Reconciling complexity with relevance and uptake for fisheries advice:

An adaptative bio-economic modelling approach connected to databases and stakeholders

Macher, Merzéréaud, Le Grand, et al., 2024

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MESSH ('Mathematics for bio-Economics and Sustainability of fiSHeries') Days, on « Complexity in Bio-economics for fisheries »

Journal of Environmental Management 223 (2018) 503–516

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Research article

The role of technical protocols and partnership engagement in developing a decision support framework for fisheries management

Claire Macher[a,*], Michel Bertignac[b], Olivier Guyader[a], Katia Frangoudes[c], Marjolaine Frésard[c], Christelle Le Grand[a], Mathieu Merzéréaud[a], Olivier Thébaud[a]

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PERSPECTIVE NOTE OPEN ACCESS

Towards transdisciplinary decision-support processes in fisheries: experiences and recommendations from a multidisciplinary collective of researchers

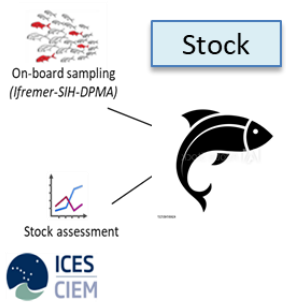
Claire Macher[1,*], Nathalie A. Steins[2], Marta Ballesteros[3], Marloes Kraan[4], Katia Frangoudes[5], Denis Bailly[5], Michel Bertignac[6], Francesco Colloca[7], Mike Fitzpatrick[8], Dorleta Garcia[9], Rich Little[10], Simon Mardle[11], Arantza Murillas[9], Lionel Pawlowski[12], Manuelle Philippe[5], Raul Prellezo[9], Evelina Sabatella[13], Olivier Thébaud[1] and Clara Ulrich[14]

Context

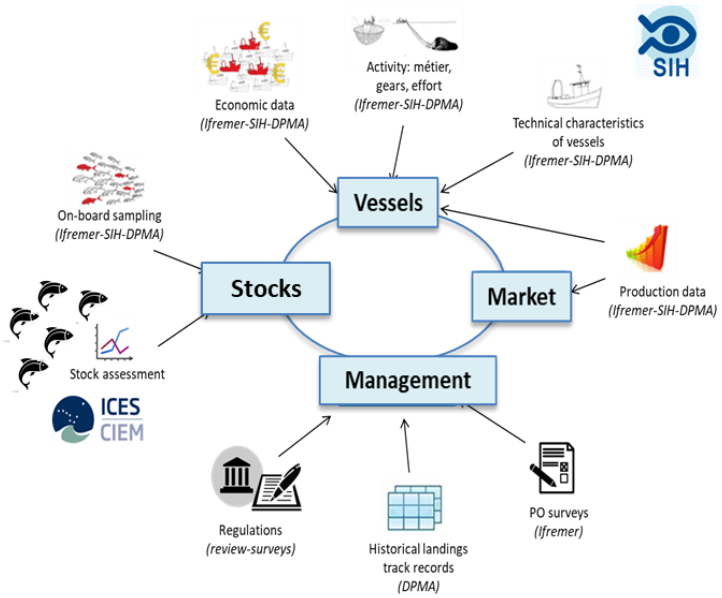
Increasing development of integrated bio-economic, ecological-economic fisheries models over the past 20 years (Prellezo et al 2012 ; Nielsen et al, 2017)

Enabled by improved observations and computational capacities

Mono-specific biological models



Integrated ecological-economic models



Context

Integrated Models developed:

- To support the Shifting policy focus towards Ecosystem Based Fisheries Management (Pikitch et al, 2004; Mc Leod et al., 2005; Leslie and Mc Leod, 2007)

With the objectives:

- to **support impact assessment of management scenarios and Management Strategy Evaluation** (Malvarosa et al. 2019; Fulton et al., 2014, Punt et al.,2016)
- to answer to the **high demand for Impact assessment from stakeholders and managers** to account for complexity and go beyond the traditional biological advice to highlight trade-offs between options from a multi-criteria point of view

Challenges/Problem Statement

However - models alone are not enough to produce relevant advices used to support decision

→ Requires **full Decision Support Frameworks (DSF)** takling at least 2 major challenges/conditions for their effectiveness, usefulness and appropriateness (Bolman et al, 2018):

