Global change, dynamics of exploited marine biodiversity, and fisheries viability (CHALOUPE): modelling approaches to explore some of the key drivers of changes in marine social-ecological systems

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Ifremer

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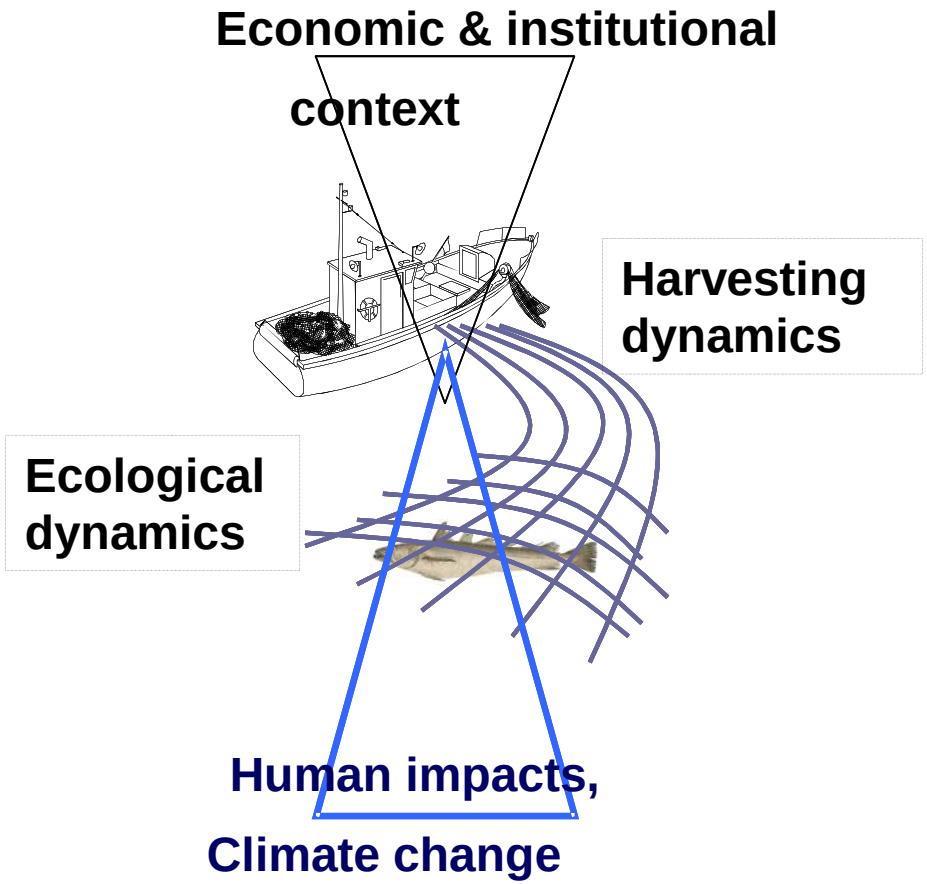
Research object :

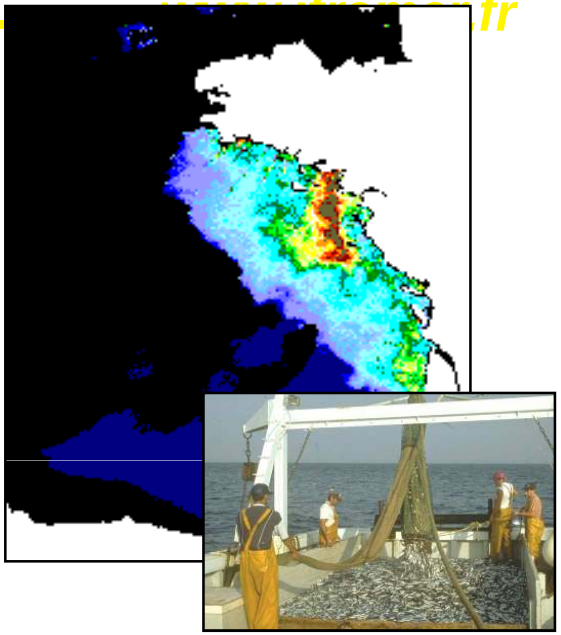
The evolution of exploited marine communities – fisheries systems



