

Simulating with ISIS-Fish the dynamics of a North-East Atlantic mixed fishery subject to spatial closures

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Modeling

- Mixed fisheries
 - ▶ Several species and fishing activities
 - ▶ Spatial and temporal dynamics
 - ▶ Technical interactions
- Evaluating the impact of management scenarii :
 - ▶ Traditional measures (TAC, effort, gear restrictions), spatial measures
 - ▶ Fishermen behaviors : efficiency of the measures

⇒ *ISIS-Fish : a spatial bio-economic model simulating the dynamics of restricted mixed fisheries*

⇒ *From the most simple fishery to the most complex one*



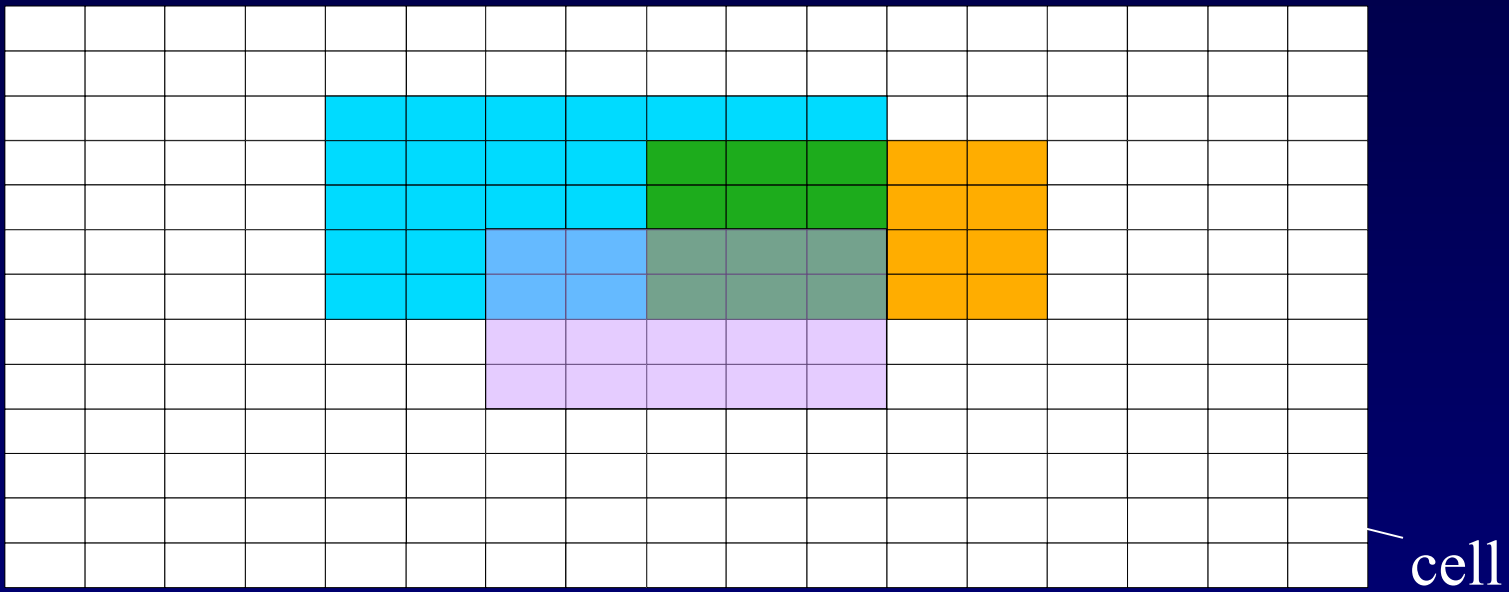
ISIS-Fish : Model/Tool

Coupling in time and space models of

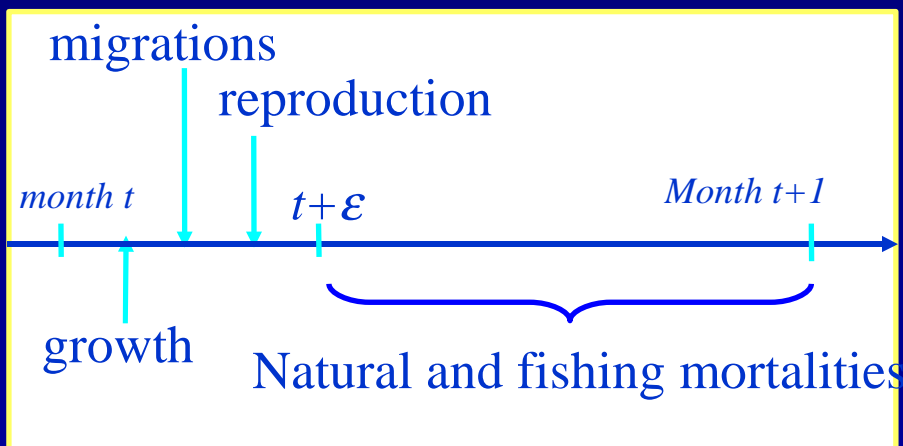
- Populations dynamics
 - Length/age, seasonal and spatial distribution, large scale migrations
 - No trophic relationship
- Fishing activities dynamics
 - Fleets, métiers (gear, areas, target species), strategies
 - Short and middle term economic parameters (costs)
 - Dynamic allocation of fishing effort (Gravity model)
- Management dynamics
 - Scenario (combining measures = area, season, rules)
 - Fishermen reactions



ISIS-Fish : Spatial and temporal scale



Chronology



Independant definition of populations, métiers and management seasons and areas

ISIS-Fish : Guidelines

1. Parametrization

- Collecting available parameters from literature
Biological parameters + selectivity