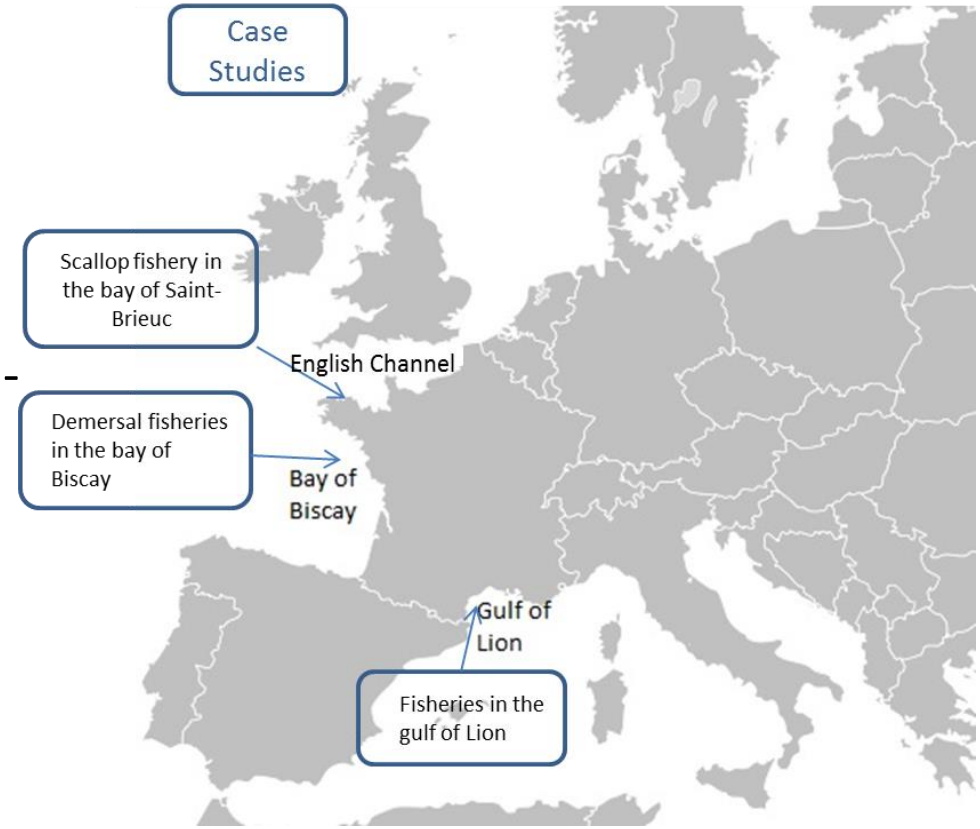
- **Ability/time and resources to operate the DSF with most updated knowledge -**
- **Partnership and engagement of stakeholders** along the process

Large consensus on added value of stakeholder engagement in support of marine resource management → relevance, salience, credibility, legitimacy, better uptake and social learning (e.g Berghöfer et al, 2008, Mackinson et al., 2011, Röckmann et al, 2012, 2018, Thebaud et al., 2014, Sampedro et al., 2017; Macher et al., 2018)

Partnership bio-economic modelling approach

- Development

- Developed up to 2009
- in the **context of the Common Fisheries Policy Reform**
- National project funded by the French Fisheries Ministry (2009-2015)- further developed in a number of other projects afterwards- still improved continuously
- Based on 3 case studies/contexts (local, EU region, Med) focus on management plans

