**Analysis of effort distribution by bottom trawlers from Motril (Spain) using FAST V.06 (Fishing Activities Simulation Tool; FAO – COPEMED)**

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**1. Identification of Data Provider**

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**2. Identification of Fleet Segment**

Data set name: Multispecific bottom trawlers based in Motril (Spain).

**3. Definition of basic geographic layers and fleet segment. Data for the validation**

Geographic projection: UTM, zone 30. Units: meters, Distance Units: meters.

Port:  Motril (Spain). Longitude: 3º 31.2W, Latitude: 36º 43.8N



Fleet Segment Description:
Name: Motril trawlers
Id: 001
Number of boats: 30
Home harbour: Motril
Nominal effort: 10500
Unit of nominal effort: HP
Speed: 10
Draught:

Autonomy and Unit of autonomy: 3 days
List of target species: *Mullus spp., Merluccius merluccius, Parapenaeus longirostris, Nehprops norvegicus, Cephalopods.*
Fishing gear: bottom trawl.
License type:
Fishing seasons: all year.

The Motril based bottom trawl fleet can be subdivided into two fleet segments:

|  | **Characteristics** | **Target Species** |
|---|---|---|
| **Small trawlers** | - Small Ships < 300 HP<br>- 3 o 4 fishermen<br>- Fishing 1 day (6 a.m. - 6 p.m.)<br>- Between (50 m - 350 m)<br>- Hauls 3 - 4 hours<br>- Maximum Distance to port 20 nm. Approx. | - *Mullus spp.*<br>- *Cephalopods*<br>- *Hakes*<br>- *Sparids*<br>- *Shrimps*<br>- *Others...* |
| **Large trawlers** | - Ships between (300 - 500) HP, modern fleet , good equipment<br>- 5 - 6 fishermen<br>- Fishing 1 week.. Landing 2 or 3 times a week, usually to nearest Port (usually Málaga)<br>- Between (50 m - 800 m)<br>- Hauls + 3 hours (can be up to 10 hours) | - *Shrimp*<br>- *Nephrops*<br>- *Hakes*<br>- *Other* |

Basic Layers:

Three vectorial georeferenced layers in decimal geographic coordinates:

- *Ports*: Arcview Point theme, including several ports from Alborán Sea (SE Spain)
- *Coastline*: Arcview Polygon Theme, including two polygons, with an ID field named "Land" and "Sea" (L and S) respectively .
- *Area of interest*: Arcview Polygon Theme, including one polygon only (S).
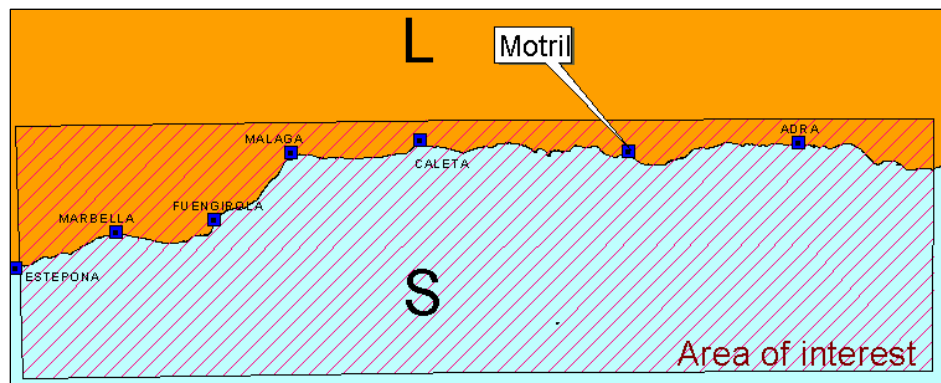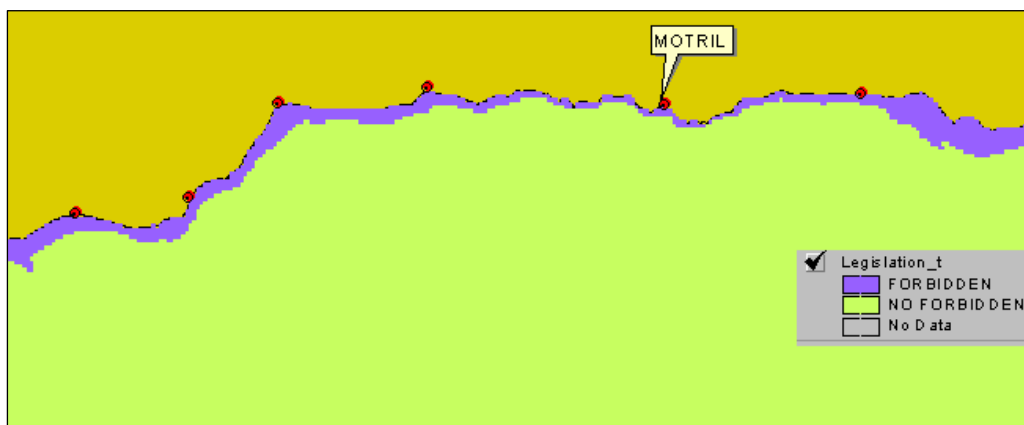
<u>Constraint layers</u>
Several grid georeferenced layers.


