

Application of ATLANTIS as a fisheries management tool in the Sicily Channel.

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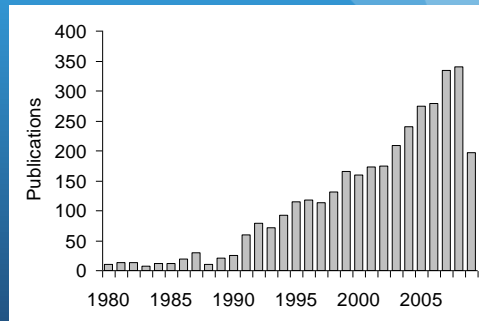
Ecosystem Based Models

The ecosystem model **Atlantis** (Fulton *et al.* 2004) provides a strategic tool for:

1. aggregating the interactions between species, climate, fisheries and habitat;
2. estimating the possible impact on the ecosystem;
3. evaluating the consequences of management decisions

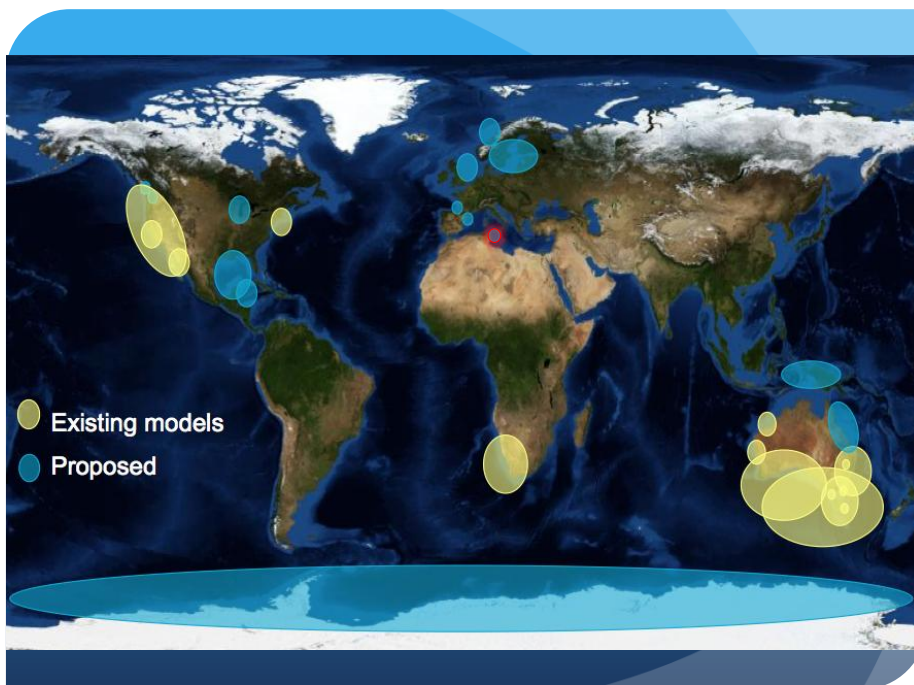
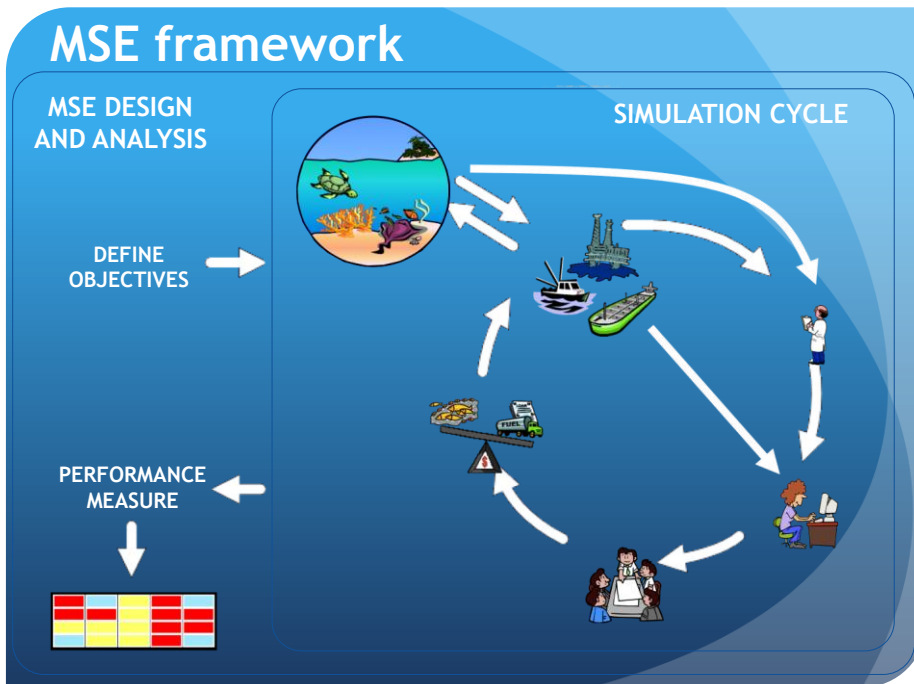
Ecosystem