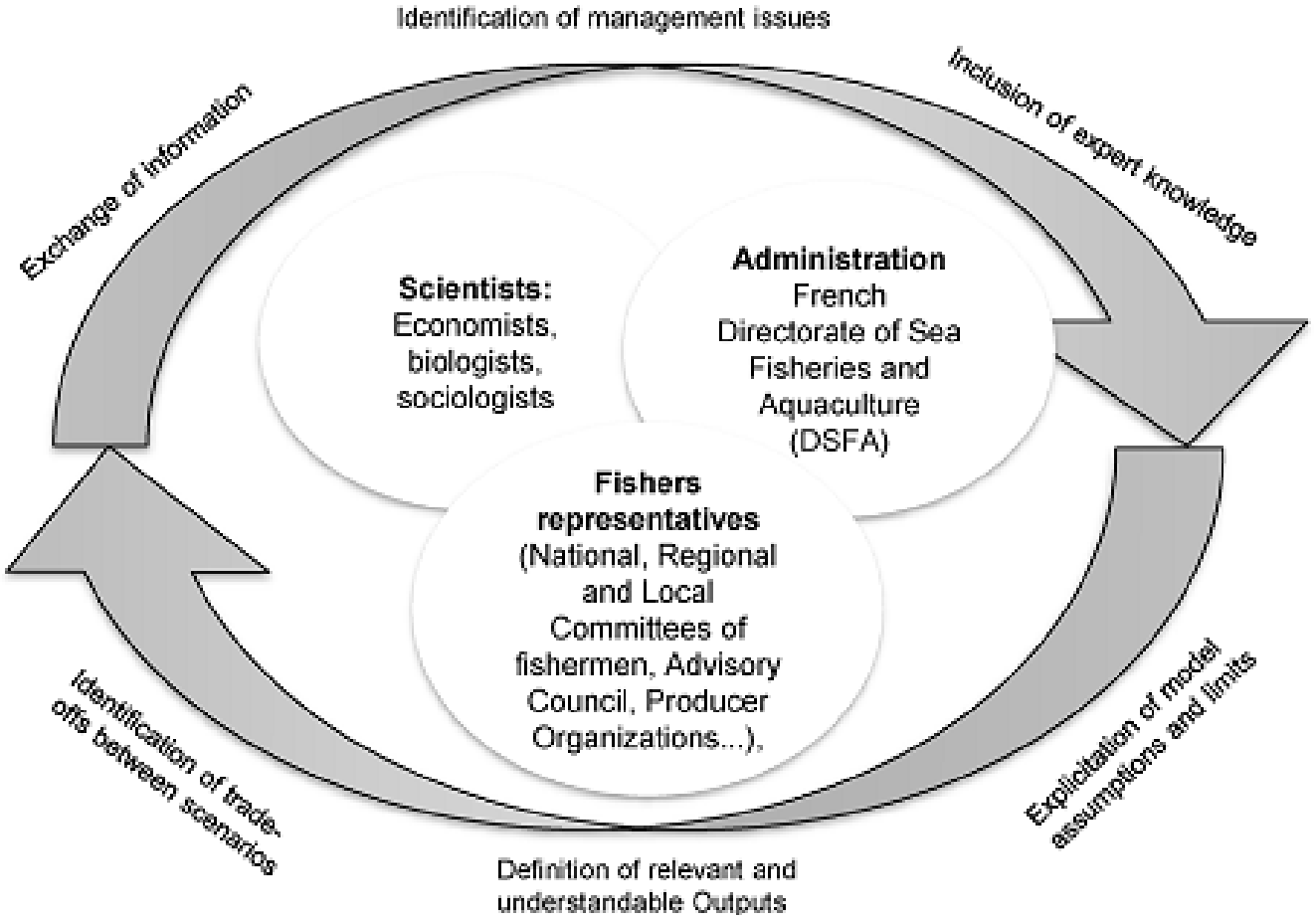


Objectives:

- Investigate a partnership transdisciplinary plateform to support management in real world context
- Address need for bio-economic decision support tools and methodologies, designed to:
  - assess and compare biological and socio-economic impacts of management options
  - highlight trade-offs of different alternatives from a multi-criteria perspective
  - help in decision based on advantages and disadvantages of each options
- **Focus** : multi-criteria impact assessment (biological and socio-economic impacts), distribution of impacts between vessels/fleets, owners/crew, impacts of governance scenarios

→ DSF: Partnership bioeconomic modelling Approach
Partnership plateform + Tools for data processing + Integrated model IAM + protocol

