

Investigating the consequences of Marine Protected Areas upon fish populations and fisheries through ISIS-Fish, a generic simulation tool

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The logo for Ifremer, featuring a stylized grey fish silhouette above the word "Ifremer" in black text on a yellow background.

Ifremer

MPA and fisheries management

an alternative option for fisheries management

- habitat protection, resource restoration
- reduction of conflicts through zoning of multiple uses

assess the consequences of MPA upon fisheries

modelling tools for assessment at fisheries-level are mostly theoretical and for single-species fisheries

The ISIS-Fish model and software

Issues addressed :

- spatial and seasonal dynamics of fishery
- mixed fisheries
- fishers' response to management

The approach :

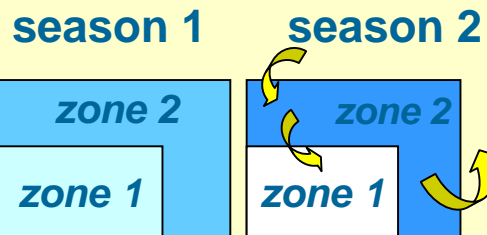
- Integration of existing knowledge and information
- Generic model : application to many fisheries
- Flexible model : generic, evolution of knowledge

Model description

1. Population model

CORE MODEL

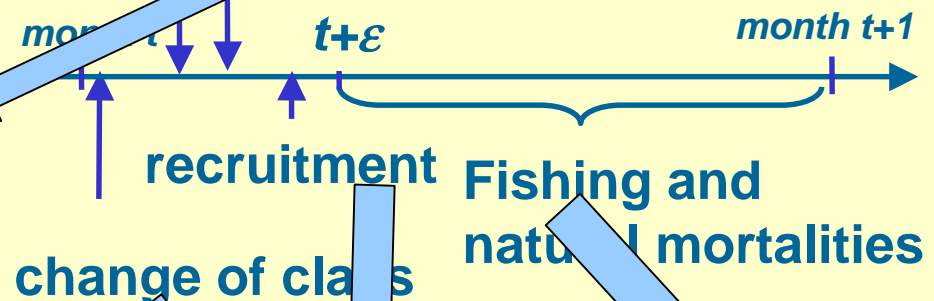
Zones and seasons



Stage-structured model



migrations
reproduction



-timing and zoning of reproduction
-spawner-egg relationship

FLEXIBLE COMPONENTS

growth model

timing and zoning of recruitment

Catchability per area

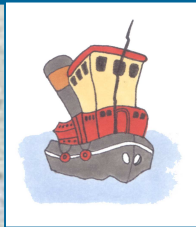
Model description

2. Exploitation model

Fishing effort = $f(\text{number of vessels, time spent fishing, fishing activity})$

SetOfVessels


- port 
- technical characteristics 

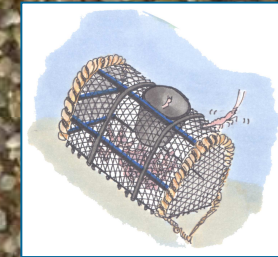


Strategies

- SetOfVessels
- Fishers' behaviour
- Métiers used each month

Métiers

- gear 
- target species
- zones and seasons 



	1	2	month	12
Métier1	$\frac{1}{4}$	$\frac{1}{2}$	• • •	
Métier2	$\frac{3}{4}$	$\frac{1}{2}$	• • •	

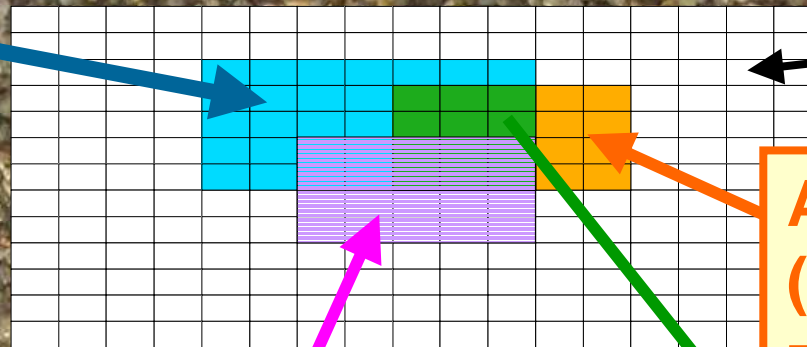
Specific Costs 

Model description

3. From fishing effort to fishing mortality

Each month:

Effort(métier1,
métier zone1)



cell

Abundance
(pop1, pop
zone1, class)