Socio-economics

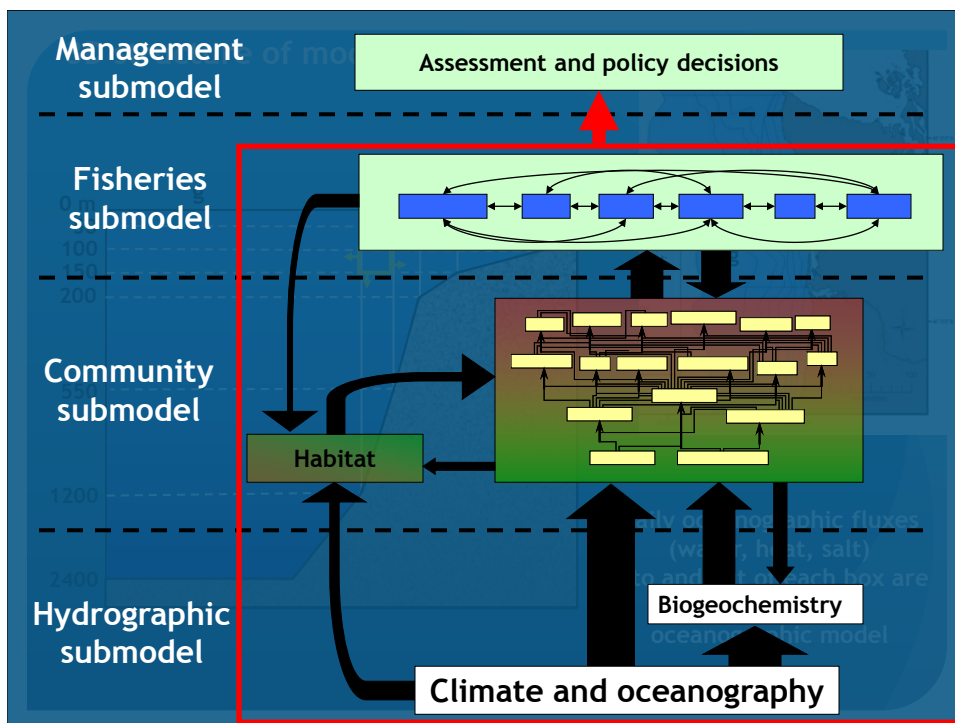
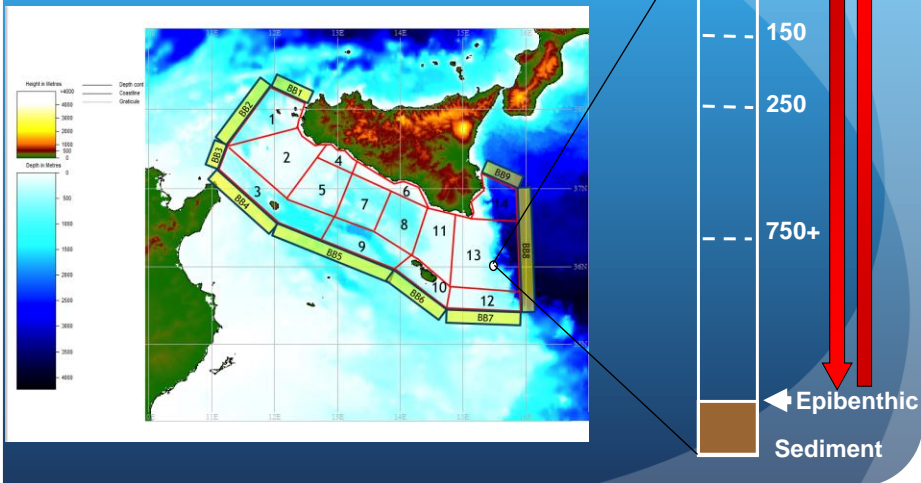


Web of Science search

“ecosystem model” or “multispecies”



Geography



Development phases

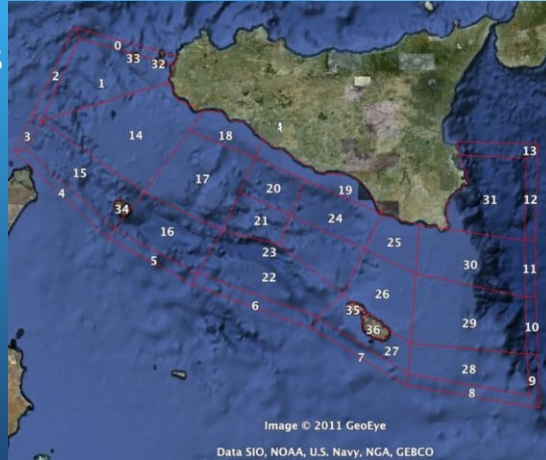
1. Identification of model domain
 - f (data availability)
2. Division in “boxes”
 - a. bathymetry,
 - b. seabed composition,
 - c. ecosystem,
 - d. fisheries,
 - e. management rules.
3. Characterization of ecosystem
4. Fisheries data
5. Management rules
6. Future scenarios
 - Management Strategy Evaluation(MSE)

Identification of model domain
and
division in boxes

Sicily Channel

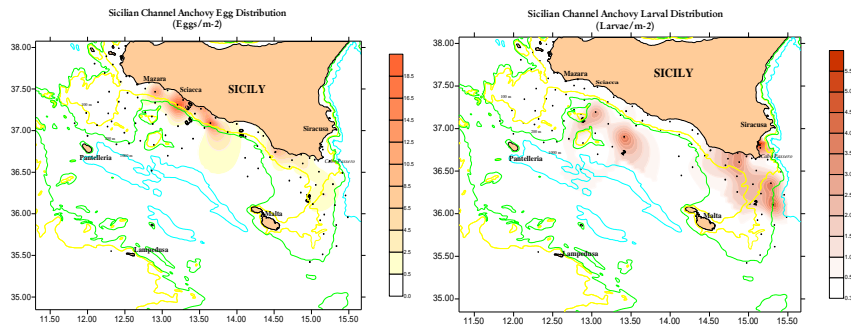
Sub-division in boxes

Bathymetry
Seabed composition
Currents
Ecosystem
Management rules



Characterization of ecosystem

Fisheries - Biological data



(a) Anchovy egg distribution during the period 19 July-8 August 1997 (egg m⁻²);

(b) Anchovy larvae distribution (larvae m⁻²) during the period 19 July-8 August 1997.

Source: Bernardo Patti

Fisheries data

Ports and fisheries

- Ports, dimension and composition of fleet
- Fishing effort
- Type of fisheries
- Management restrictions

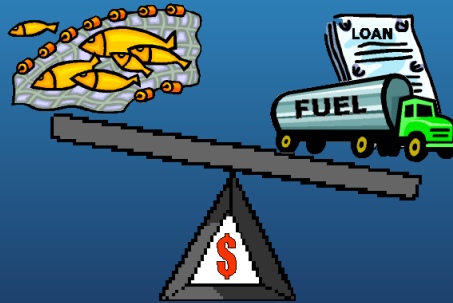


Management control

- Gear (size, selectivity, access to habitat types, bycatch mitigation)
- Swept area (or soak time)
- Spatial zoning (per sector through to closures, Fisheries Restricted Areas)
- Seasons
- Discarding rules (BRD, size, per species, per area, limits)
- Bag limits
- Quotas (overall, stock-based, regional, basket, companion, bi-monthly)
- Trip limits
- Effort limits (days-at-sea)
- Changing practices

Socio-economic drivers

- vessel size, number crew, size, fuel expenditure, gear, held quota, efficiency etc
- market, investment, trading, planning sub-models



Scenarios

Anthropogenic Components

What impacts?

- Inputs and pollution
- Fisheries
 - Different fleet
 - Commercial
 - Charter
 - Recreational
- Tourism
- Shipping
- Clearing and coastal development
- Ports and dredging
- Economics and markets
- Management

Table 2-7: Summary of management strategies used in the Scenarios tested. Evolving indicates the gear control is changing through time in the course of the simulation (through variable uptake or staged implementation), while increasing indicates a relaxation (an increase) in the number of hooks allowed for use by auto longline.