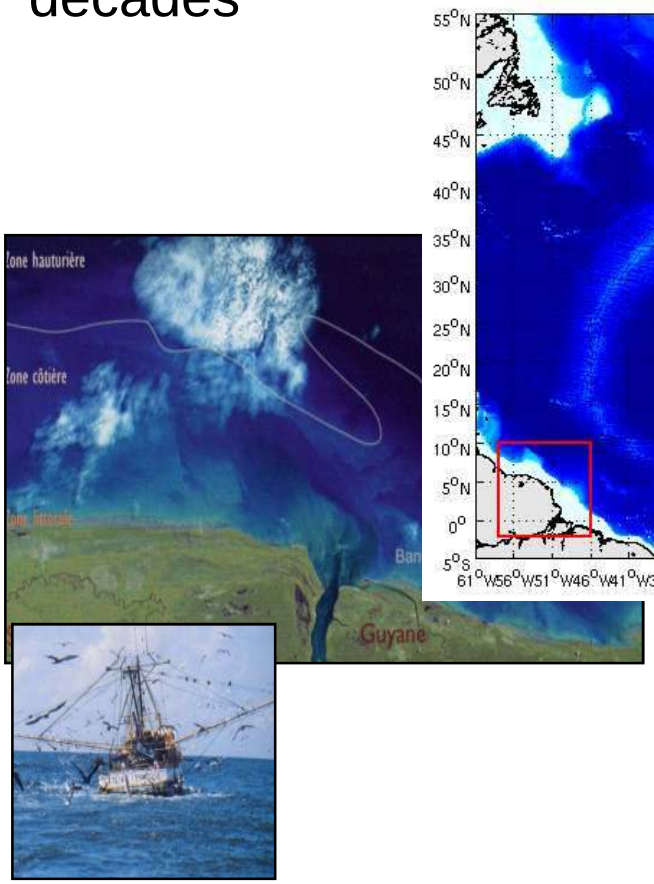
- Interfaces between ecological and socio-economic systems
- Dynamics depend on interactions between ecological and economic processes
- Considering some forcing factors :
  - climate
  - institutional framework
  - economic context

Objective

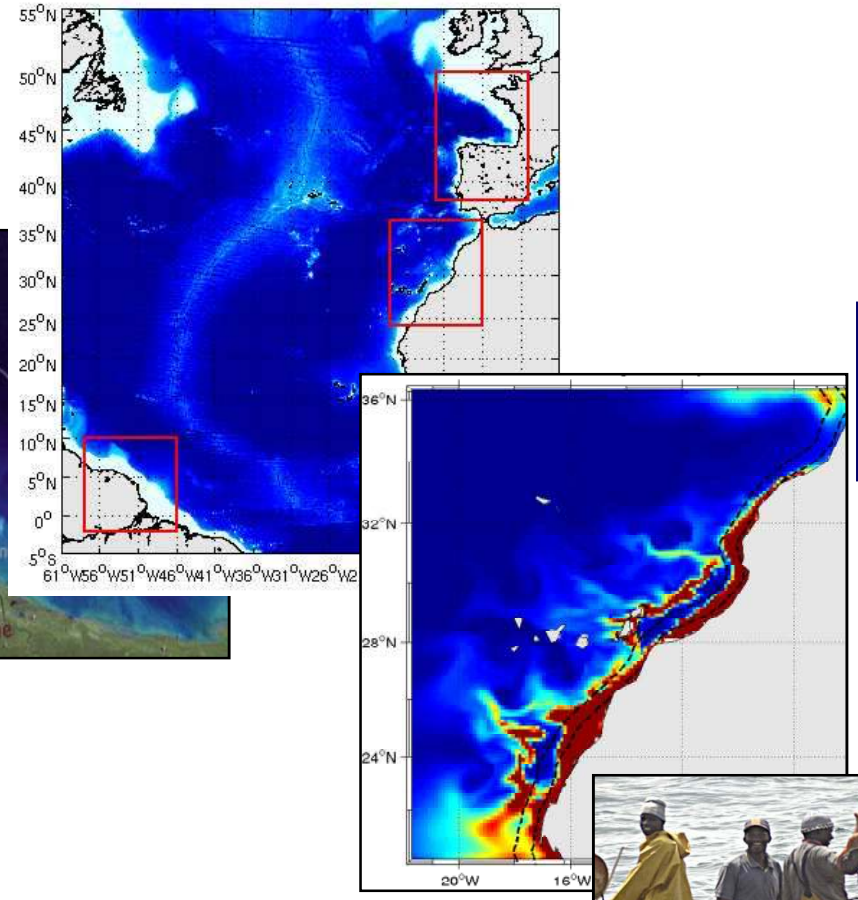
→ identify the main drivers of bio-economic changes in three systems over the past decades



