AN APPROACH TO THE SPATIAL DISTRIBUTION OF FISHING EFFORT IN THE GULF OF CADIZ

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SUMMARY

The spatial distribution of the fishing effort exerted by the trawl fleet of Isla Cristina port (Huelva, Spain) is simulated by means of an application (FAST) for Geographic Information Systems (ArcView), which can offer results just with limited input data.

The simulation were carried out with three input variables: depth, distance from fishing grounds to port and the fishing laws in force in the area. The results obtained from two simulations tested match up the effort distribution detected in the area for both the fleet as a whole and a given segment of the same.

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INTRODUCTION

Given the fact that the fishing intensity is proportional to the mortality per catch and this is one of the most important parameters used in fishing models, the study of the spatial distribution of the fishing effort exerted by a fleet in a certain fishing ground turns out to be a very important element to carry out a proper management of a fishery. On the other hand, the spatial allocation of the effort exerted by a fleet has a growing interest in the management necessary for the appropriate conservation of the most intensively exploited resources. Nevertheless, there are very few studies directly stressing this subject in the Gulf of Cadiz, the closest examples being in some Mediterranean areas (Corsi 2000; Baro & Serna-Quintero, 2001).

MATERIAL AND METHODS

The trawl fleet of Isla Cristina port (Huelva) has been chosen for the tested simulations. This fleet is the second one in number of vessels in the area recording the highest values in power and GRT, it exploits most of the fishing grounds in the Gulf of Cadiz (*Ramos et al,* 1996).

The spatial distribution of the fishing effort has been obtained by means of the extension for ArcView (ESRI, 1998) called FAST (Fishing Activity Simulation Tool) v.0.6 (FAO, 2002). This application is based on two empirical approaches, one of them based on the concept developed by Isard and Liossatos (1979), called `friction of distance´(Seijo *et al*. 1994; Caddy and Carocci, 2000), and the other one based on a deductive model on the use of space (Corsi 2000). Both models are developed in FAST giving values to a set of variables taking part in the spatial distribution of effort ('scoring function'). These values are distributed as percentage of the total effort exerted for every variable considered. We have used data related to the different type of trips of the Isla Cristina fleet (Jiménez, 2002) and the spatial distribution of fishing grounds (Ramos *et al.*, 1996) to obtain the scoring functions of each variable.

In the tests carried out, the variables are defined according to three basic information layers. First of them related to the place where it is possible to fish (in the simplest form: land or sea), second one related to the location of the home ports of the fleet operating in the area, and the last one regarding to the area of interest for the fleet (Figure 1).

To simulate the effort spatial distribution we have used three variables: the depth, the distance from the ports to the different fishing areas and the fishing rules in force in the area.

In the first simulation, the whole fleet of Isla Cristina has been considered (Figures 2, 3 and 4).
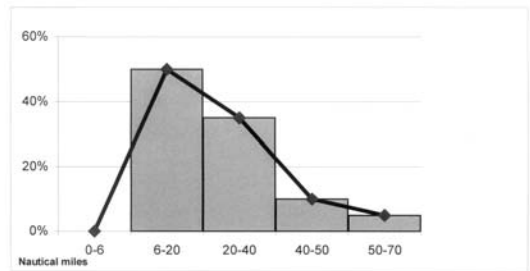

Figure 2.
*Fishing intensity according to the distance to Isla Cristina port.
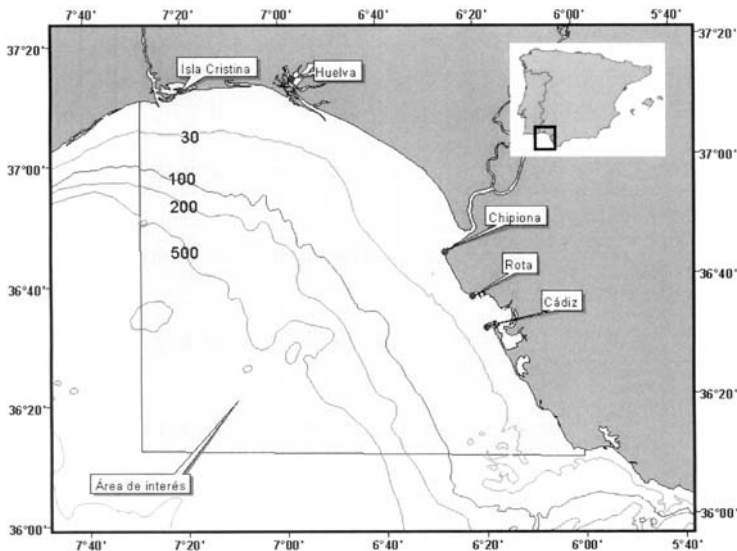Using the whole trawl fleet.*