Management Control	Scenario 1	Scenario 3	Scenario 4	Scenario 9	Scenario 10
<i>TACs</i>					
TACs constraining (with harvest strategies)	No	Yes	Yes	Yes	Yes
Additional quota species	No	Yes (more)	Yes (few)	No	No
Non-quota species	No	Baskets	Baskets	No	Gulper basket
Companion TACs	No	Yes	Yes	Yes	Yes
Accounting for discards (qs)	No	No	Yes	Yes	Yes (Banned)
Regional TACs	No	Yes	Yes	Yes	Yes
Fishing without quota	Yes	Yes	Yes	Yes	No
<i>Spatial management</i>					
MPAs (SERMP)	Yes (largely ineffective)	Yes	Yes	Yes	Yes
Fishery closures (no take)	No	No	Yes	Yes	Yes
Sectoral closures (by method)	Existing	Additional	Extensive	Yes	Extensive
Industry closures	No	No	No	No	Yes
<i>Gear controls</i>					
Trawl – mesh size	Existing (ineffective)	Additional	Additional	Yes	Existing
Trawl – ground gear	None	Additional	Additional	Yes	Existing
Gillnet – length, height, mesh size	Existing	Existing	Existing	Yes	Existing
Auto longline – no. hooks/licence	Increasing	Existing	Existing	Yes	Existing
Shark longline	Existing	Existing	Existing	Yes	Existing
Drop line	Existing	Existing	Existing	Yes	Existing
Trap	Existing	Existing	Existing	Yes	Existing
On new methods of fishing being introduced	No restrictions	Restrictions	Restrictions	Yes	No restrictions
BRDs	Evolving	Evolving	Evolving	Yes	Evolving
<i>Input controls</i>					
Limited entry	Yes	Yes	Yes	Yes	Yes
Choice of gear	No	No	Yes	Yes	No
Vessel length (GABTF)	Yes	No	No	Yes (ALL)	Yes

Ref: Fulton et al 2007: Alternative Management Strategies for Southeast Australian Commonwealth Fisheries: Stage 2: Quantitative Management Strategy Evaluation
ftp://ftp.marine.csiro.au/pub/fulton/AMS_Final_Report_v6.pdf

Economic indicators

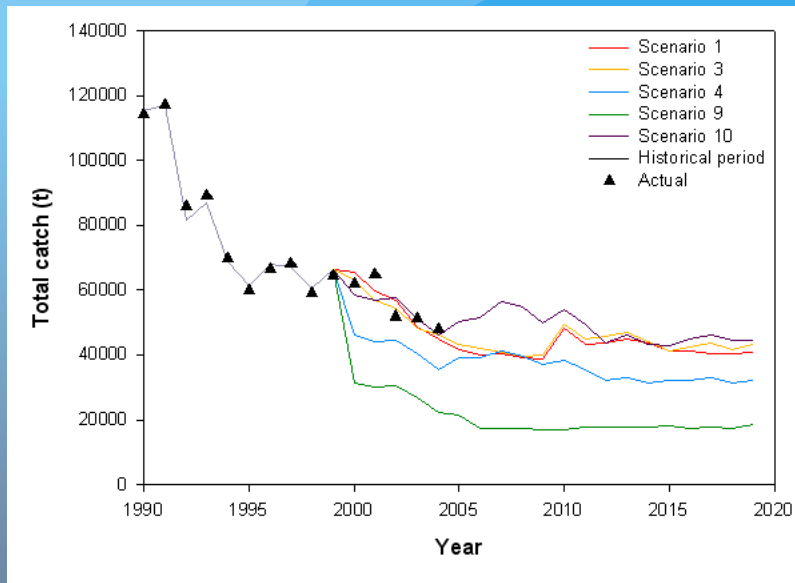
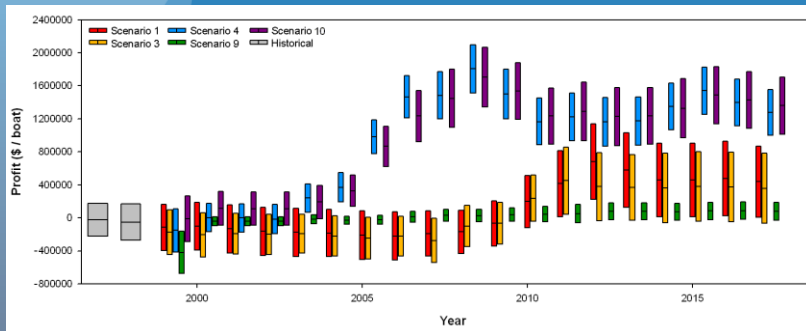
Costs

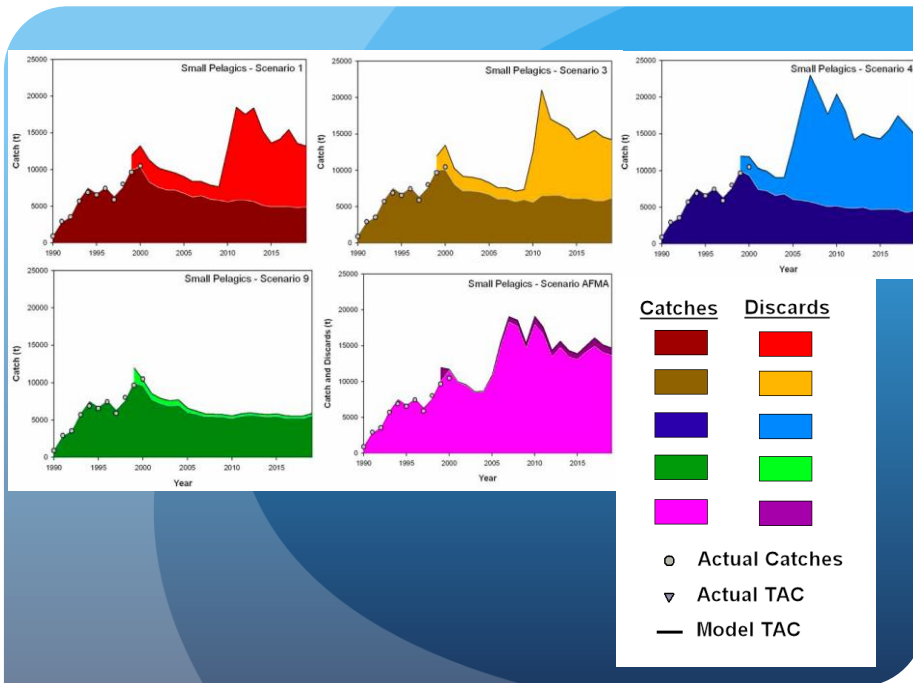
per boat (fixed, variable)

management (monitor, compliance, research)