**Bathymetry layers**
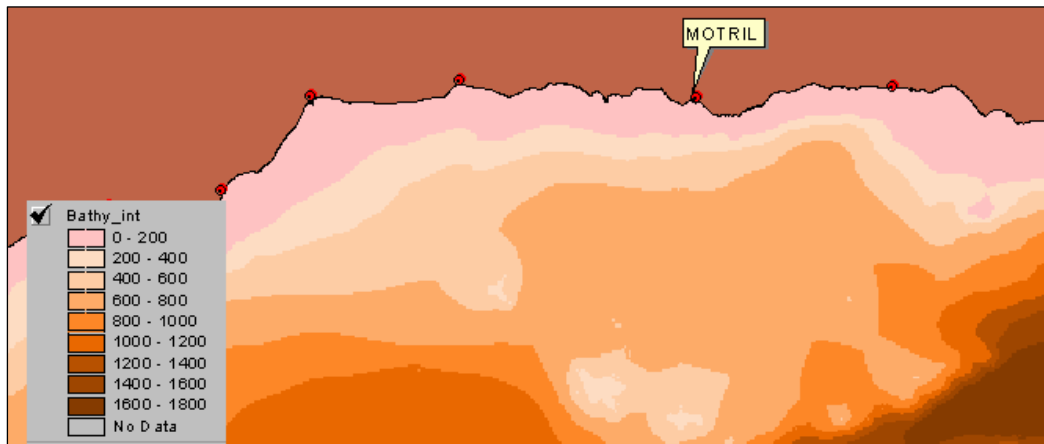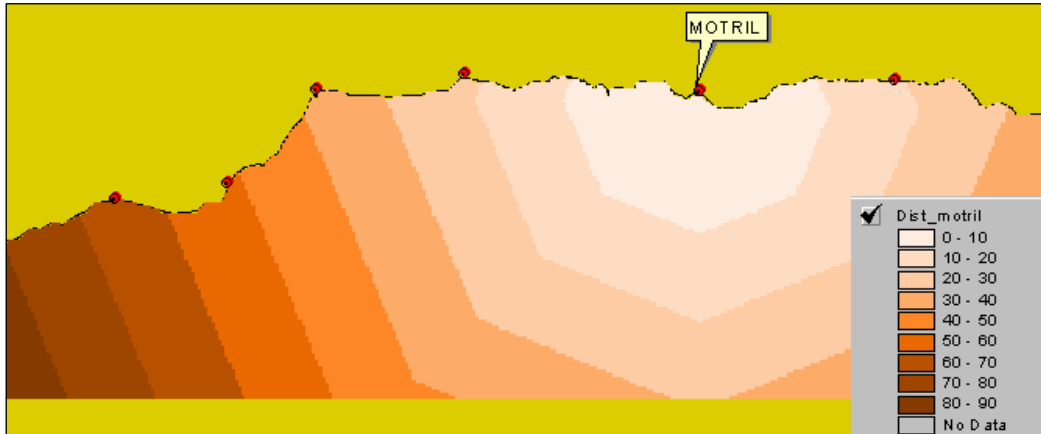


**Legislation layers**
The legislation defines a forbidden area for trawling, which is delimited within the 50 bathymetry meters.
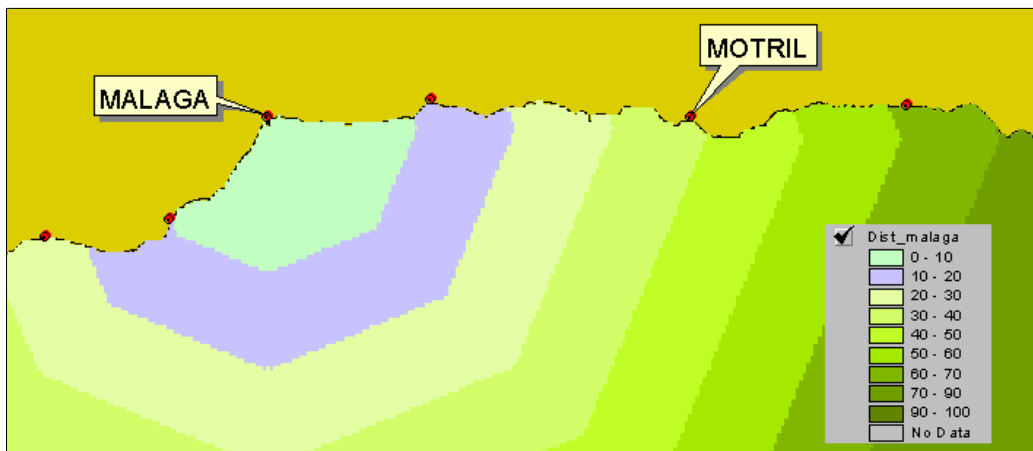
**Distance layers**

These two layers were generated by the FAST application.

Distance From Motril, home port of fleet, calculated by FAST in Nautical Miles unit.



Distance from Malaga, port with large fish market, calculated by FAST in Nautical Miles unit.



Resolution:

To generate constraint layers, a 750m resolution cell size was defined, except in the case of bathymetry constraint for which a 500m cell size was chosen. In a second step, when using FAST Simulation Wizard, the check box "Min Constr. Res." was activated, so a final resolution of 750m was obtained .

