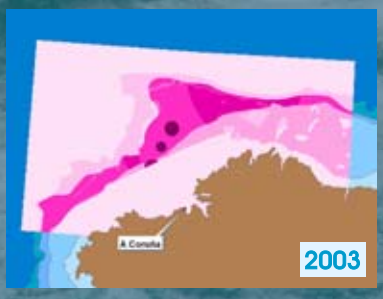
Two fishing ports, A Coruña and Marín, were selected as the most important landing sites of greatest affected area to carry out this work. Otter-trawl fleet was chosen as representative fleet because of its importance, both socio-economically and biologically. Fishing effort data for the years 2000, 2003 and 2004 were selected as representative of periods pre-spill, during oil spill and post-spill. The effort unit was the number of trips for fleet and ports in the studied years. Observers onboard data from these years were used to locate the fishing fleet geographic locations during the periods. Year 2000 was chosen because it presents the best sampling coverage of last years preceding the oil spill. In 2003 onboard sampling was more restricted due to banning of fishing operation.

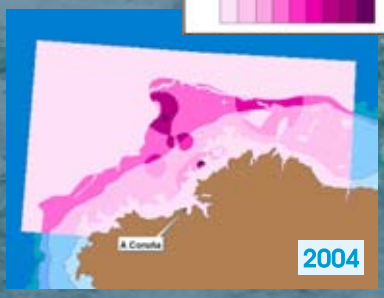
The distribution of fishing effort is obtained by FAST, a computerized simulation tool based on two models focussing on the analysis of the spatial components. One of these models was developed by Caddy and Carocci (1999) and is based in two methods, the "friction of distance" approach and the Gaussian Effort Allocation Model approach. The other is based on deductive modelling of use of space (Corsi, 2000). This application is an extension of Arcview GIS software (v. 3.2). The distribution is based on the assigned score to each value of the variables in each location. So, each space unit of the affected area will have assigned a proportion of the effort based on the combined score of different information layers. These constraint layers determine the fishing effort density distribution.

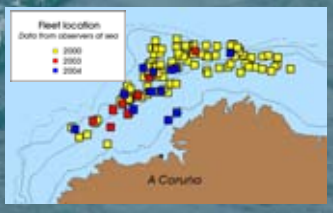
The accessible zone, the authorized zone and the exploited area were defined. The basic information geo-referenced layers were land-sea, location of the ports and the area of interest for the fleet segment. The constraint layers were bathymetry (fleets bathymetry segregation), seabed substrate (fishable areas), regular fishing regulation and specific oil spill regulation (fishing closure areas) as well as hauls duration.











RESULTS AND DISCUSSION

ABOUT THE SOFTWARE

FAST simulations do not show the real effort distribution in some cases. FAST is a tool which allow to obtain a probabilistic distribution of effort by using quite basic and limited input information. This probabilistic distribution is the result of the combination of different "constraint layers".

Despite the scoring of each layer are based on previous knowledge of the fishery, the application gives as results zones with identical characteristics that can be really exploited or not, as maps of data from observers at sea show it. A greater precision in score functions and a better definition of the area of interest are needed to improve the simulations.

Other softwares as ArcGIS, GRASS, interfaces GRASS-R, could be used in the same analysis to obtain a higher assessment of this application.

ABOUT THE EFFECTS ON SPATIAL DISTRIBUTION

Both areas, Marín and A Coruña, were affected by the Prestige fishing closure, with an effort movement towards deeper waters. In the case of Marín, this was the only option to this fleet because of the fishing closure location. The banned zone was delimited in an area with very high effort density in 2000. After the ban, in 2004, this fleet continued fishing in deeper waters, probably because a change in target species occurred, without rejecting a fishing closure effect. In A Coruña, it is necessary to clarify why during 2003, movement towards not restricted area have not been detected. Maybe this shallower waters are not a traditional fishing ground. For this port, in 2004 (post-spill) the effort spatial distribution was similar to pre-spill period. A further analysis is necessary to determine if an insufficient sampling in 2003 due to the complications derived from the oil spill, could have had an effect in the simulations.

A spatial pattern in relation to effort (hauls duration) can be observed. This pattern define high effort density localized areas, that could correspond to fishing grounds.

Further work could improve the application. For instances using abundance data of target species from the commercial fleet. In this case, information on total commercial catch and effort by ICES squares, or any other georeferenced grid, would be necessary. Both observers onboard data and surveys are quite useful information but they are more restricted spatio-temporally than the total commercial catch and effort. The use of fish abundance based on survey data could distort the commercial effort distribution, since spatial exploitation pattern and sampling survey are totally different.

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