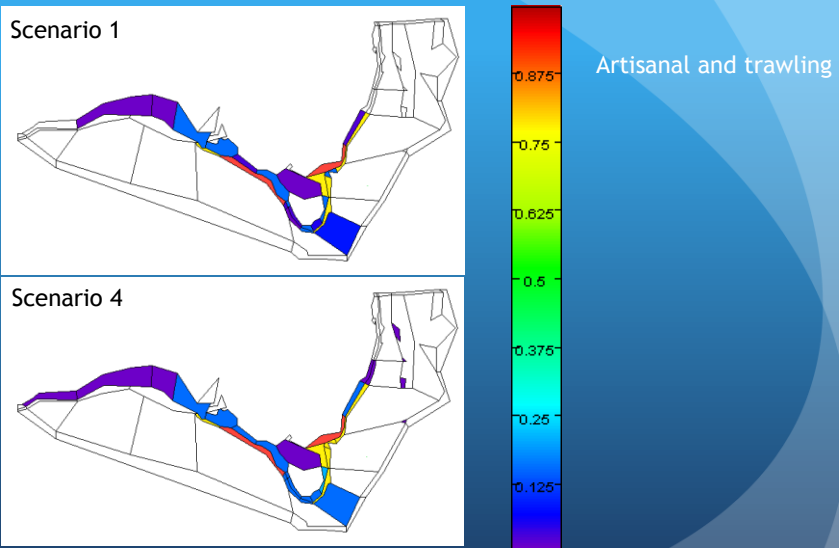
Value

Profits (per day, ton, boat)





Gear conflict



Next...

- Gathering all biological data
- Communication
- Fluxes through boxes sides (Hydrodynamic model)
- Calibration
- Validation
- Choosing future scenarios
 - Climate Change
 - Change in fishing pressure
- GUI

Pelagic invertebrates	9	Large Phytoplankton Small Phytoplankton
Benthic invertebrates	15	Dinoflagellates Small Zooplankton
Fin-fish	13	Mesozooplankton Large Zooplankton
Top Predators	5	Gelatinous Zooplankton Pelagic Bacteria
Detritus	3	Squid
Nutrients	4	

Pelagic invertebrates	9	Sediment bacteria
Benthic invertebrates	15	Carnivorous infauna
Fin-fish	13	Deposit feeders
Top Predators	5	Deep water filter feeders
Detritus	3	Shallow water filter feeders
Nutrients	4	Scallops
		Benthic grazers (Herbivorous)
		Deep water macrozoobenthos
		Shallow water macrozoobenthos
		Megazoobenthos
		Meiobenthos
		Prawns
		Microphytobenthos
		Macroalgae
		Seagrass

Pelagic invertebrates	9	Large Planktivorous Fish
Benthic invertebrates	15	Small Planktivorous Fish
Fin-fish	13	Deep Piscivorous fish
Top Predators	5	Shallow Piscivorous fish
Detritus	3	Tuna and swordfish
Nutrients	4	Shallow demersal fish
		Vulnerable Demersal fish
		Deep Demersal fish
		Flat Deep demersal fish
		Herbivorous demersal fish
		Demersal Shark
		Pelagic Shark
		Skate and Rays



Pelagic invertebrates	9	Dissolved organic nitrogen
Benthic invertebrates	15	Ammonia
Fin-fish	13	Nitrate
Top Predators	5	Silicate
Detritus	3	
Nutrients	4	

Contents

- ATLANTIS
 - Structure
 - Applicability potential
- Sicily Channel
 - Identification of boxes
 - Characterization of food-web
 - Observations
- Scenarios

Introduction

-

Habitat dependency

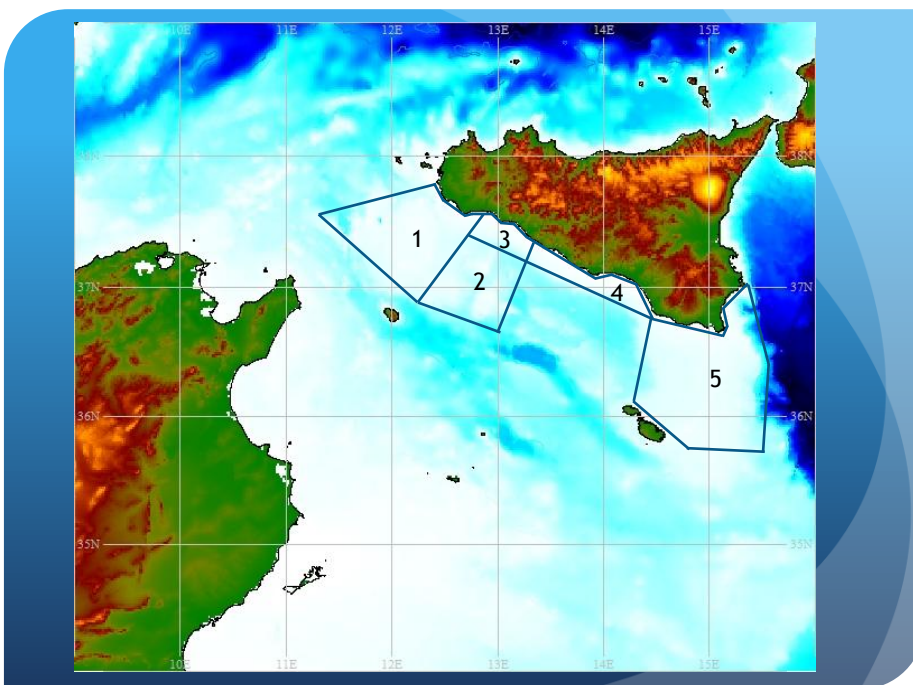
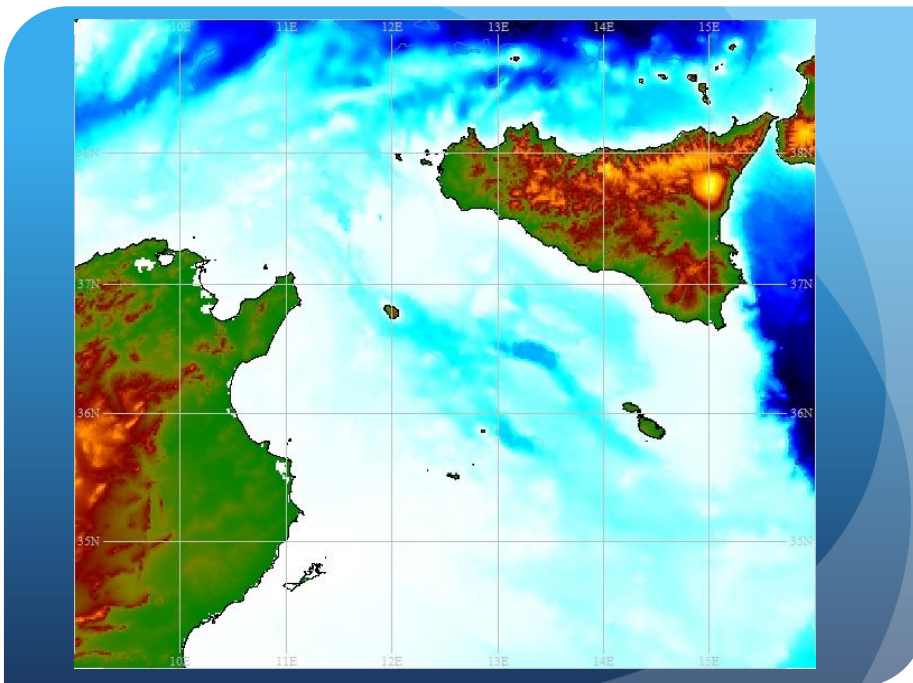
Habitat types:

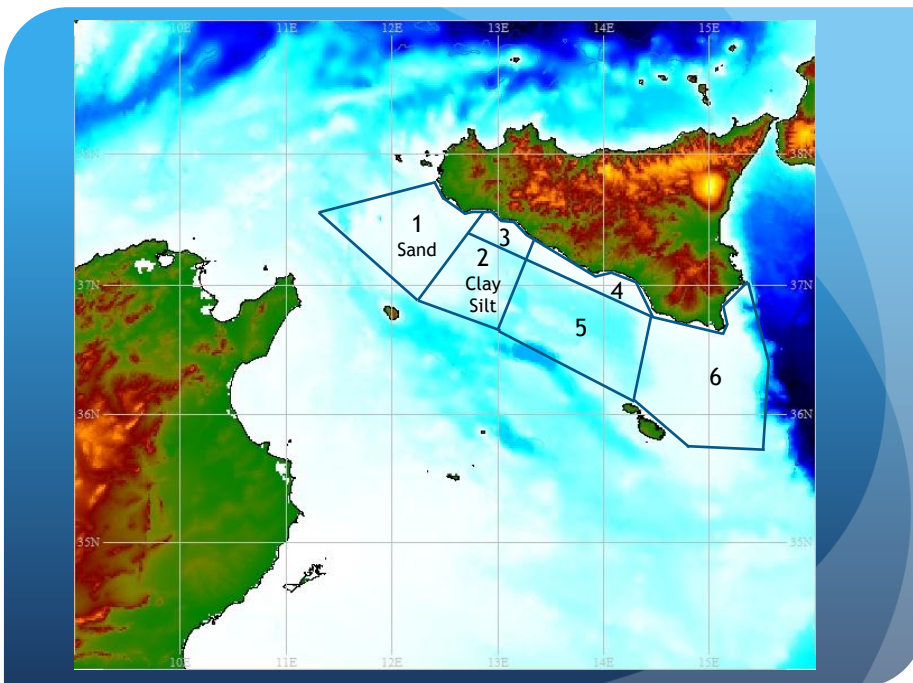
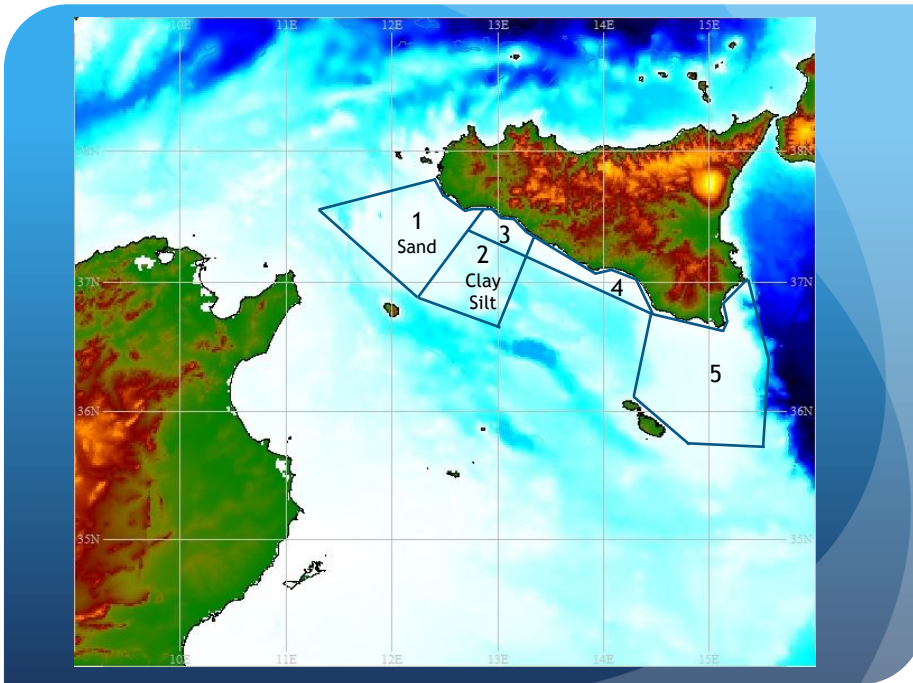
- Rough
- Flat
- Soft