Data on direct observations of fleet activity can be used to check (validate) the results. Part of these data comes from observations made by helicopters patrolling the area and other part by observers boarding on the fishery fleet. Data cover the area of interest in space and time.
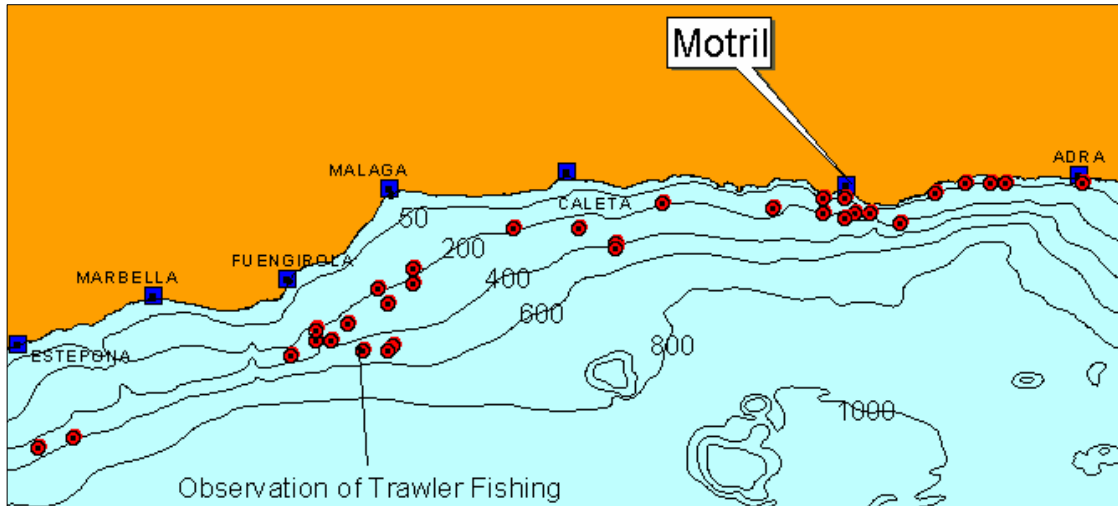


This compilation of information does not represent a random sampling of trawler activities in this area because it is more concentrated in the forbidden fishing zone (<50 m).
However, the identified points correspond to position of ships really fishing. Then, the recurrence of observations in specific zones provides a first idea of the fishing grounds extension and their distribution.

## 4. Simulations

This case studies starts with a limited dataset, present intermediate results and progressive integration of new data.
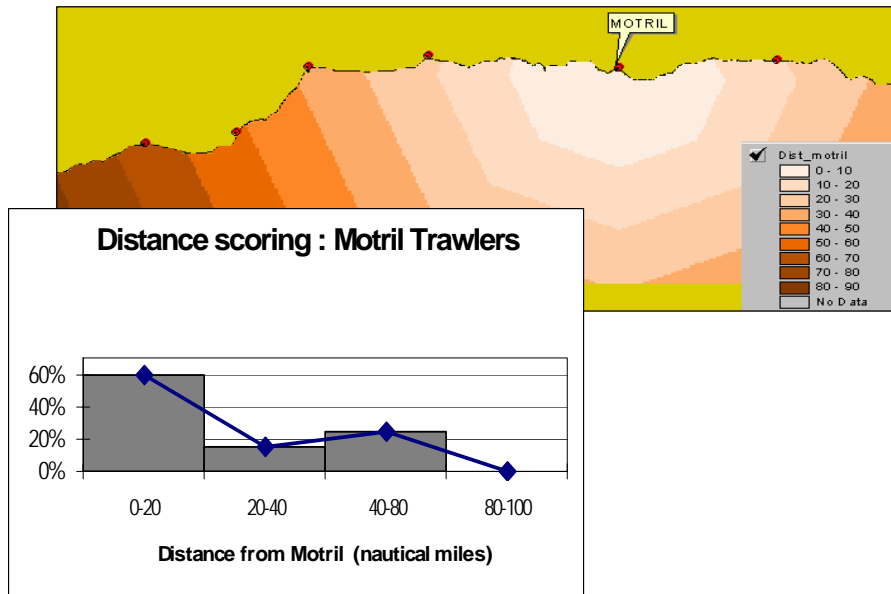
## 4.1 First Simulation