Abundance (pop2,
pop zone2, class)

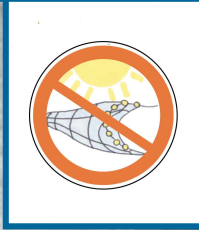
Catch(pop1, pop zone1, class,
métier1)
Catch(pop2, pop zone2, class,
métier1)

FishingMortality
(pop1, pop zone1,
class, métier1)

Model description

4. Management and fishers' behaviour

Each Policy
defined by :



- a zone
- months of application
- years of application
- métiers or gears concerned
- vessels concerned
- fish populations concerned

Ex : catch quotas, MPA, effort controls, gear restrictions..

Fishers' behaviour :

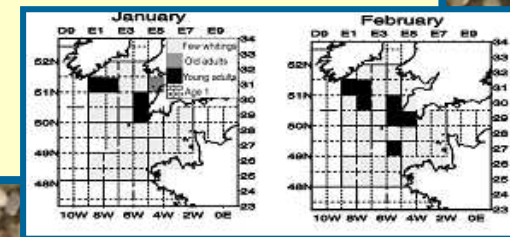
- response to policy (reallocation of fishing effort)
- adaptation to changing conditions (resources, economy)

FLEXIBLE COMPONENTS

Input parameters and uncertainties

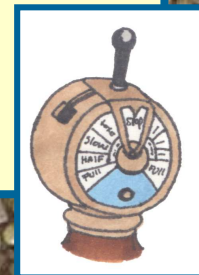
Synthesis of knowledge and data analysis

- spatial resolution tuned to available information
- assumptions , parameter estimates and corresponding uncertainties



Simulation designs and experiments :

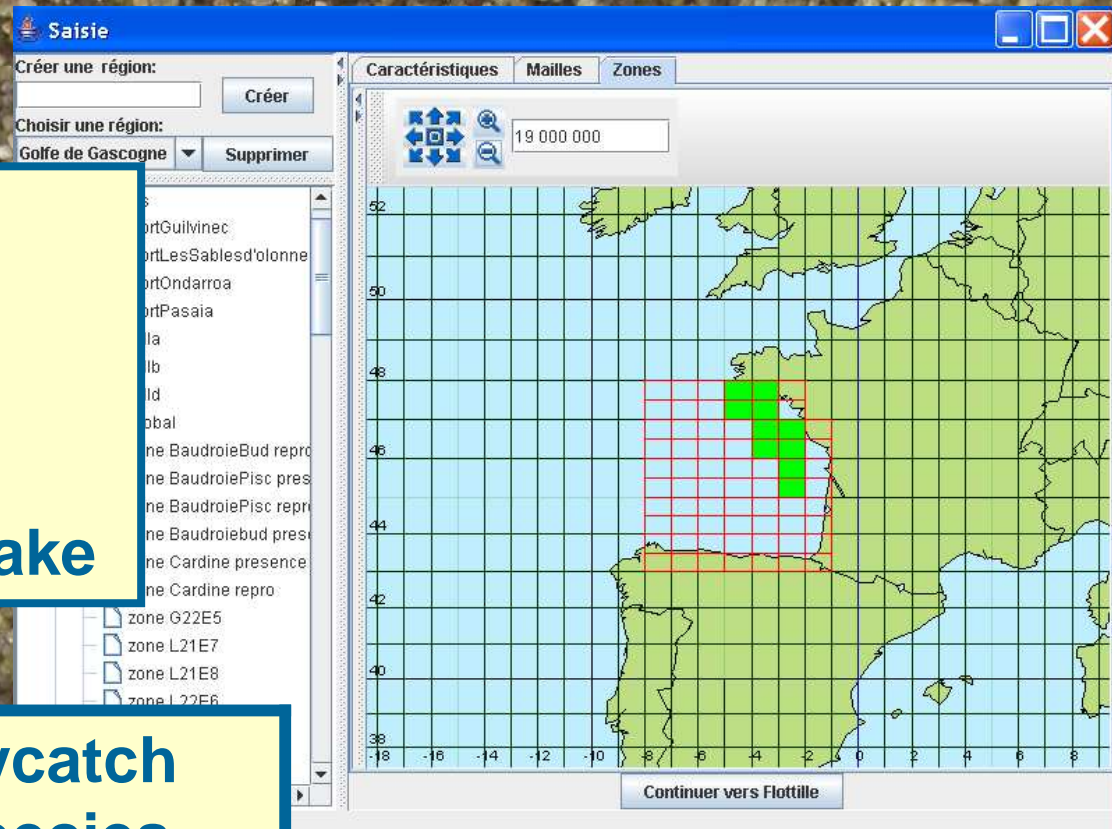
- account for alternative assumptions and uncertainties
- statistical analysis of results from simulation experiments