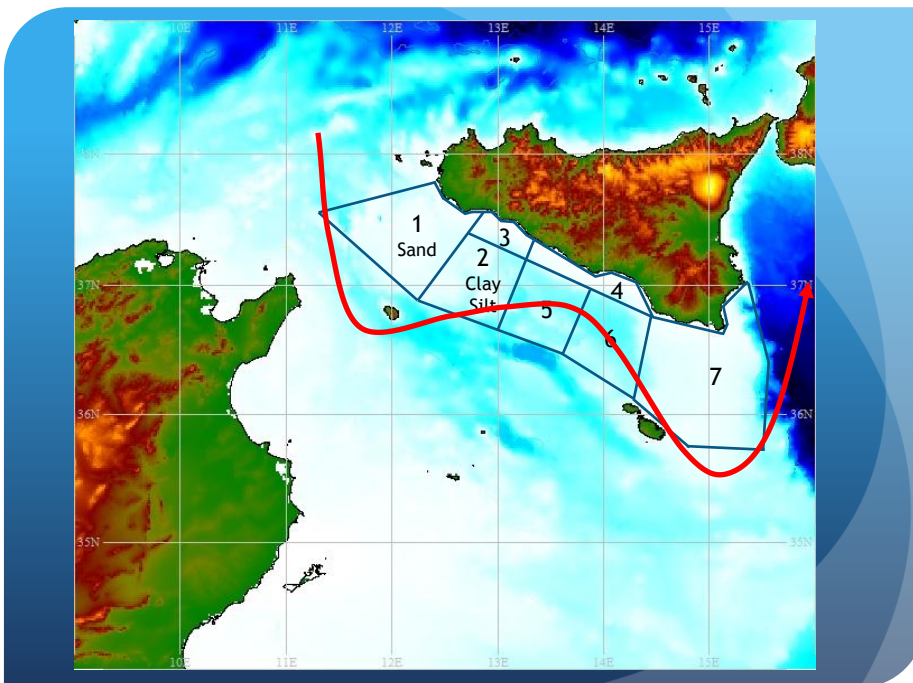
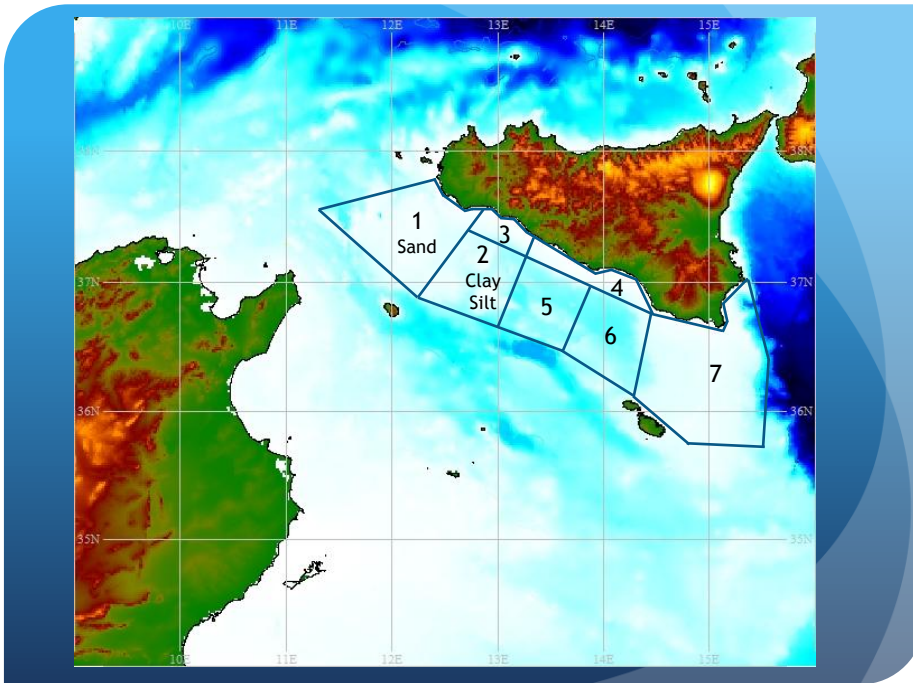
Biogenic habitats:

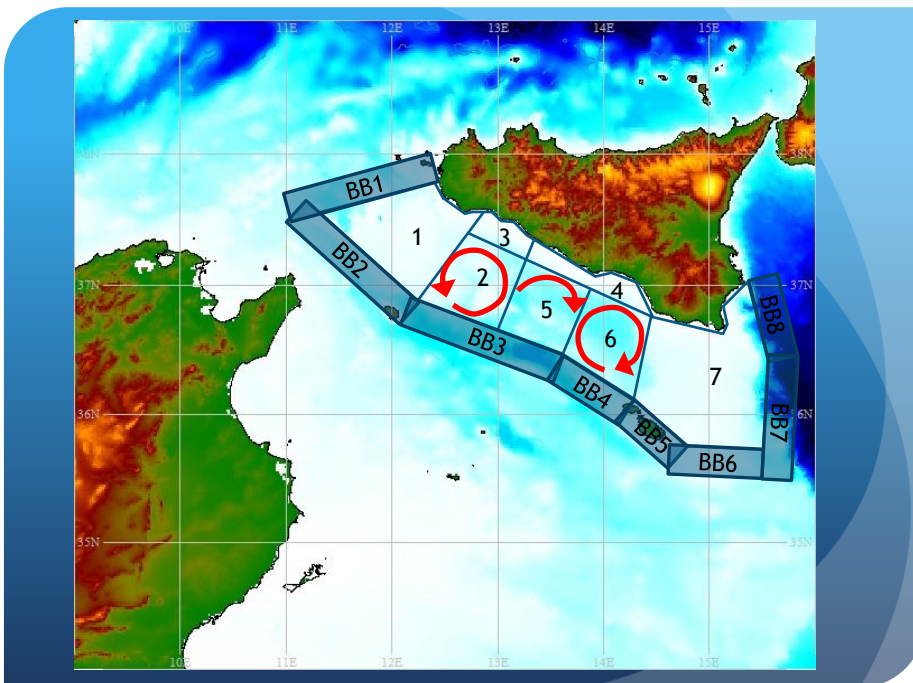
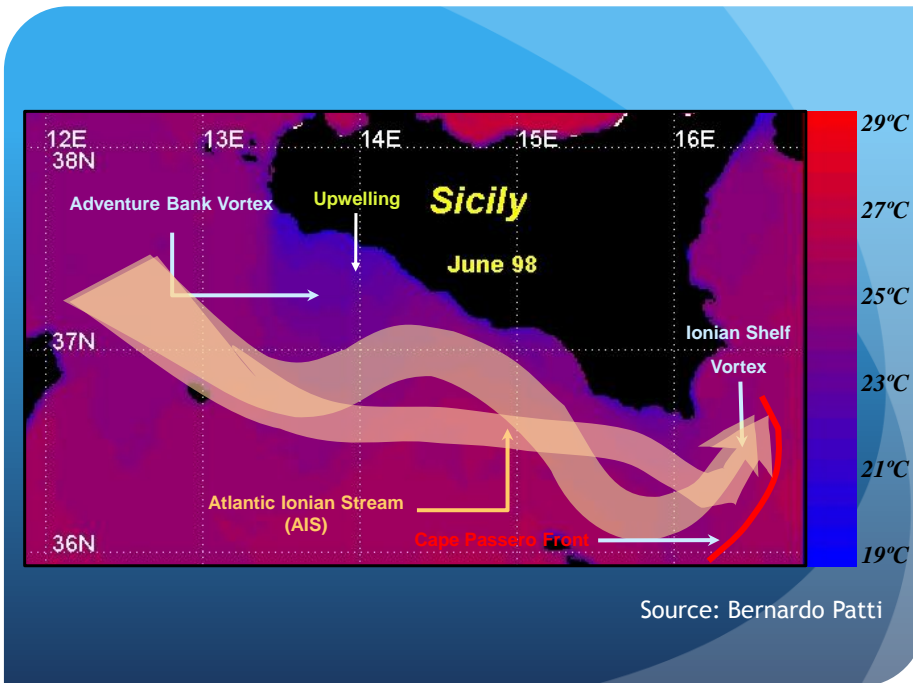
- Macroalgae
- Seagrass
- Filter feeders