a) Fleet parameters

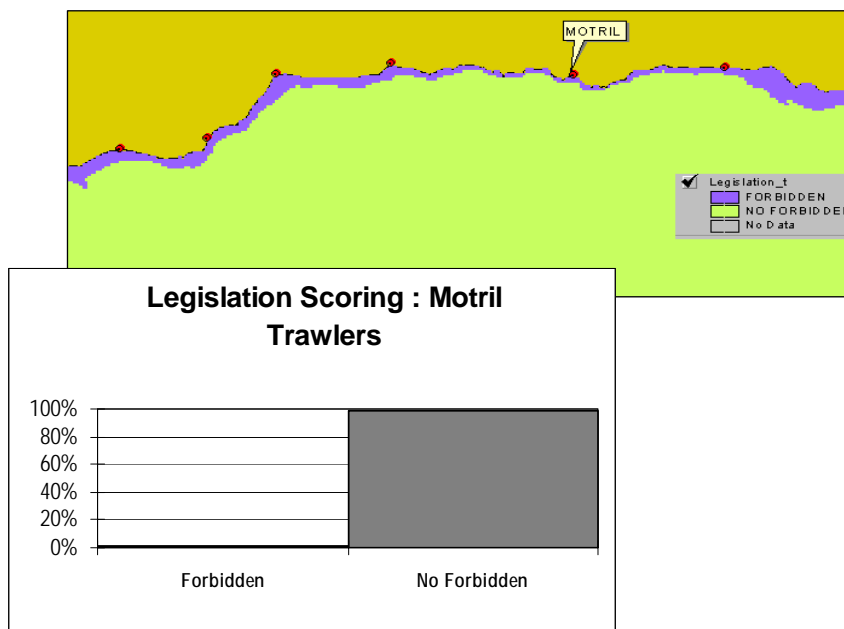| | |
|---|---|
| Name: "All Motril Trawlers" | Speed: 10 knots |
| Id: 001 | Autonomy: 3 days |
| Number of boats: 30 | Fishing gear: bottom trawl |
| Nominal Effort: 10500 HP | Target Species: Multispecific |

b) Basic Cartography
Alborán ports – Motril selected
Coastline
Area of interest

c) Constraints

Type: Distance from port (Motril)
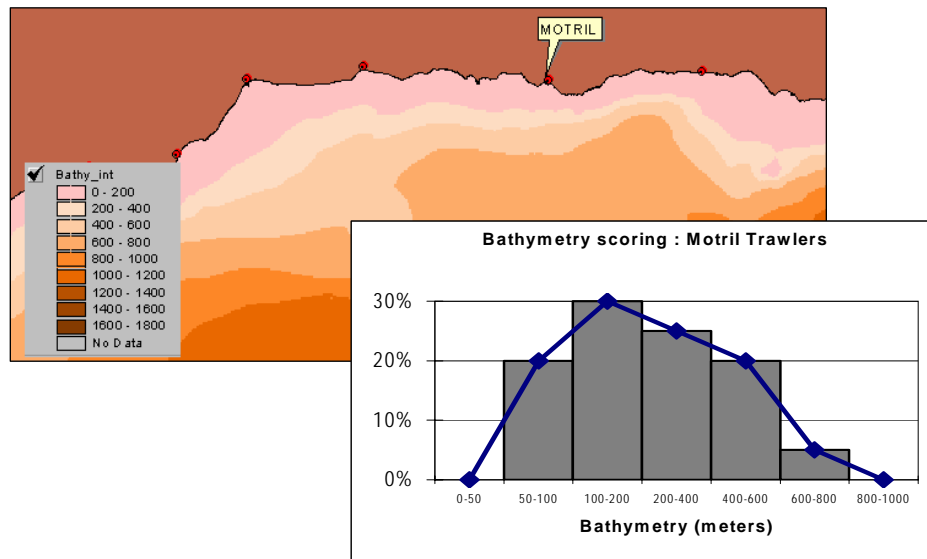


**Distance scoring : Motril Trawlers**

Distance from Motril (nautical miles)