Applications

Mixed fishery in the Bay of Biscay

- high economic value
- depleted resources
- discards of juvenile hake



gear	target species	bycatch species
gillnet	hake, monkfish	
trawl	nephrops	young hake
trawl	monkfish	nephrops

Management issues :

- technical interactions
- hake recovery plan:
selective device, closures

Applications

Lobster fishery in the West of Brittany

- high economic value
- almost collapsed

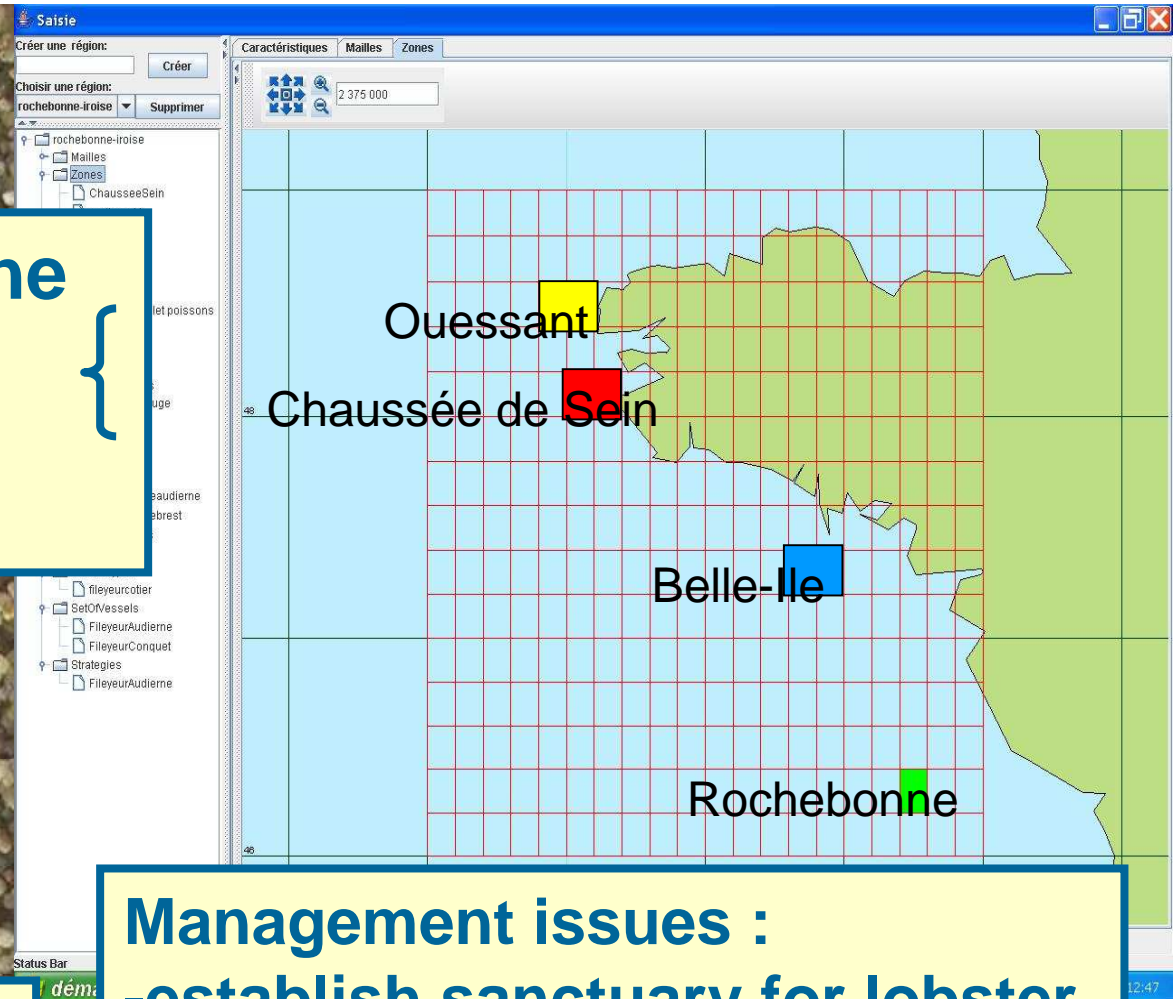
Duration et extent of larval dispersion poorly known