Temperate continental shelf of the Bay of Biscay



Amazonian continental shelf of the French Guyana



Moroccan upwelling area

Important outcome : reinforce collaboration between fisheries scientists, marine ecologists, economists, mathematicians and computer scientists to progress towards integrated approach for marine ecosystem management, including fisheries resources

Ecological Dynamics

Ifremer (Fisheries Sciences, Ecology And Modeling, tropical Fisheris Sciences)

National Institute of Fisheries Science Research (Morocco)

Economic Dynamics

Ifremer (Marine Economics)

Univ. Bretagne Occidentale (Law and economics of the Sea)

CNRS-Museum

World Fish Center

Modelling

IRD (Upwelling Ecosystems)

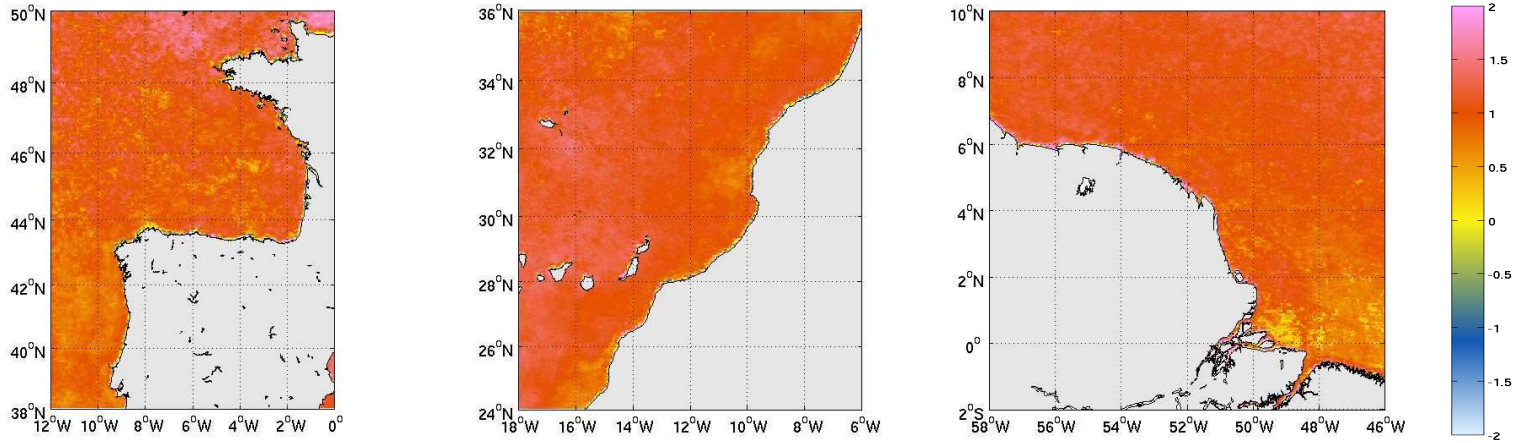
CNRS-Museum

World Fish Center

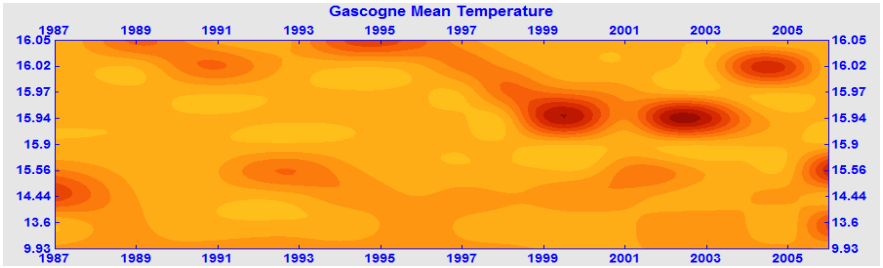
ENI-Brest (Virtual Reality)