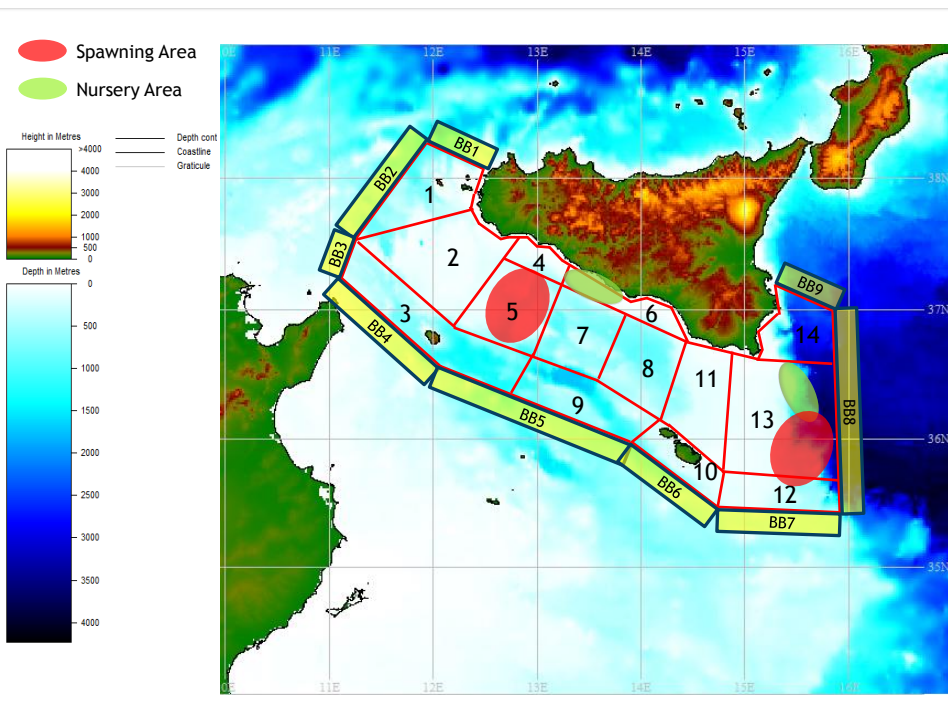
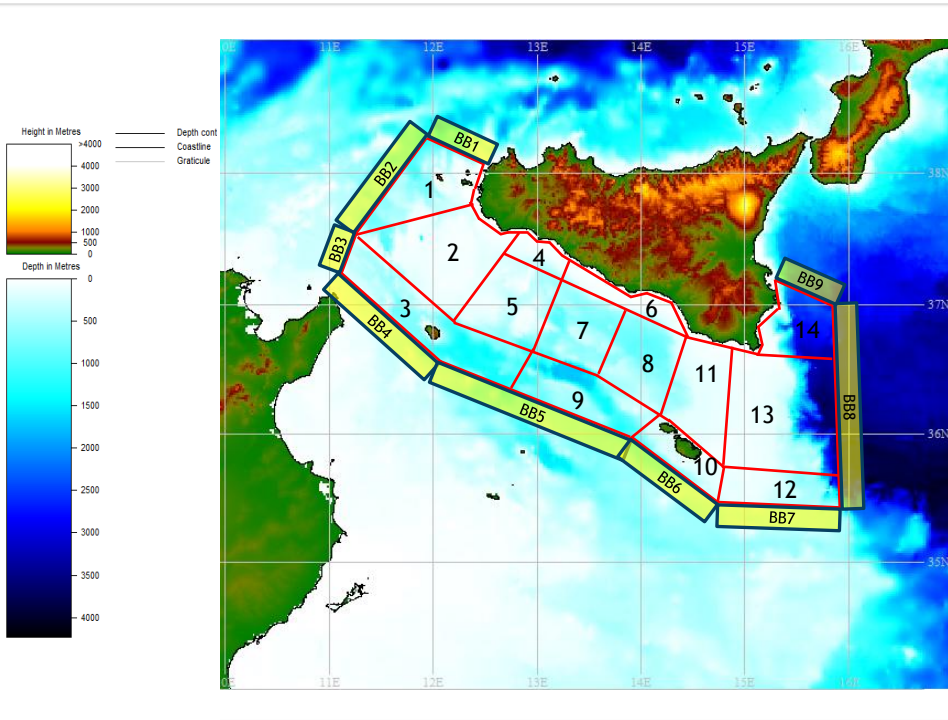