Type: Legislation
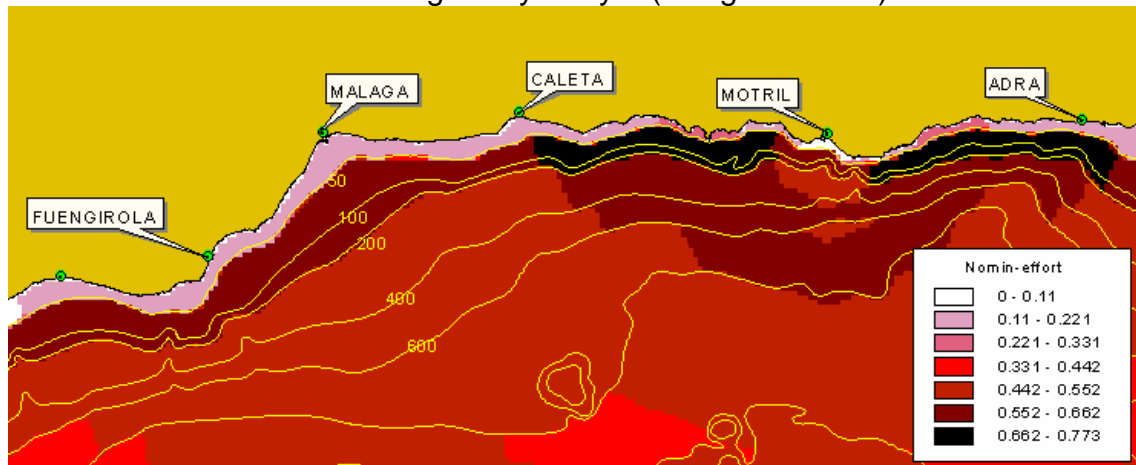


**Legislation Scoring : Motril Trawlers**
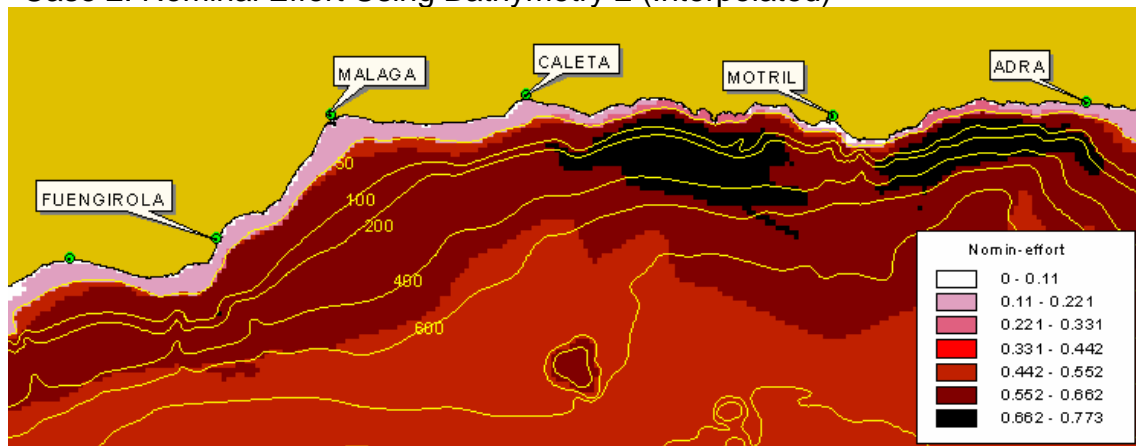
Type: Bathymetry



e) Results and conclusions

- Case 1: Nominal Effort Using Bathymetry 1 (Range Classes)



-Case 2: Nominal Effort Using Bathymetry 2 (Interpolated)

1. In general, neither of both cases fits well with our knowledge of the fishery, showing the highest effort concentration areas on both sides of Motril harbour. However, just in the closest areas to the port, the effort is lower than in farther areas.

2. The effort in bathymetric range from 0 to 50m is bigger than expected in both cases.

3. In both cases, it is observed that there are a unreal effort probability in deepest stratum in areas close to the harbour, maybe caused by the distance effect. On the other hand, it was expected a higher nominal effort value in areas farther than 40 nautical miles from the port, as it is showed in the correspondent scoring function.

4. In this particular case, the utility does not represent well the effort distribution of the Motril fleet, it seems necessary to get additional variables to achieve a better adjust.

## 4.2 Second Simulation

The Motril fleet was divided into two segments: small and large trawling fleets. The FAST simulation was run focusing on the Large Trawler Segment to estimate their effort distribution. This segment has a mean power and autonomy bigger than the small Trawling segment, and can be separately characterised to apply the distance scoring effect.
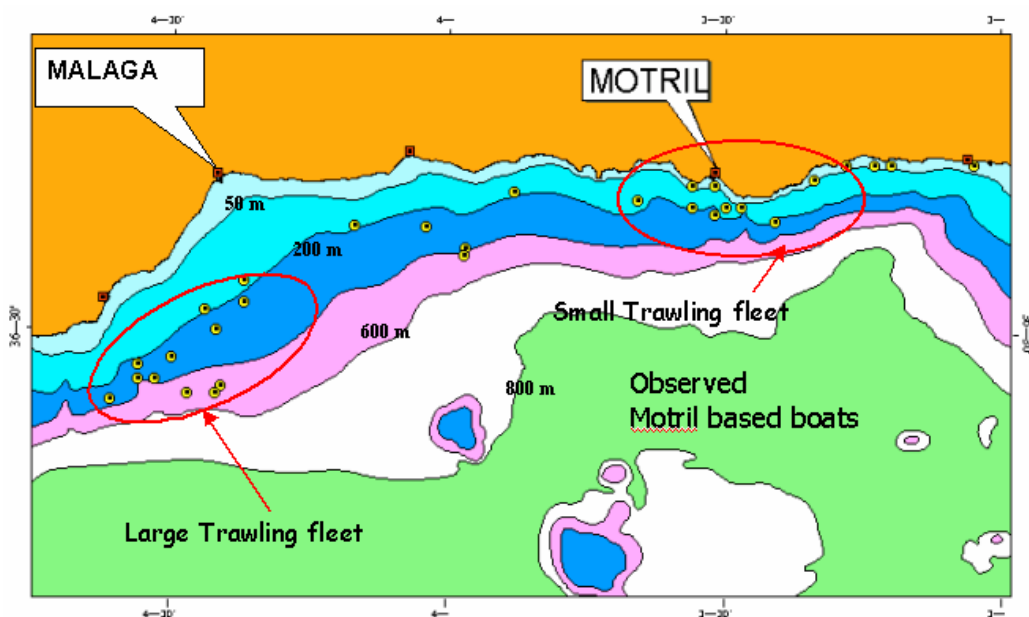
a) Fleet parameters

| Name: "Motril Large Trawlers"<br>Id: 002<br>Number of boats: 15<br>Nominal Effort: 7500 HP | Speed: 10 knots<br>Autonomy: 2 - 3 days<br>Fishing gear: bottom trawl<br>Target Species: *Nephrops norvegicus, Shrimps, Hakes...* |
|---|---|

b) Basic Cartography
   Alboran ports – Motril selected
   Coastline
   Area of interest

c) Constraints
   The same constraints were used but adding a new one: "Málaga Distance Effect". Higher prices in Málaga fish market attract fishermen to sell their catches there. Only large Motril trawlers have autonomy to operate in front of Málaga.