Univ. Littoral (informatics)

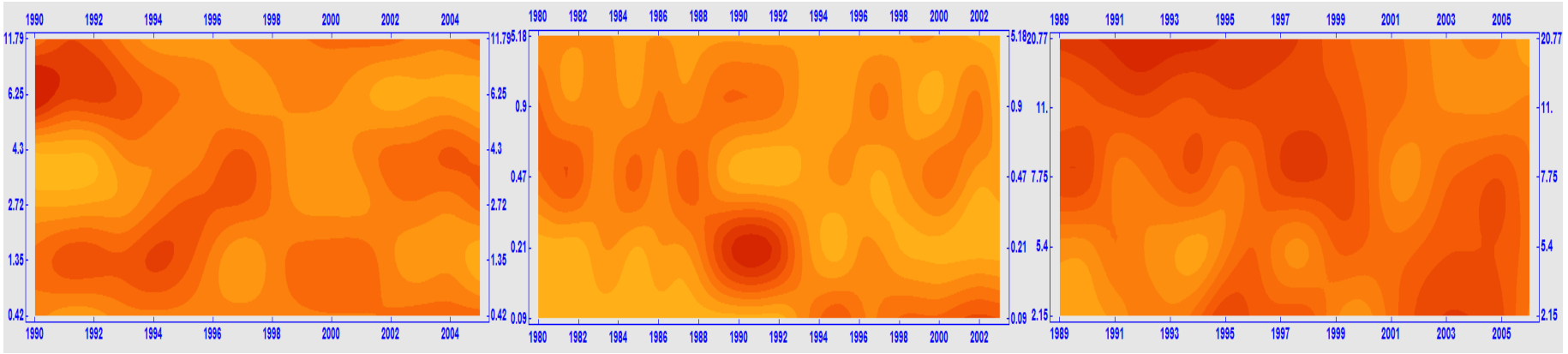
Some results…(not all!)



Increase of SST (1985-2006, from satellite data)



Biomass increase of species with affinity for warm waters in the Bay of Biscay (from bottom trawl surveys, 1987 to 2006)



Changes in the landings of species according to their value (€/kg) for the main species in the Bay of Biscay, Morocco. Same kind of results observed for a given fishery targetting one species : and for shrimp size class in F. Guyana. Combined impacts of environmental variations, overexploitation, changes in the markets, management….

The modelling approach to represent these changes, at various scales…some debates