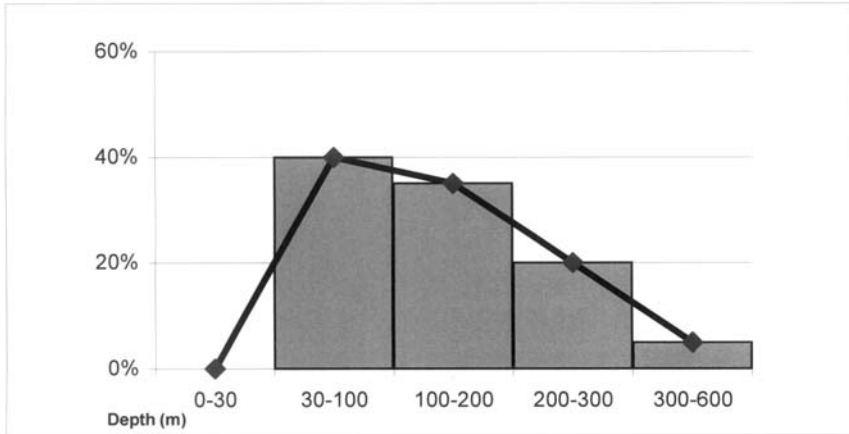Figure 1. *Area of interest and main home ports of the Gulf of Cádiz fishing fleets*

Figure 3. *Fishing intensity according to the bathymetry. Using the whole trawl fleet.*

In a second simulation it has been taken into consideration only the segment of the fleet targeting on Nephrops norvegicus. In this case, the values of the "scoring function" related to the distance to the port and the bathymetry (Figures 5 and 6), have been modified adapting them to this segment of the fleet. (Jiménez 2002).

RESULTS AND DISCUSSION

The result of the first simulation, carried out for all the Isla Cristina fleet (Figure 7), is a good representation of the probabilistic distribution of the fishing effort when is compared with the spatial distribution of more common fishing grounds (Ramos *et al.*, 1996). However, a certain influence of the "distance effect" it is detected in those areas in which the fleet does not fish. This "distance effect" produces higher probabilities than expected in the shallowest and in the deepest areas.

In order to minimize the effect caused by the values of the distance to the port, a second simulation has been carried out taking into account only a segment of a more specialized fleet operating in a limited area (Figure 8). The result of this simulation agrees with the observed spatial distribution of the species in the area of interest (Baro et al, 2001). However, a certain "distance effect" still remains, since high probabilistic values of the distribution of fishing effort are observed in zones where they were not
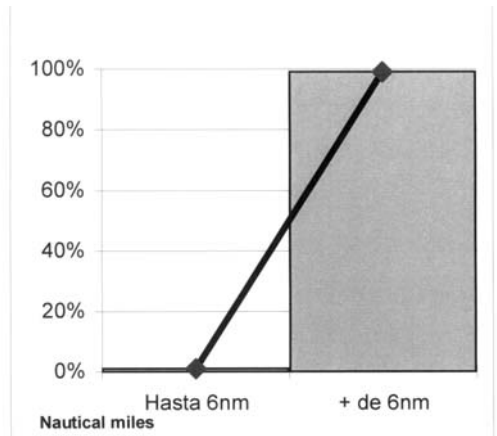

Figure 4.
Fishing intensity according to the rules applicable to trawl fleet.

expected. Probably, the effect of the distance could have been minimized in a more appropriated way by fitting the area of interest to the aim of this simulation.