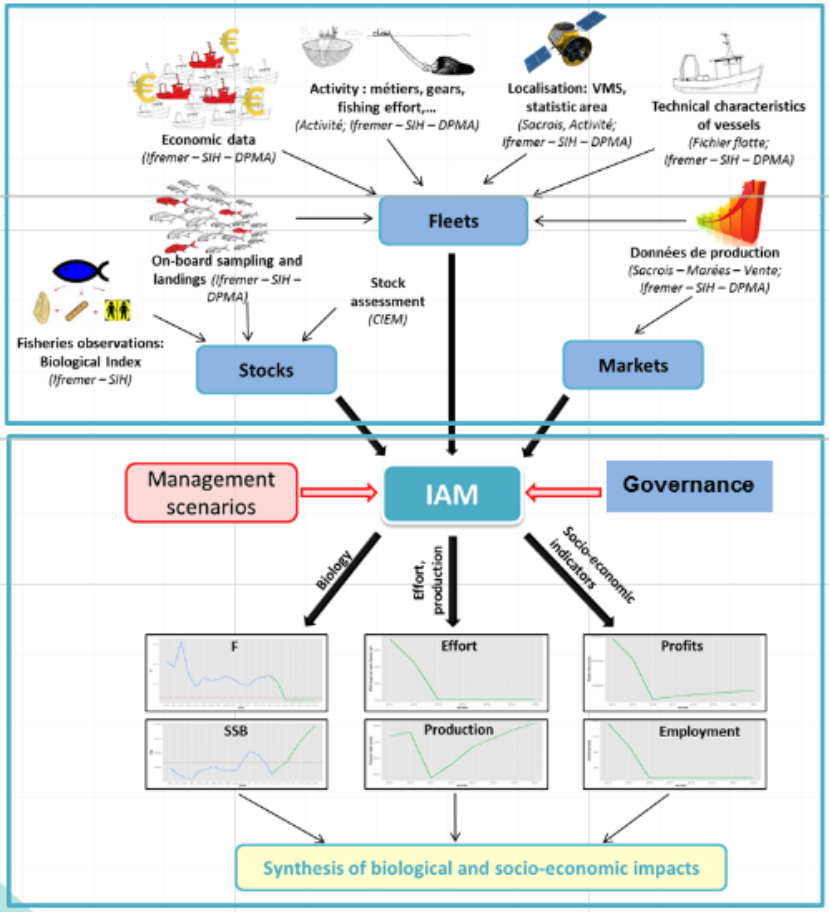
Partnership plateform



Macher et al., 2018. Journal of Environmental Management

Development of operational tools from data to bio-economic impacts

2 complementary operational tools



Tools for data processing

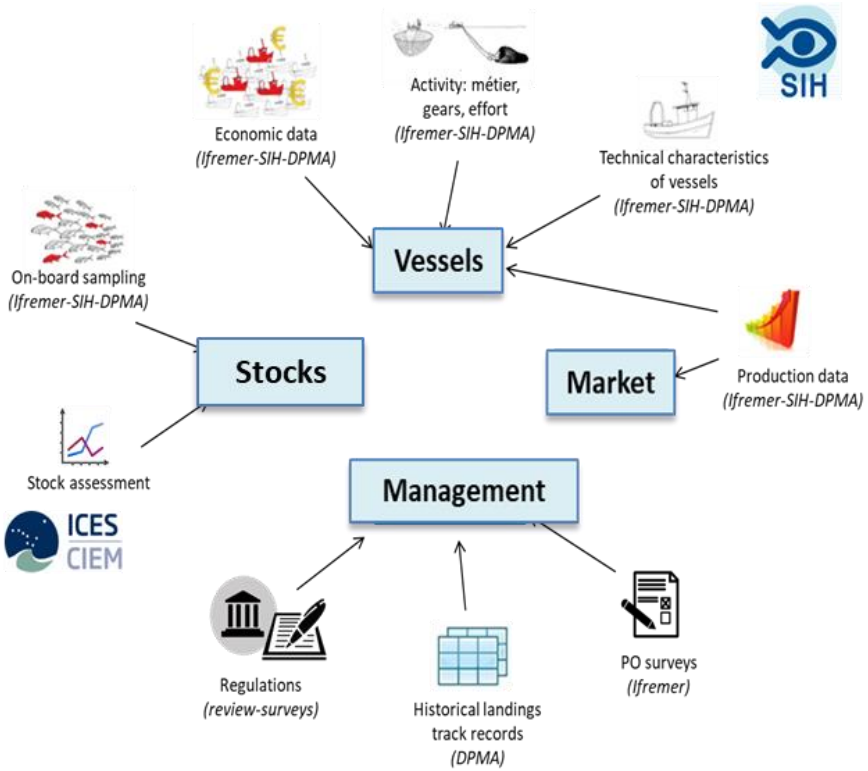
R tool for data processing and past and present dynamic representation

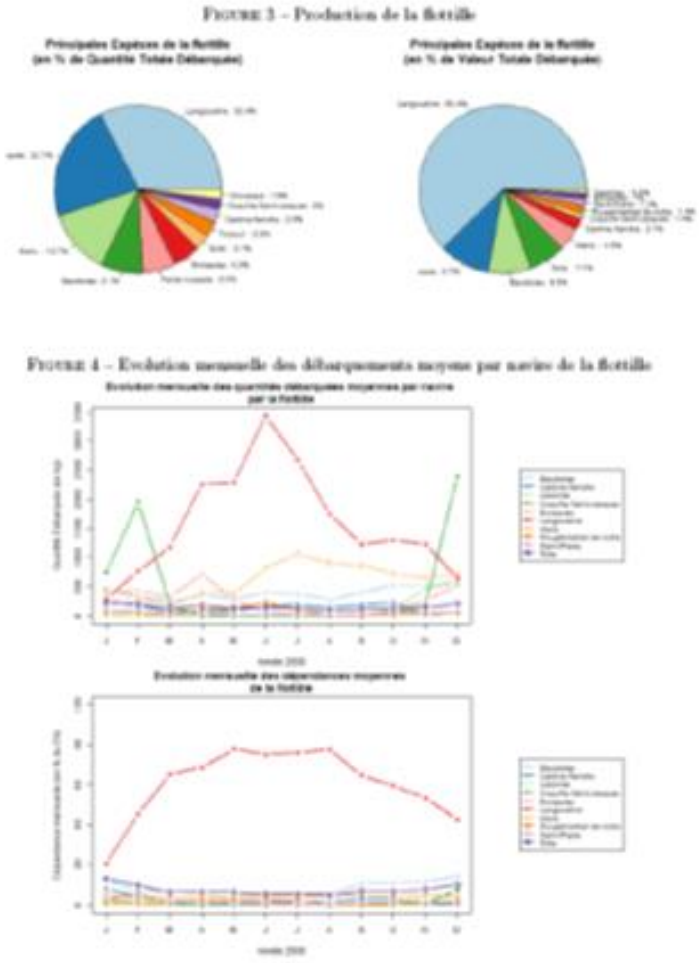
Bio-economic Impact Assessment Model IAM for ex-ante analysis of scenarios