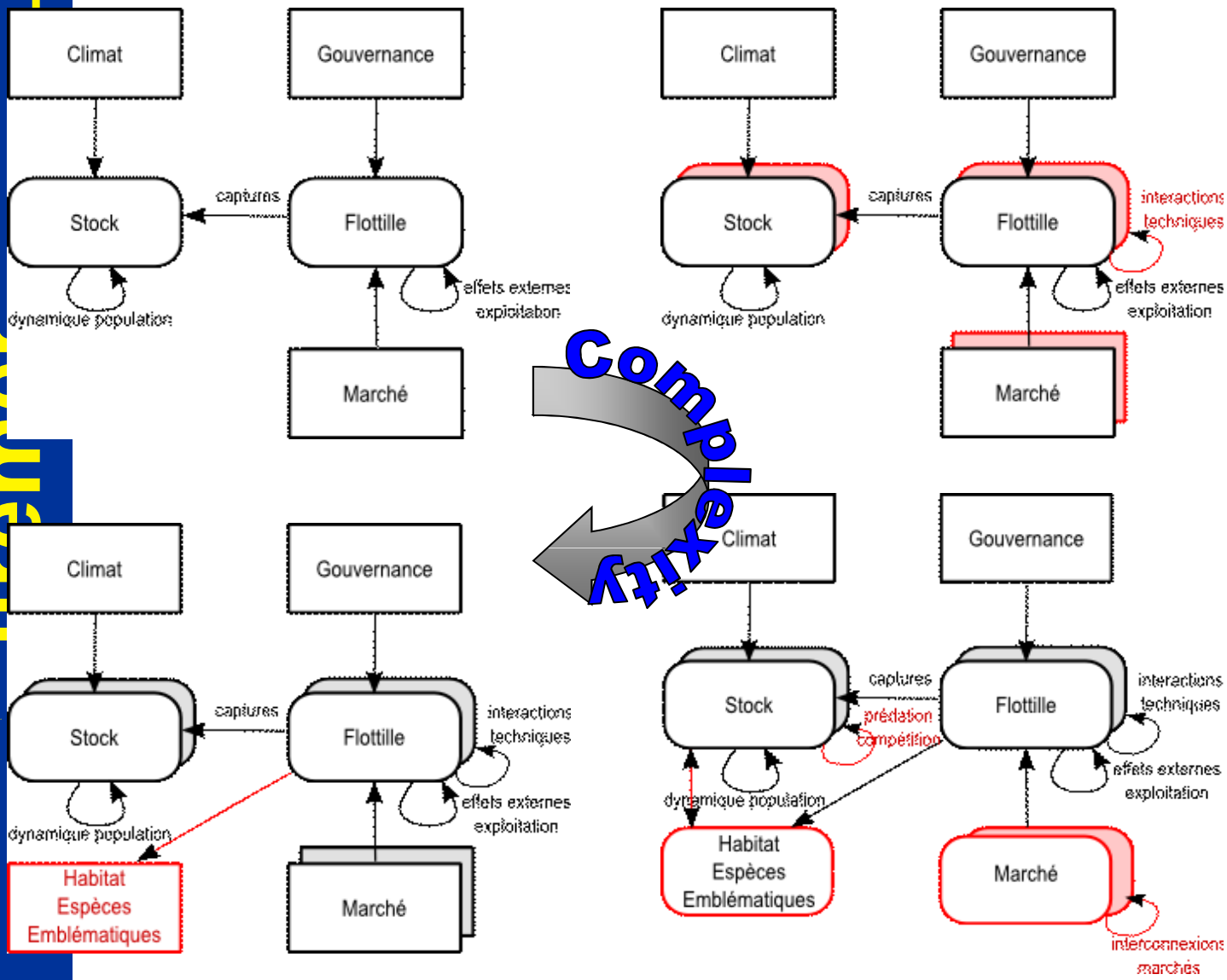
Universalism vs culturalism **: can we adress the question with one generic model (bio-economic, ecosystemic…) or do we need a new model for each case study and each question?**

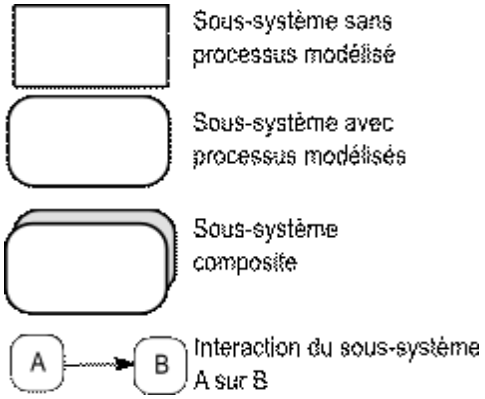
Complexity vs simplicity **: do we need theoretical comprehensive models to better understand the system functionning or only increasing step by step some existing models operational for management?**