- Lots of gillnetters targetting fish (lobster bycatch)
- Few gillnetters targetting lobster

Management issues :

- establish sanctuary for lobster
- transition from gillnet to trap

To be evaluated under alternative assumptions about larval dispersion



Applications

Sea bream (*Diplodus sargus*) fishery / Banyuls Reserve :

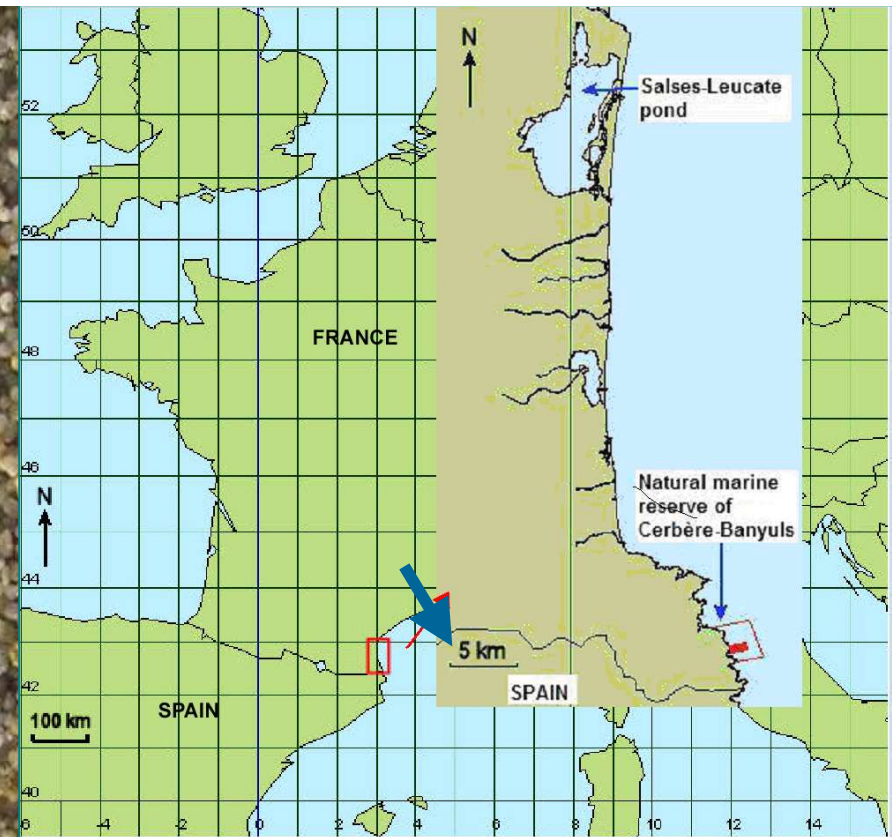
- catch decline
- high economic value

Commercial fishing :

- gillnet
- trawl

Recreational fishing :

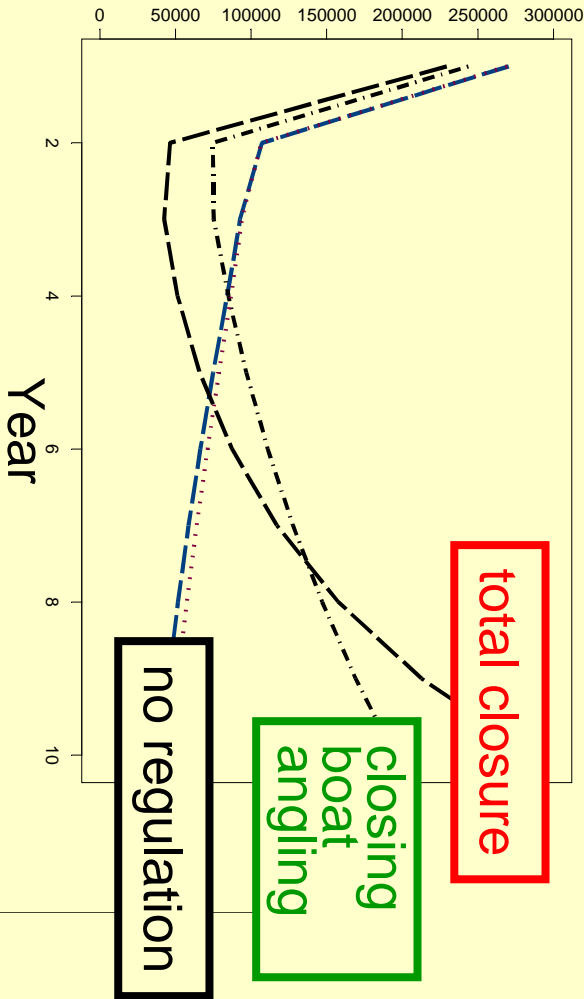
- shore angling
- boat angling
- spearfishing