Bio-economic model IAM

Tools for data processing

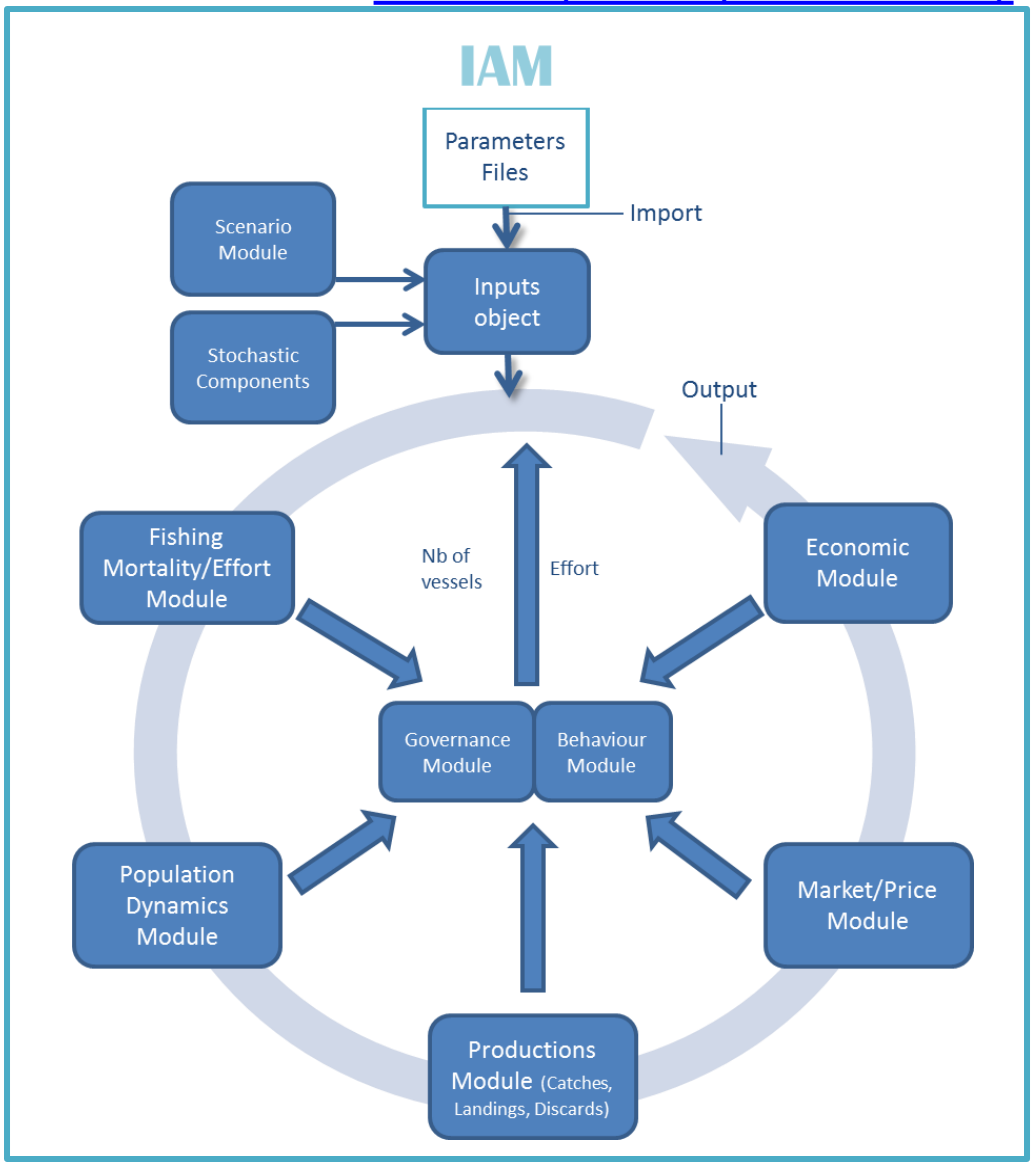
Description + IAM parameterization + internal calibration – Partial Ff/v,m,s





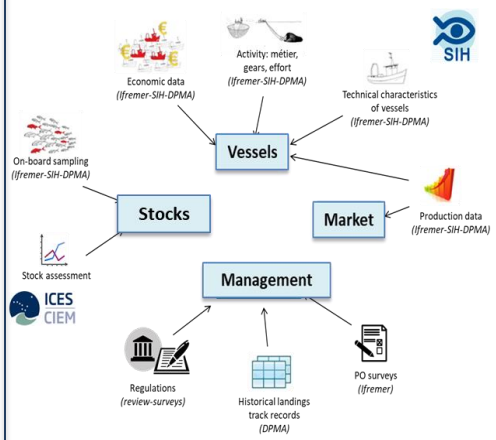
Bio-economic model IAM

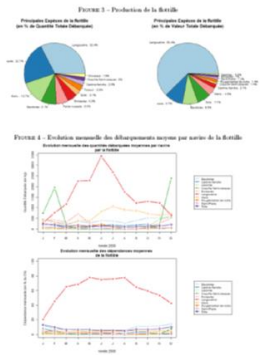
https://www.umr-amure.fr/modelisation-bio-economique-des-pecheries-iam/