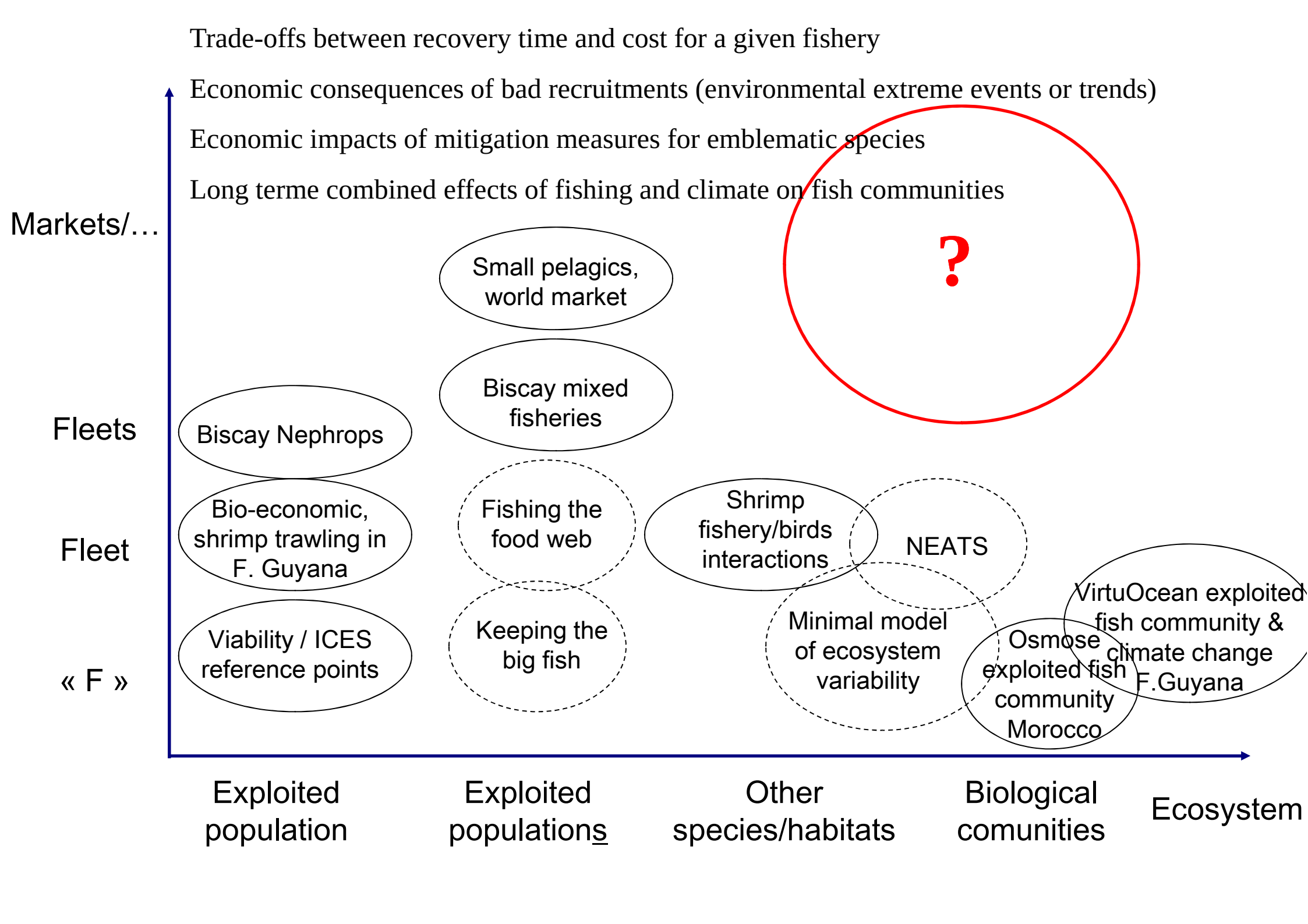
Stock/fishery local point of view of fisheries biologists *vs* ecosystem/global point of view of marine ecologists

Modelling approach within the "Chaloupe" project

Implementing and/or developing models with increasing complexity levels,






Trade-offs between recovery time and cost for a given fishery
Economic consequences of bad recruitments (environmental extreme events or trends)
Economic impacts of mitigation measures for emblematic species
Long terme combined effects of fishing and climate on fish communities
Markets/…
Fleets
Fleet
« F »
?
Small pelagics, world market
Biscay mixed fisheries
Biscay Nephrops
Bio-economic, shrimp trawling in F. Guyana
Viability / ICES reference points
Fishing the food web
Keeping the big fish
Shrimp fishery/birds interactions
NEATS
Minimal model of ecosystem variability
Osmose exploited fish community Morocco
VirtuOcean exploited fish community & climate change F.Guyana
Exploited population
Exploited populations
Other species/habitats
Biological comunities
Ecosystem