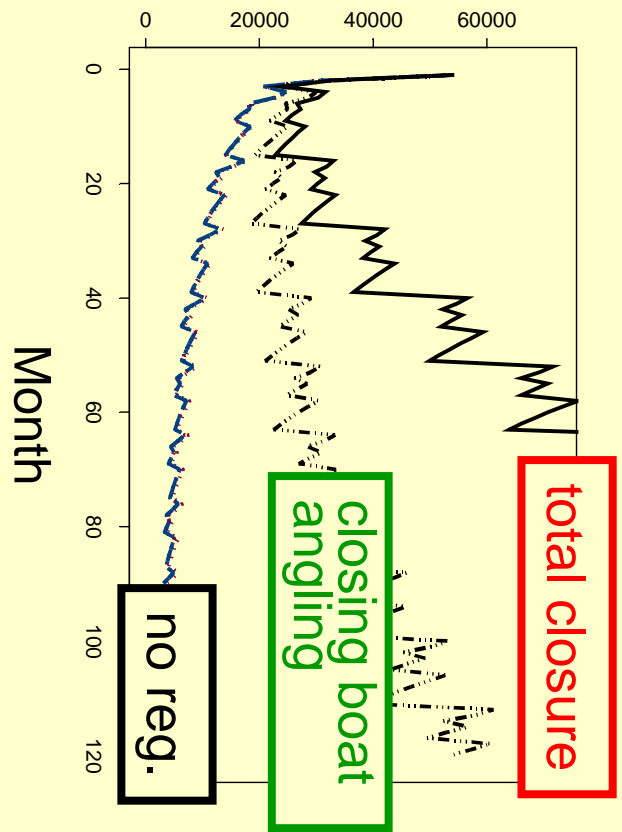
Issues raised by managers :

- impact of each métier
- relevance of changing regulations within and outside the Banyuls reserve

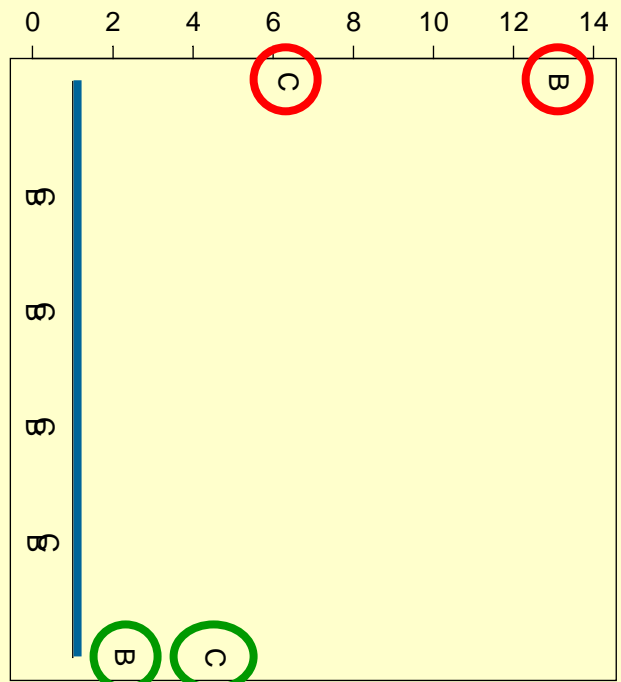
Catch (t)



Biomass (t)



Final/Initial Ratio



Total closure partial reserve

No regulation

Closure to spearfishing

Closure to gillnet

Closure to shore angling

Closure to boat angling

Perspectives

ISIS-FISH

Integration of Spatial
Information and
Simulation of
FISHeries

Un outil pour intégrer
la connaissance sur les
pêcheries et pour en
simuler la dynamique

Applications

- consolidate results through improved parameter estimation and simulation experiments
- used in european project PROTECT (Hoffman, IMPAC1)
- further develop applications with managers :
(Pelletier, IMPAC1)
→ communication and policy-screening tool

Software

- finalize user's manual, help and web site
- GNU/GPL license and freely downloadable