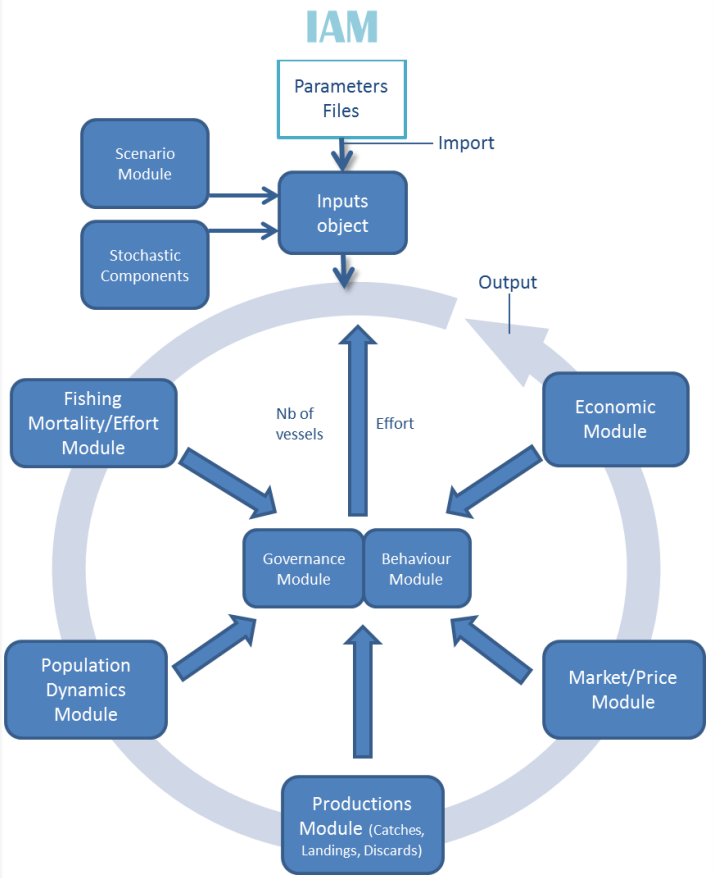
DSF: Partnership platform /Tools for data processing/ Integrated model IAM

Tools for input data processing and visualization

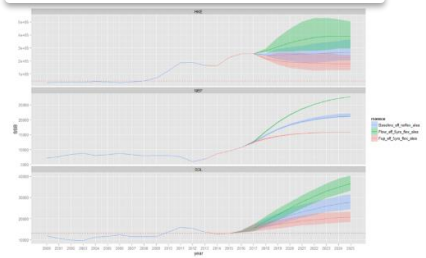


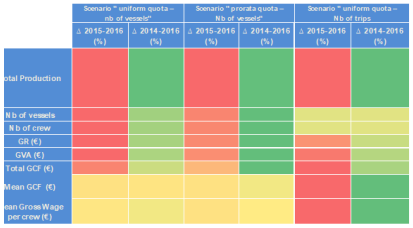


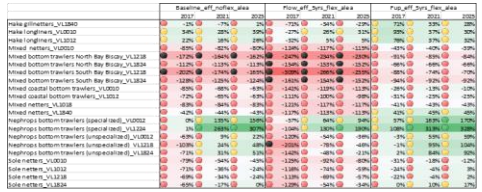
Bio-economic model IAM



Tools for output data processing and visualization







Partnership bio-economic Modelling Approach

Protocol : steps, actors, methods, and outcomes

System description and Scoping

Modelling and Simulating

Interpreting

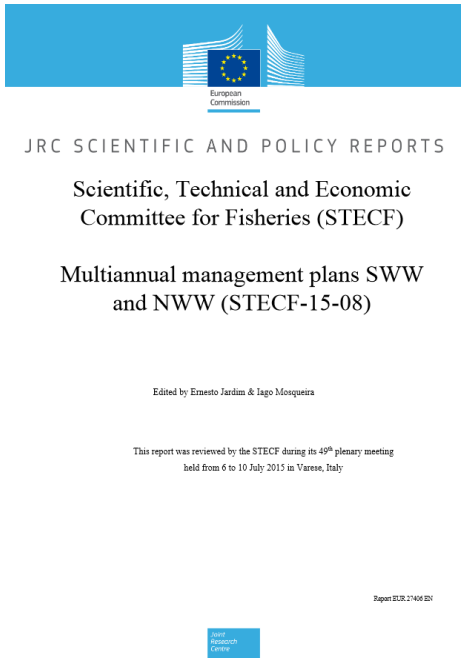
Steps of the protocol

1. Identification and engagement of actors
2. Institutional context and management issues
3. **Delimitation of contours of the CS (species, fleets, markets) according to key issues**
4. Selection/co-construction of appropriate typology
5. Extraction of data, analysis of sampling
6. Description of ex-post fisheries dynamics
7. Parameterization/calibration
8. **Scenarios development**
9. Simulation
10. **Production/vizualization of results**
11. **Results analyses, limits + additionnal qualitative knowledge on IA**