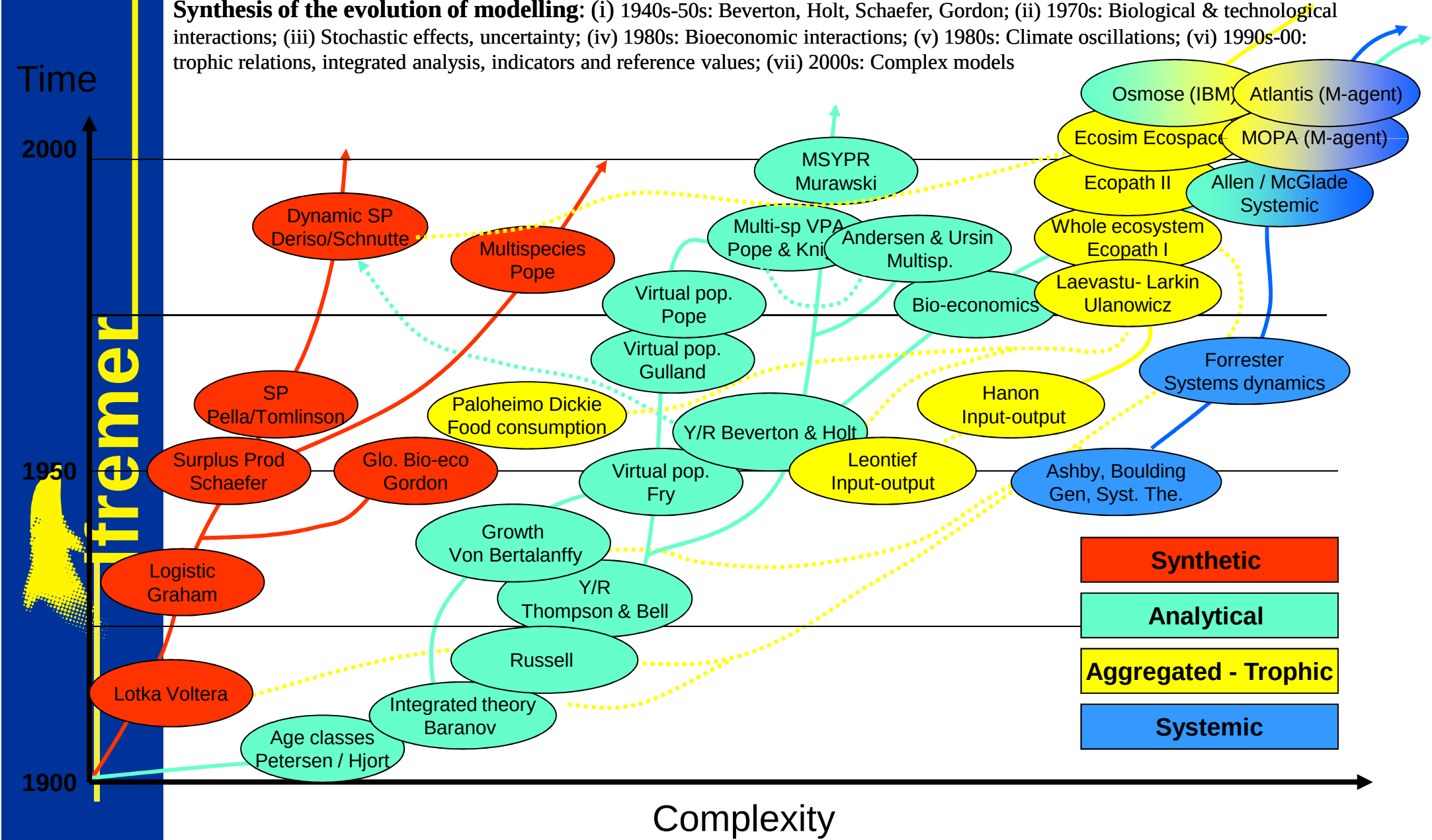
www.ifremer.fr

Fishery science response to societal demand

S.M. GARCIA and A.T. CHARLES

ICES International Symposium on Fisheries Management Strategies, Galway, Ireland, 27-30 June 2006.

Synthesis of the evolution of modelling: (i) 1940s-50s: Beverton, Holt, Schaefer, Gordon; (ii) 1970s: Biological & technological interactions; (iii) Stochastic effects, uncertainty; (iv) 1980s: Bioeconomic interactions; (v) 1980s: Climate oscillations; (vi) 1990s-00: trophic relations, integrated analysis, indicators and reference values; (vii) 2000s: Complex models



Thank you for attention

Projection of individual species – Bay of Biscay

size of marks = f(share in total landings)

« high price » species / « medium price » species / « low price species »