The application tested in this study seems to be useful to know how the fishing intensity is distributed when only a limited information is available. If simulations of the same type were made for all the fishing ports in an area, could be possible to obtain a general map of the spatial effort distribution for the whole fleet overlapping the different simulation layers
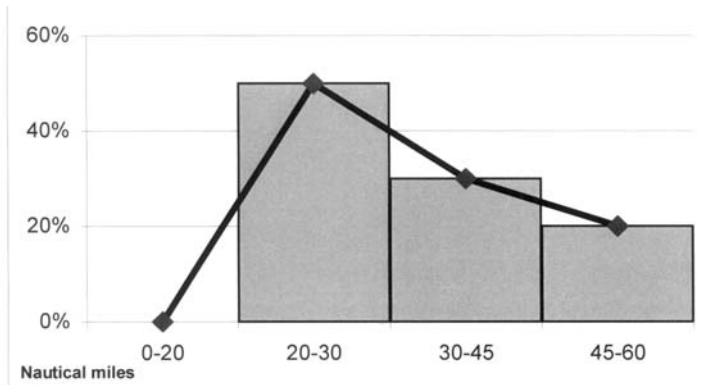
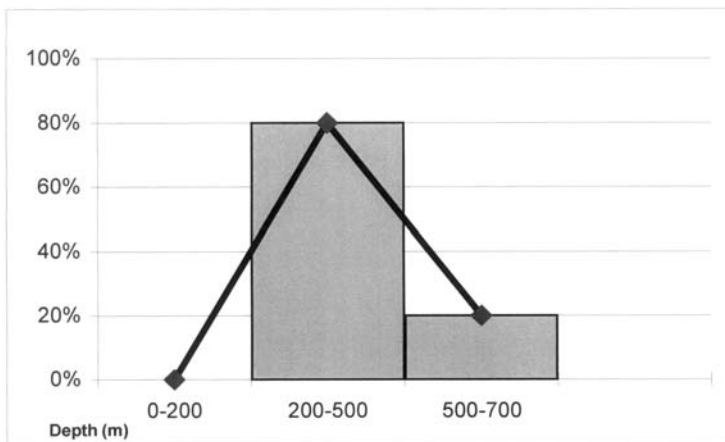Figure 5. *Fishing intensity according to the distance to Isla Cristina port. Fleet targeting Nephrops norvegicus.*

Figure 6. *Fishing intensity according to bathymetry. Fleet targeting Nephrops norvegicus.*

These kind of maps can be very useful to improve the management of fisheries. The use of a larger number of variables and a better adjustment of the basic information layers will produce a more realistic final result.

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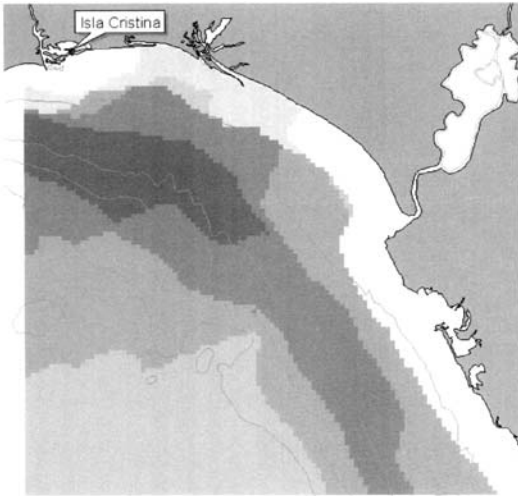
Figure 7.
*Probabilistic distribution of fishing effort for the whole
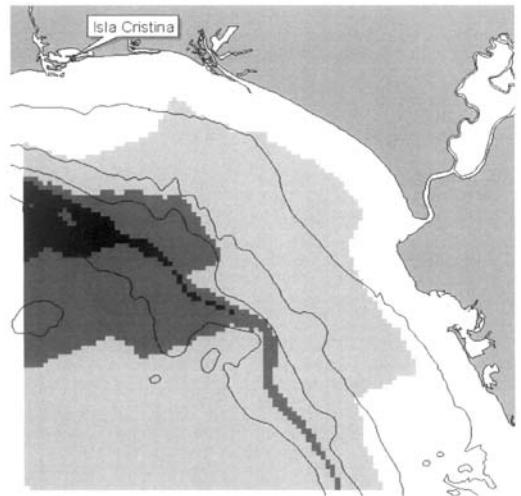Isla Cristina fleet.*

Figure 8.
*Probabilistic distribution of fishing effort of the Isla Cristina fleet
targeting Nephrops norvegivus.*

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