   This zone is also attractive for fishermen because many high-valuable species (mainly shrimps and prawns) are concentrated near Málaga. In this simulation stage, the availability of resources is not included as a factor affecting effort distribution.

For the above reasons, the "Málaga Port Distance Effect" and an associated scoring function was introduced in this simulation.
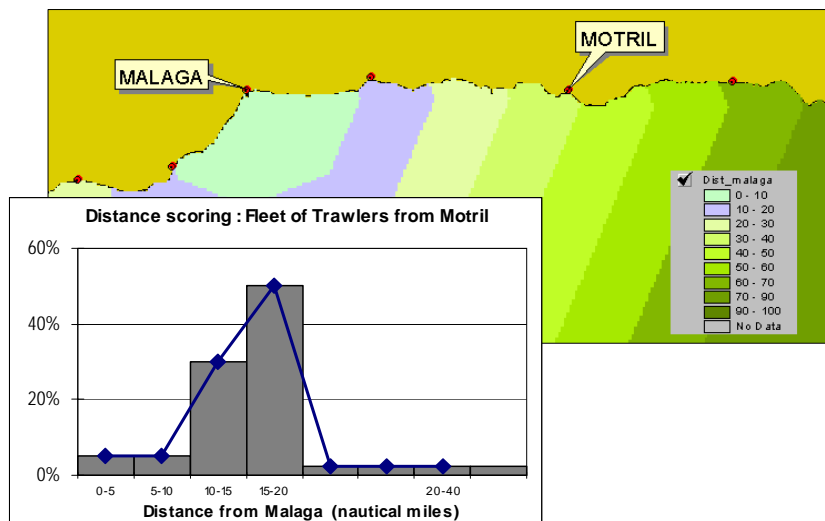
The scoring function of large trawlers for "Motril Port Distance" is different from the scoring function applied to the whole fleet.
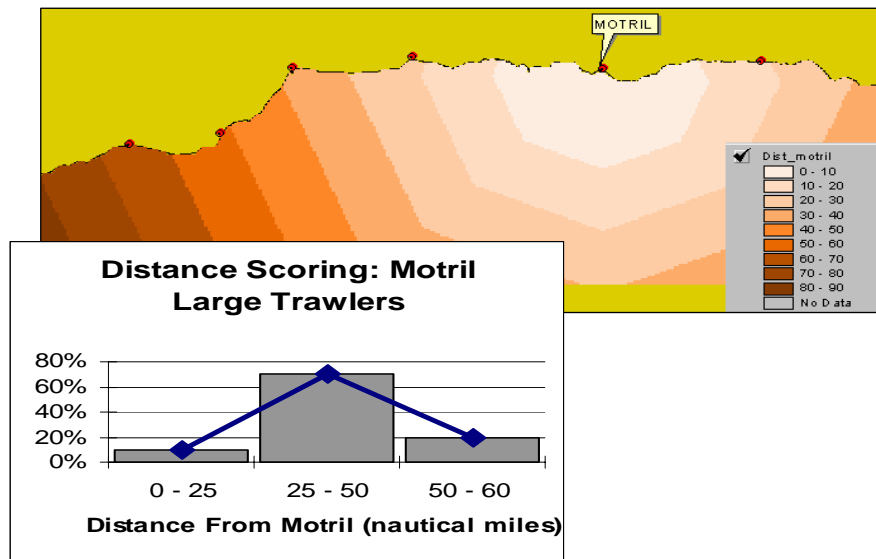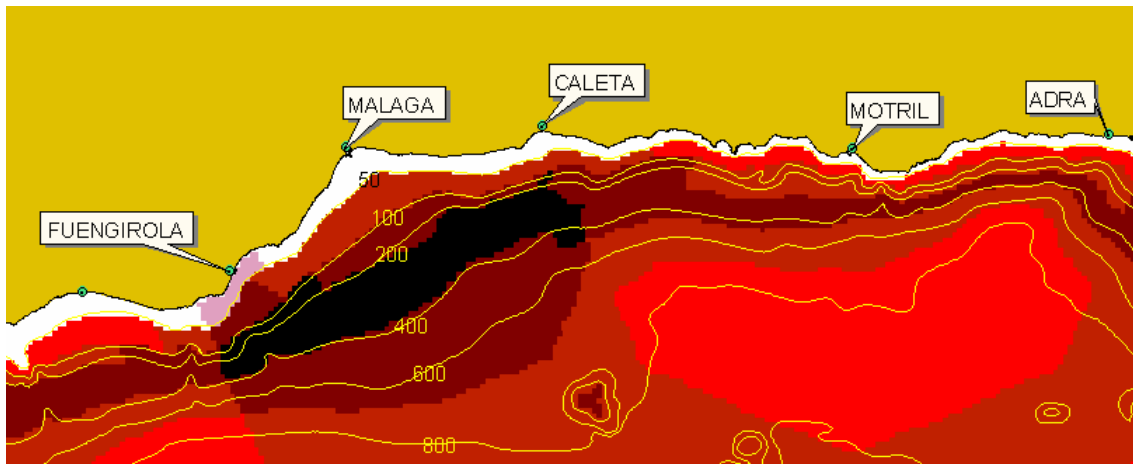