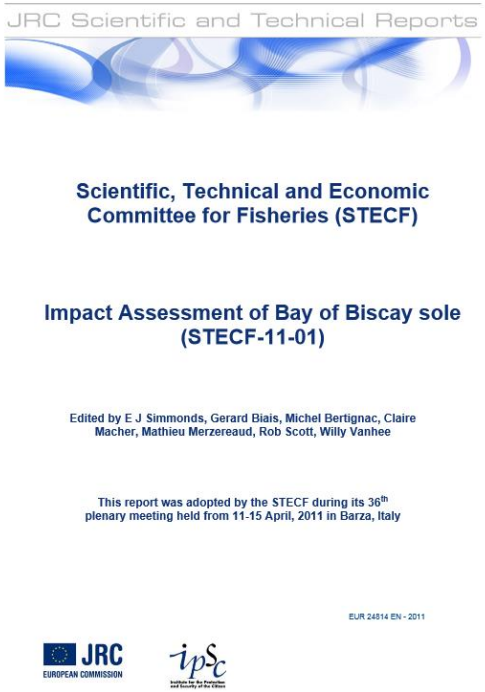
Partnership approach – expertise and co-construction

Use for Decision Support

STECF
Bay of Biscay Sole Management plan
Multi Annual Plan SW
Med Management Plan

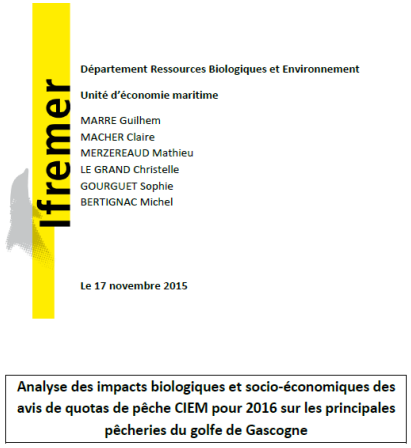


ICES special request



National requests

- Socio-economic impact of annual TAC advices
- Landings Obligation
- Mediterranean Management plans



Exploration of research questions -

Marine Policy 40 (2013) 64–74

Contents lists available at SciVerse ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Estimating MSY and MEY in multi-species and multi-fleet fisheries, consequences and limits: an application to the Bay of Biscay mixed fishery

Jordi Guillen [a,*], Claire Macher [a], Mathieu Merzéréaud [a], Michel Bertignac [b], Spyros Fifas [b], Olivier Guyader [a]

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[b] IFREMER, Unité Sciences et Technologies Halieutiques, BP 70, F-29280 Plouzané Cedex, France

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DOI: 10.1051/alr/2012035
www.alr-journal.org

Aquatic Living Resources

A bio-economic analysis of experimental selective devices in the Norway lobster (*Nephrops norvegicus*) fishery in the Bay of Biscay

Adriana RAVEAU[1], Claire MACHER[2,*], Sonia MÉHAULT[3], Mathieu MERZEREAUD[2], Christelle Le GRAND[4], Olivier GUYADER[2], Michel BERTIGNAC[5], Spyros FIFAS[5] and Jordi GUILLEN[5]

Canadian Journal of Fisheries and Aquatic Sciences
Article In Press
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http://dx.doi.org/10.1139/cjfas-2017-0075
http://archimer.ifremer.fr/doc/00416/52779/

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Investigating trade-offs in alternative catch-share systems: an individual-based bio-economic model applied to the Bay of Biscay sole fishery

Bellanger Manuel [1,*], Macher Claire [2], Merzéréaud Mathieu [2], Guyader Olivier [2], Le Grand Christelle [3]

Environmental Modeling & Assessment (2020) 25:307–325
https://doi.org/10.1007/s10666-019-09685-7

Providing Integrated Total Catch Advice for the Management of Mixed Fisheries with an Eco-viability Approach

Florence Briton[1] · Claire Macher[1] · Mathieu Merzeréaud[1] · Christelle Le Grand[1] · Spyros Fifas[2] · Olivier Thébaud[1]

ICES Journal of Marine Science

ICES Journal of Marine Science (2021), 78(5), 1599–1613. doi:10.1093/icesjms/fsab057

Flexibility of joint production in mixed fisheries and implications for management

Florence Briton [1,2,3,*], Olivier Thébaud[1], Claire Macher[1], Caleb Gardner[4], and Lorne Richard Little [3,5]

