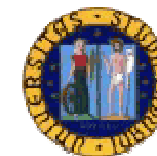




# Bio-economic modelling of the small pelagics fishery in the Northern Adriatic Sea

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## Why apply a bioeconomic model to the Northern Adriatic Sea?

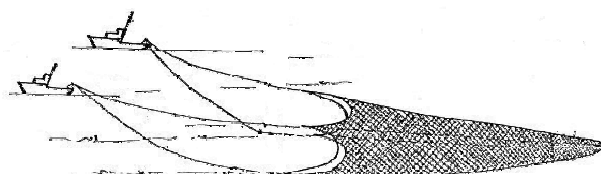
In the last years in the Northern Adriatic Sea we observe an increase of the captures of the pelagic species, but, on the other hand, a gradual decline of the demersal resources and a considerable reduction in the number of vessels, operators and hours of the activity (1). The abandonment of the sector, is principally caused by the high costs sustained to manage the activity and it is linked to the reduction both of the wholesale and retail consumption, for excessive price, and of the net contribution margin for every kilogram of captured and/or commercialized product. Another factor to consider is the reduction of the competitiveness linked to the opening of larger markets.

Considering the economically most important pelagic species, we attempt to verify the sustainability of the fishing activity in the Northern Adriatic Sea through a bio-economic model called MEFISTO (Mediterranean Fishery Simulation Tool) (2).



## Fishing systems and species to which we apply the model

The mid-water pair trawl ("volante"), towed by two fishing boats



Sardine (*Sardina pilchardus* Walb.) and anchovy (*Engraulis encrasicolus* L.)



## Bio-economic model: MEFISTO

- ✓ Multispecies, multifleet and multigear
- ✓ Output:
  - biological indicators (biomass, number, catches)
  - fleet indicators (number of boats, catch by boat)
  - economic indicators (revenues, costs, profits)
  - stochasticity