- Estimating missing parameters : available data and statistical methods (factorial analyses, maximum likelihood,...)
Fishing activity parameters

4. Sensitivity analysis

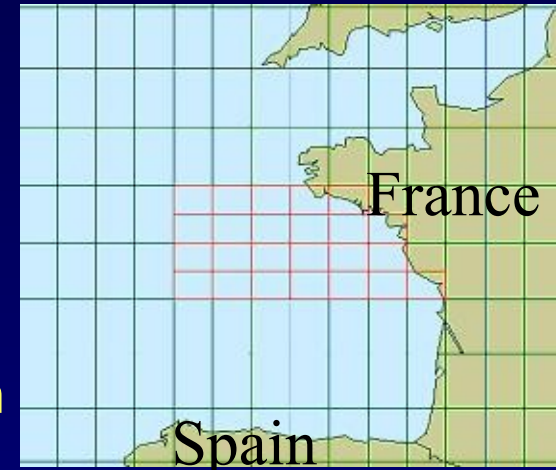
- Identifying uncertain parameters
- Statistical experimental designs for simulations
Group screening + modeling outputs variability + factorial fractional design

5. Simulations

- Defining measures
- Statistical experimental designs for simulations
modeling outputs variability + D-optimal design



Case study : Bay of Biscay demersal mixed fishery



- Mixed fishery
 - French and Spanish fleets (single and twin trawls, on/offshore)
 - Hake, Nephrops, Megrim and Monkfish
- Restoration plan
- Technical interactions
- Alternative measures to mono-specific TACs? MPAs? Technical measures? Seasonal? Spatial?
- Parametrization of ISIS-Fish 2.0 (TECTAC)
 - Available data : logbooks, fishers annual interviews (face to face), biological sampling, scientific surveys
 - French fleets + Hake and Nephrops

Sensitivity parameters

- Uncertain parameters (+-20%) : catchability, migration coefficients, reproduction, growth, standardization factors, natural mortality
- Experimental design :
 - 106 factors with 2 modalities
 - Group screening => Nb of groups : 9
 - Quantification of second order interactions : 128 experiments
- Outputs variables: final abundances, final catches, 5-years cumulated catches
- Analysis : linear model with second order interactions