Using the same constraint for bathymetry as before but with the following scoring function:
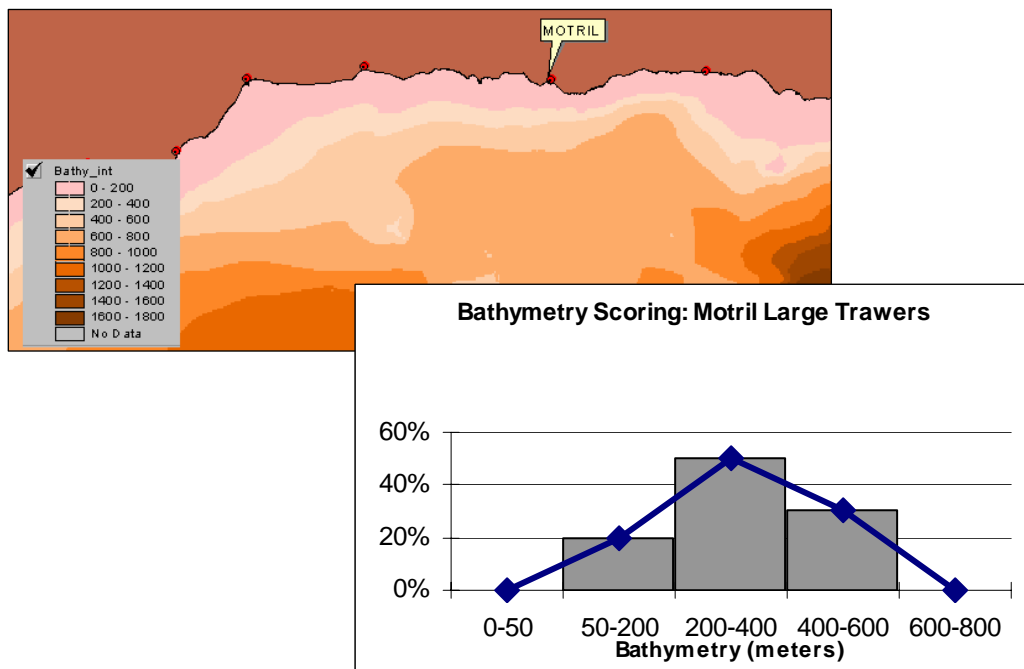


The same constraint and scoring function for legislation as in the first simulation.

d) Results and conclusions



**Nominal Effort For Large Trawlers With Distance Effect From Málaga**

1. The result of the model is coherent with observed activities and expert knowledge.

2. A port distance effect from the base port, as well as from Málaga fish market, was observed, locating the highest values of nominal effort probabilities in Málaga bay at depths from 200m to 400m and at 18 nautical miles from Málaga as expected.

3. Effort distribution inside the banned area adjust better to reality than in previous simulations.

4. This combination of constraints generalises the knowledge synthesised by means of "scoring function". The map describes for any zone a probability of fishing effort. In some places, no real fishing effort can be recorded, however these places obtain a similar probability from this combination of criteria. This simulation suggests a point of view about potential distribution of fishing effort.

**4.3 Third Simulation**
The FAST simulation was run focusing on the Small Trawler Segment to estimate their effort distribution.

a) Fleet parameters

| | |
|---|---|
| Name: "Small Trawlers From Motril" | Speed: 10 knots |
| | Autonomy: 1 days |
| Id: 004 | Fishing gear: bottom trawl |
| Number of boats: 15 | Target Species: *Mullus spp., Cephalopods,* |
| Nominal Effort: 3000 HP | *Hakes, Sparids,  Shrimps, Others*... |

b) Basic Cartography
   Alboran ports – Motril selected
   Coastline
   Area of interest

c) Constraints
   Three constraints were used:
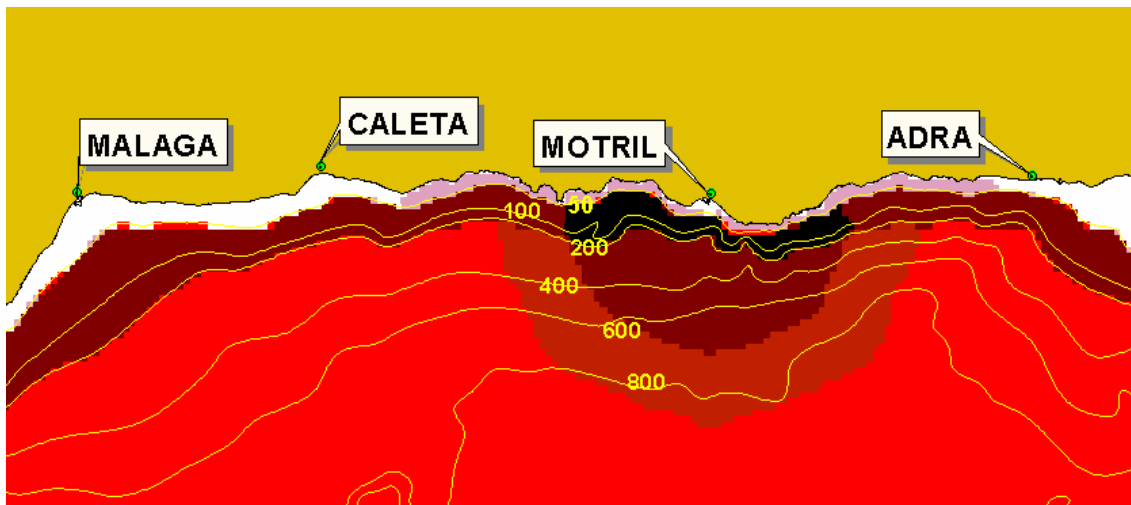
   - *Legislation* in the same way than previous simulation.