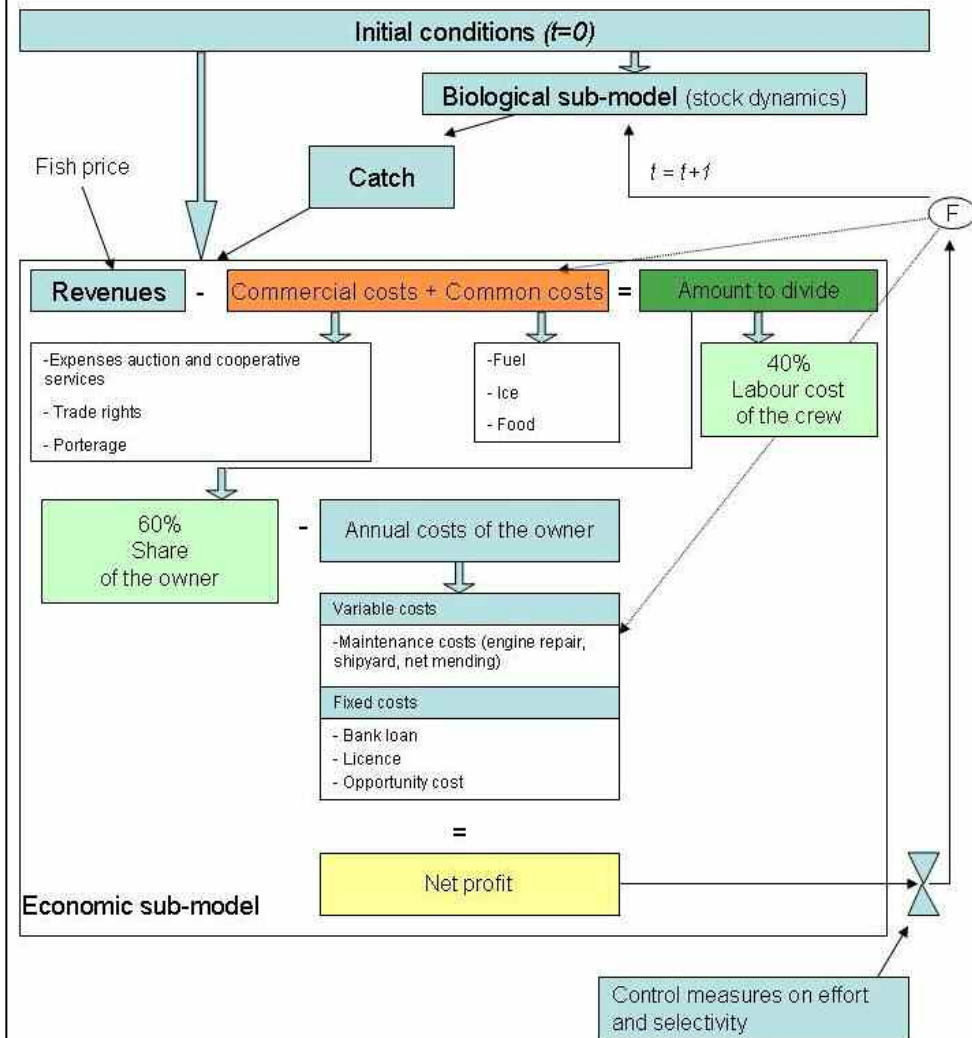
## Simulation

We employed bio-economic simulation (1000 iterations, 10 years) analysis to assess the performance of biological and economic indicators under different management scenarios.

The simulations regard:

- Fuel price
- Number of days/year

## Bio-economic model MEFISTO



Starting from an initial condition, the simulation model incorporates the known trajectory of the resources and the fishing fleet and allows to compute the most probable future trajectory when some parameters in the model are changed.

## Small pelagics fishery in the Northern Adriatic Sea

We applied the MEFISTO model to the fishery of the small pelagics that take place in the Veneto Region. This kind of fishing is performed with a *volante*. The mid-water pair trawl *volante* is towed by two fishing boats working in pair and holding a tow-line, each one tethered to the head rope, and the other one to the foot rope. *Volante* vessels generally fish only by daylight, and land their catches every evening: each fishing trip lasts about 11-15 hours. The boats leave the harbour at 2.30-3.30 a.m. and come back between 11.00 a.m. to 7.00 p.m. depending on the success of the fishing day (3). The working week is from Monday to Friday. 20 pairs of *volanti* fishing vessels operate usually in the area, their average engine power is 470 HP and the average size is 88 GRT, but there are wide variations in both size and engine power.

In this study we divided the fleet in 4 classes according to vessel size including vessels of 12 GRT as well as vessels of 200 GRT.

The target species of the mid-water trawl are mainly sardines and anchovies, even if also other species living mid-water or in the proximity of the bottom could be caught occasionally, as mackerel (*Scomber scombrus*) and sprat (*Sprattus sprattus*).

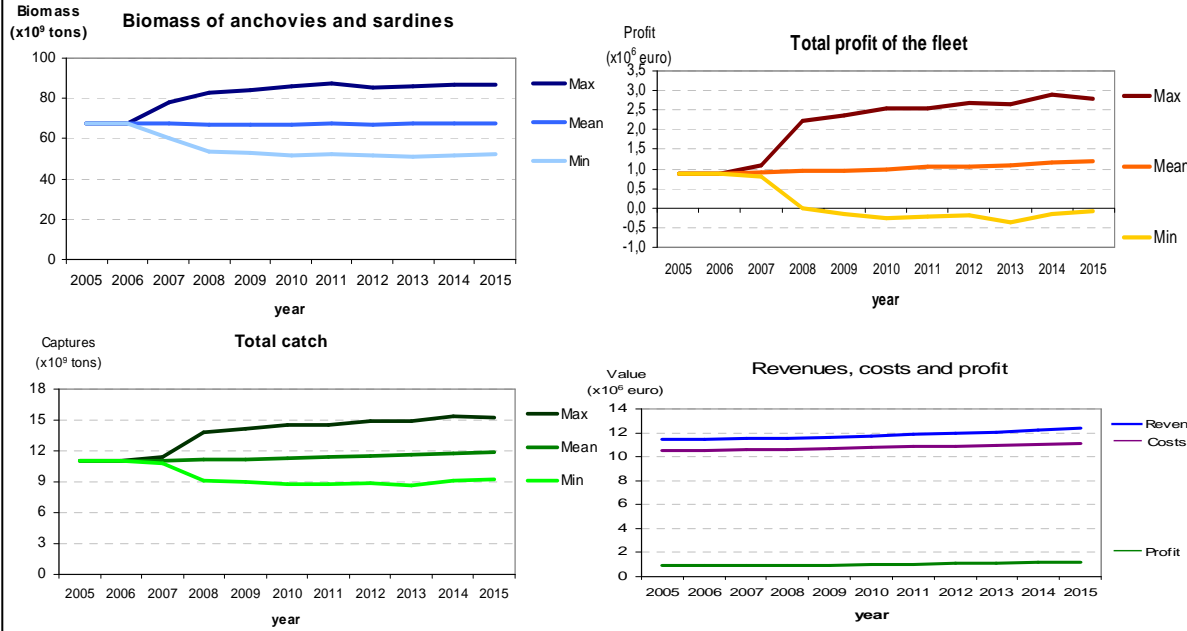
In order to apply the model we estimated the growth parameters and population numbers by the VIT (4) program from catch data.