	Hake Biomass $R^2=0.99$	Hake Cumulated catch (5 last years) $R^2=0.999$	Hake Cumulated catch (last year) $R^2=0.999$	Lobster Biomass $R^2=0.988$	Lobster Cumulated catch (5 last years) $R^2=0.998$	Lobster Cumulated catch (last year) $R^2=0.993$
Catchability	9.5	-4.9	-1.2	4.3	5.8	6.9
Growth	18	-1.2	0.36			
Gear	6.1	-3.4	0.9			
MigrationA	5.8					
MigrationB	10	12	4.0			
MigrationC	-8.5	2.3				
Morta	170	38	12		1.3	
reproLobster						
reproHake	31	5.7	1.9			

No significant interaction

Sensitive parameters

- M
- Catchability
- Hake reproduction
- Migration

Management measures impact

▪ MPA

Modalities : *area, season, gears*

Reaction: *effort reallocation on the remaining accessible area*

• TACs

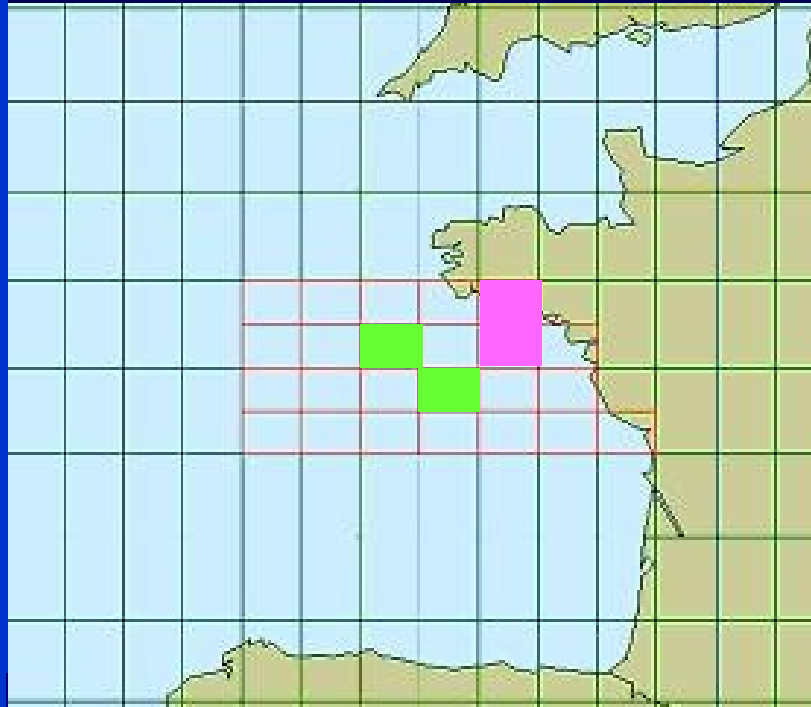
Modalities : *constant, variable*

Reaction: *if targetted species, change métier, otherwise discard*

• Gears

Modalities: *mesh size increase (70 à 100 mm), selective device*

Reaction: *compliance*



• MPA

« reproduction »