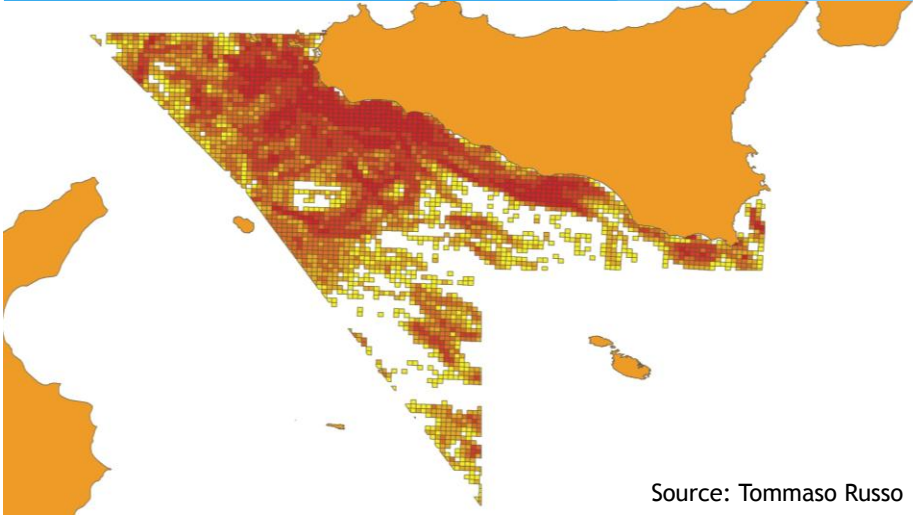




Data needed to implement ATLANTIS

	Nutrients	Primary producers	Benthic invert.	Plankton	Nektonic invert.	Fish	Shark and rays	Mammals and birds	Humans
Ecosystem									
Period of activity			/	/	/	/	/	/	/
Habitat dependencv		/	/	/	/	/	/	/	/
Distributions and abundances	/	/	/	/	/	/	/	/	/
Swimming speeds						/	/	/	
Migration times and routes			/	/	/	/	/	/	
Diets			/	/	/	/	/	/	
Consumption (clearance) and growth rates		/	/	/	/	/	/	/	
Length-weight relationships						/	/	/	
Size at age						/	/	/	
Non-predation mortality rates		/	/	/	/	/	/	/	
Maximum age						/	/	/	
Age at maturity						/	/	/	
Spawning area and season			/		/	/	/	/	
Larval or gestation period					/	/	/	/	
Location of recruits						/	/	/	
Fecundity			/		/	/	/	/	
Size of recruits (young of the year)				/	/	/	/	/	
Fisheries related									
Catchability (and/or selectivity)			/		/	/	/	/	
Targeting									/
Discarding									/
Catch and effort									/
(time series and distributions)									/
Management rules									/
Socioeconomic									
Prices									/
Costs									/
Crew size									/
Vessel size									/
Trip length									/

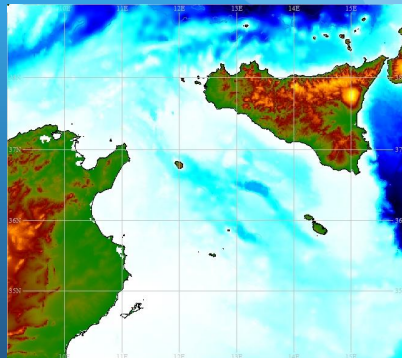
Fisheries data - Effort



Source: Tommaso Russo

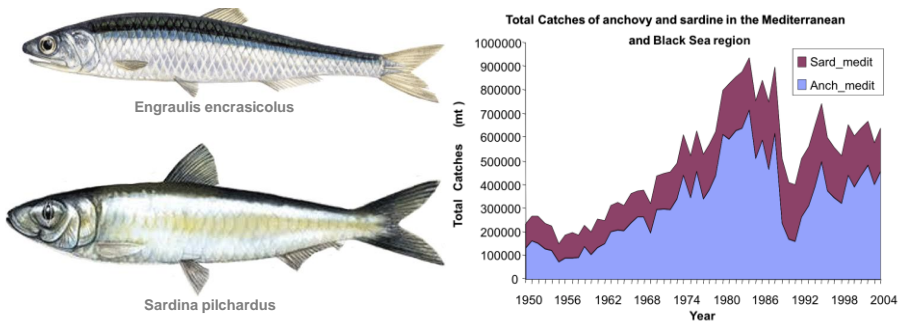
Sicily Channel

- Sub-division in boxes
 - Bathymetry
 - Seabed composition
 - Currents
 - Ecosystem
 - Management rules
- Overlay maps



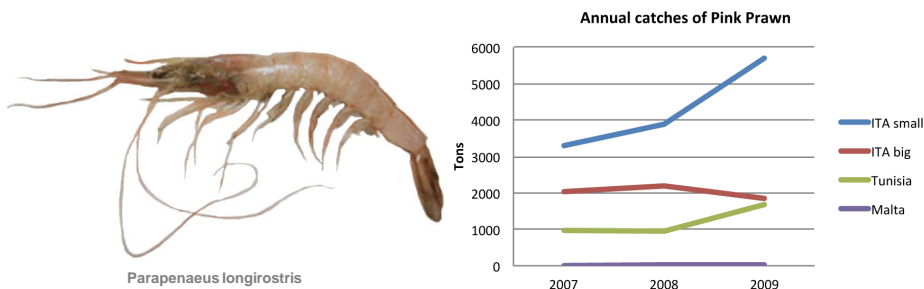
Small Pelagic Fisheries

- Anchovy and sardine contribute 33% to 51% of the total Mediterranean landings.
- Small pelagic fish (anchovy and sardine) are key-stone species in the marine ecosystems because:
 - of their contribution to total landings;
 - are the link between lower and higher trophic levels in a marine ecosystem.



Pink Prawn Fisheries

- Pink prawn represents the main resource for trawling fisheries in the Sicily Channel
- In recent years (2002-2009)
 - Sicily landed between 6,000-8,000 tons yr⁻¹
 - total commercial value of about 80 million euro.
 - 50% of the total Mediterranean landings
- Overexploited



Management Control

TACs

- Additional quota species
- Non-quota species
- Companion TACs
- Accounting for discards
- Regional TACs
- Fishing without quota

Spatial management

- MPAs
- Fishery closures (no take)
- Sectoral closures (by method)
- Industry closures

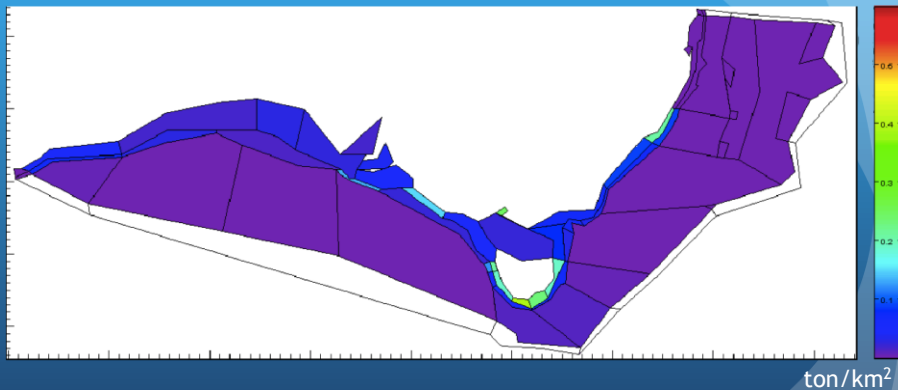
Gear controls

- Trawl - mesh size
- Trawl - ground gear
- Gillnet - length, height, mesh size
- Auto longline - no. hooks/licence
- Shark longline
- Drop line
- Trap
- BRDs

Input controls

- Limited entry
- Choice of gear
- Vessel length (GABTF)

Ecosystem - Small pelagics biomass



Trophic interactions