In 2004 the total catch of the small pelagic fishing for the Veneto region amounted to 12,414 tons, of which, 1,300 are sardines and 11,130 are anchovies.

In terms of market price, sardines are considerably more valuable than anchovies, and it is required above all for the processing industry. The average price of sale for the markets of the Veneto region amount to 0.852€ for anchovy and 1.727€ for sardine.

The economic information was obtained from annual statistics, interviews or hypothesis.

## Analysis of the most probable future trajectory without management interventions

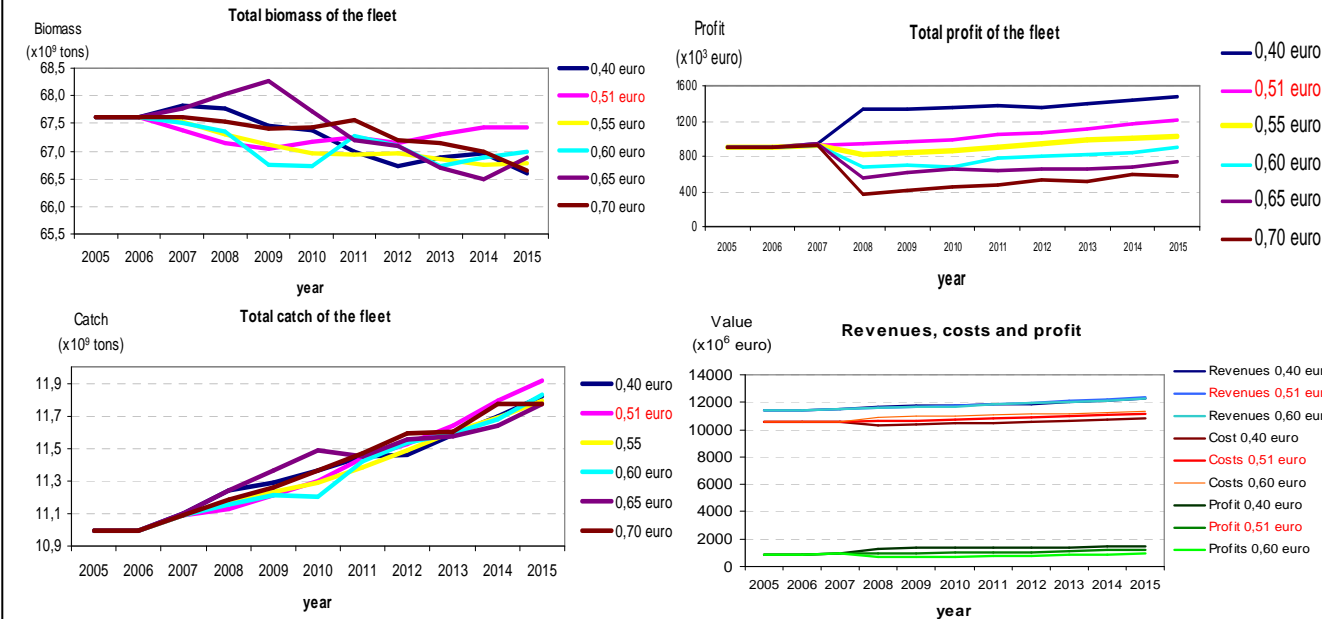


From the observation of the graphics that show the most probable future trajectory for the next 10 years without management interventions we can see a situation of substantial stability of the conditions in which fishing is running.

In particular the biological parameters of biomass and recruitment highlight a not important reduction of the resource. This reduction can be explained with an increase of the captures from on the part of the fleet.

On the average the profit of the fleet will be positive and show on the whole an increase. The profit could be become negative beginning from 2009 with a probability of about 14% that could attain at 21% in 2013. In the first years of the simulation, all the vessels will be affected by a decrease of the profit, while, the profit will be substantially maintained positive for the vessel with a GT > 135 tons, from 2013, to coincide with extinction of the bank debt, that represents one of the considerable fixed costs.