1 or 2 rectangles

• MPA

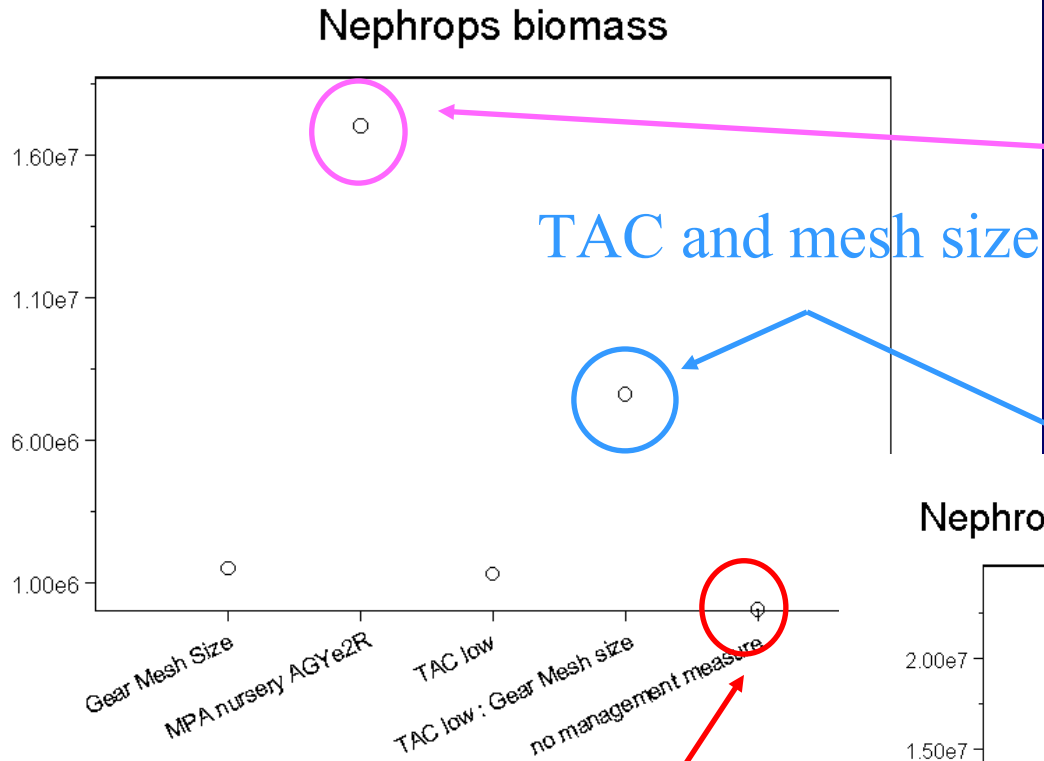
« nursery »

1 or 2 rectangles

• **D-optimal experimental design**

• **Analysis : linear model of 2nd order interactions**

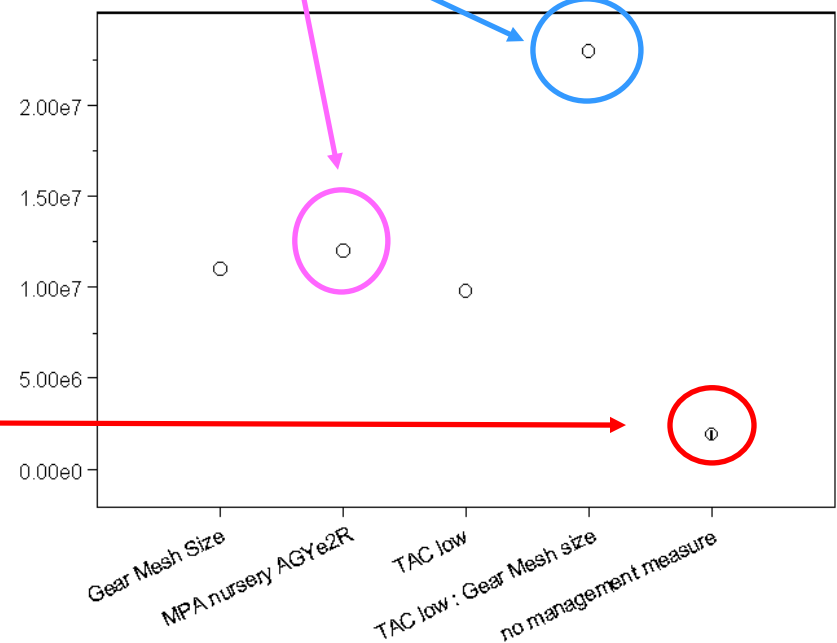
Comparison of management measures



MPA « nursery »
2rect over the year

TAC and mesh size

Nephrops cumulated catch over the last five years



No management



Conclusions

- ISIS-Fish : an operational and available simulation tool
- Quantitative approach: sensitivity analysis, simulations design
- Results quality depends on available data quality
- Catchability (coupling acoustic/trawling/video), natural mortality (tagging)

Prospects

- Running simulations with the whole parametrization
- Sensitivity to fishers reactions
- Indicators of the state and the dynamics of the fishery
- European training in November (PROTECT)



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THE END!
But to be continued ...

Thank you