   - *Bathymetry*, using the following scoring function:



Bathymetry Scoring: Small Trawers From Motril
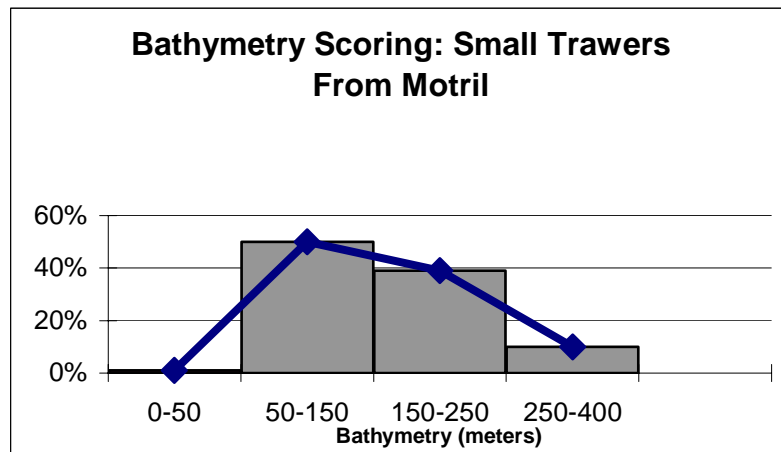
   - *Distance* from Motril Port, using the following scoring function:



Distance Scoring: Small Trawers From Motril
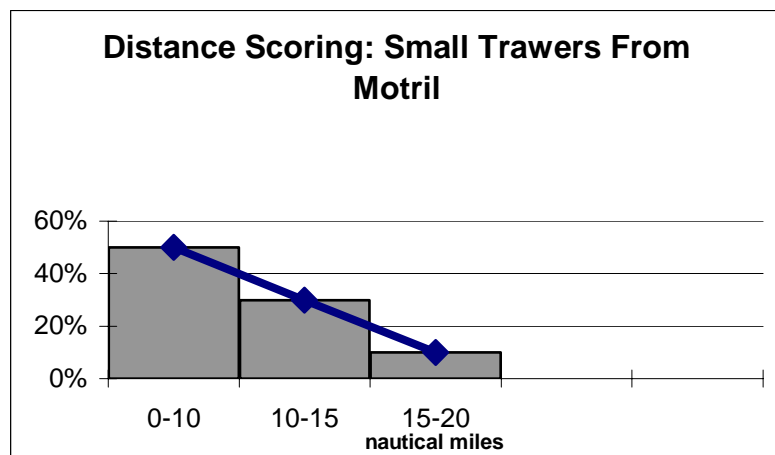
d) Results and conclusions



**Nominal Effort For Small Trawlers With Distance Effect From Motril.**

1. The highest effort is located in the expected zone and bathymetric range.

2. High values of nominal effort, even in remote zones, can be found in areas in which the small trawlers don't work. This is probably caused by bathymetry scoring function.

3. The above problem could be solved using a more appropriated  Area Of Interest, for this segment of the fleet. New AOI could be constructed using a circular polygon with 20 nautical miles of radio and centre in Motril Port.

4. A distance effect from Motril can be noted in this simulation according with the scoring function used.

5. This combination of constraints produce a non realistic effort distribution into banned zone. Fishermen always knows previously if an area is banned or not to fish, so first they go to the legal zone and after they search the better fishing ground.


## 5. Final considerations

1. In the present report, we have to take into account that FAST application presents the results of all the zones which correspond to a combination of constraints. These results are probabilities. Some of these zones are really exploited and others are not exploited, but have identical characteristics. The scoring values used in the simulations to test the software were based in the expert knowledge of the fishery, but not necessarily fitting precisely the situation. In particular, we apply the same behaviour to the whole fleet that can be qualified as a first approximation.

For better simulations, we have agreed that it would need more accuracy of score functions and also, supplementary constraints to better describe how the fishing effort can be distributed in the area for particular segments of the fleet.

2. In our opinion to improve the results will be necessary to obtain better information respect to types of bottoms, untrawlable areas and target species abundance. In this sense probably the application will work better if we taking into account only one target species and a more suitable AOI.

3. The tested area presents a narrow continental shelf, so the fleet is distributed in a wide longitudinal area. This fact probably makes that the FAST application do not represent the effort distribution as well if the area was not so affected by distance effect.

4. In this work, all constraints have had the same weight, maybe better results were obtained using different weights. Nevertheless, using different weights could produce biased results since this is a subjective criterion.

5. After a first formalisation of the expert point of view, new questions arise that needs of a recurrent process aimed to a progressive elaboration of a more realistic representation of the case.

## 6. References

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