## First simulation: analysis of the most probable future trajectory due to variation on the fuel price

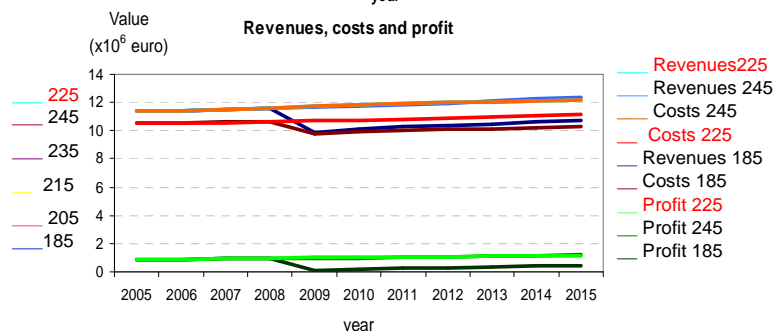
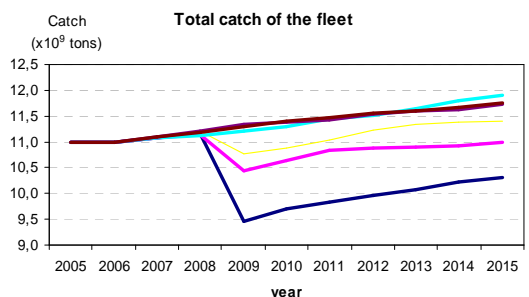
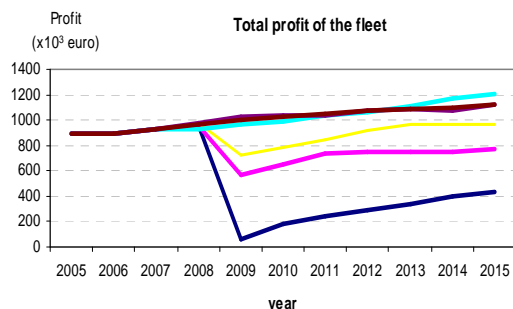
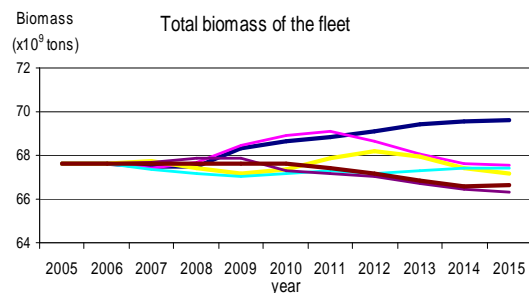


In red is highlighted the present cost of the fuel. The simulation propose a change of cost beginning from 2008. The profit shows an inverse relation with the price of fuel: when it increases the profit decreases in a proportional way. On the other hand, generally, the more the price of fuel increases, the worse the catch decreases, according to the higher costs that the fishermen could support.

From a biological point of view a minor cost of the fuel lead to an increase of the fishing effort and to reduction of the biomass.

**The larger costs of the fuel imply, indirectly, preservation of the biomass.**

## Second simulation: analysis of the most probable future trajectory due to variation on the number of days/year



In red is highlighted the present number of fishing days. The simulation propose a change of number of days beginning from 2008. We can observe that, more time available to exercise the fishing activity allows to obtain the major catches. However, considering the economic condition in which is developing in the Veneto region the fishing of anchovies and sardine, we can arrive at a point in which a major number of days do not guarantee major profits.

In particular, this occur for the vessels that present a small tonnage and have a limited fishing power.

**From a biological point of view the biomass shows an inverse relation with the number of days: when this increase the biomass decreases.**

### Conclusion

We analyzed the possible trajectory deriving from modifications of some parameters put in the model.

The employed model does not provides a point of balance, because it is not an optimization model but a simulation model. Therefore it allows to verify the effects that can get in the sector some of the taken measures. In these terms this is a cause-effect model that can support policy maker on the decisional processes. With this aim, for example, it shows that the adjustment should be done segmenting the fleet. The impact of each measure produces different results depending on the size of the vessels to which it is applied.

Variation on the price of fuel: we can see that the profit shows an inverse relation with the price of fuel (when it increases the profit decreases in a proportional way). On the other hand, generally, the more the price of fuel increases, the worse the catch decreases, according to the higher costs that the fishermen could support. From a biological point of view a minor cost of the fuel leads to an increase of the fishing effort and to reduction of the biomass. The price of fuel cannot be reduces by far with respect to the present price that is about 0,50 €/l.

Variation on the number of days: to preserve the biomass reducing the number of days can have a considerable negative effect on the profits of the fleet. If we decrease the number of days to 215 the profit decreases about 20%, but, on the other hand if the number of days increases to 245, the profit decrease anyway, although for about 6% only.

**We could: ✓ apply a politic of differentiation on the basis of the dimension of the fleet:**

**- compensative policy for the smaller fleet**

**✓ apply an import policy to support local products**

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