Conclusion

Essential role of :

- **Data processing tools for operational use of most updated data at the right agregation level and visualization of inputs/outputs**

→ perspectives with projects under the digital twin of the ocean call / development of AI

- **Partnerships/participatory approach for:**
  - Sharing a common understanding of dynamics and issues in fisheries
  - Integrating academic and non-academic knowledge in modelling approach, Including expert knowledge eg on behaviors and probable options, qualifying results and limits
  - better aligning scientific developments, complexity, needs for knowledge and political agenda
  - building trust and capacities for engagement in policy process
  - Ensuring information flow and thus uptake and use of science for decision

→ Promote development of transdisciplinary plateforms

Research Perspectives

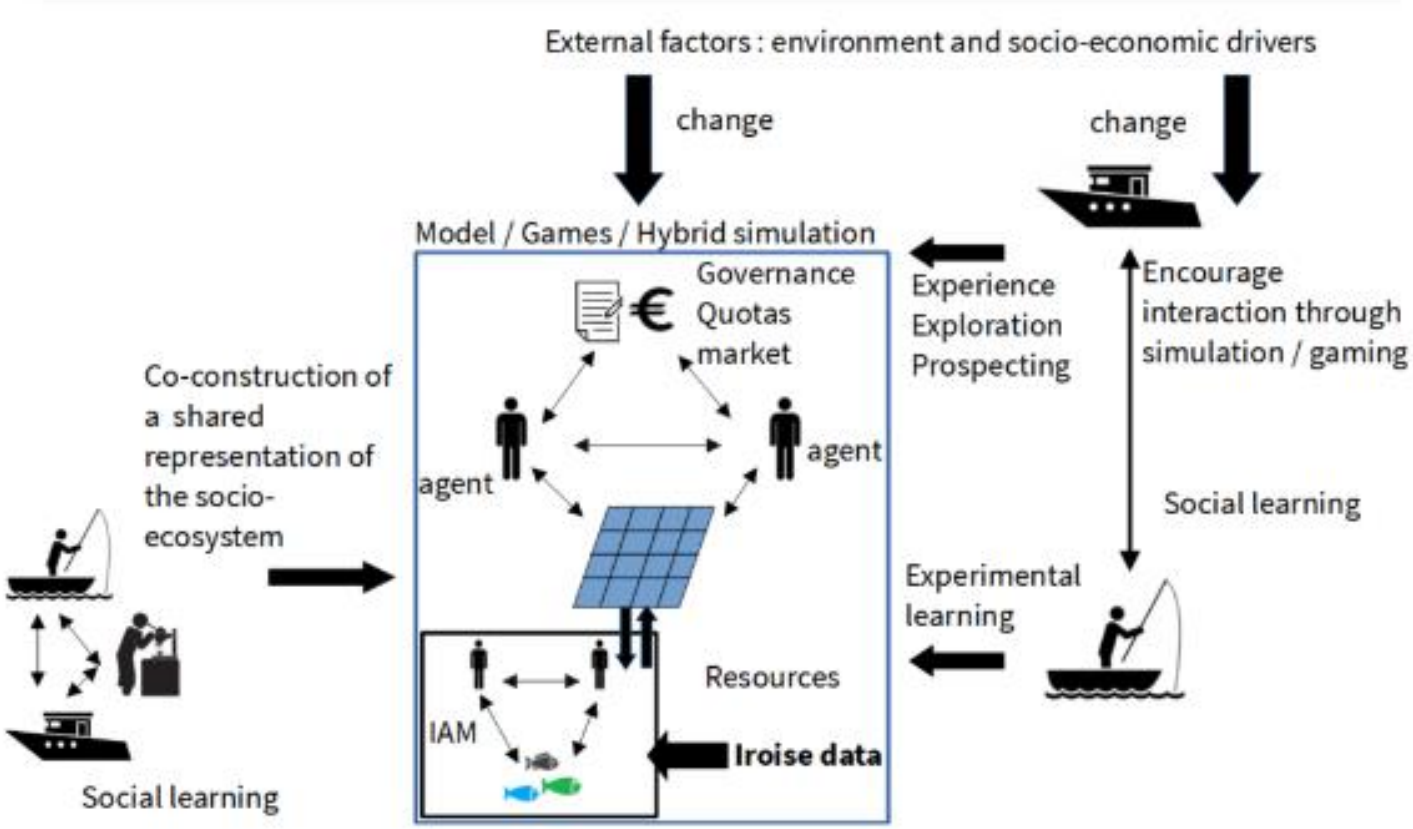
Models as intermediary object – to foster social learning and transformation

The future of Humans & fish pOPulations: fOstering transdisciPlinarity and interdisciPlinarity for sustainable marine social-ecological systems

Page web HOPOPoP

HOPOPoP sur Twitter/X

Research Perspectives

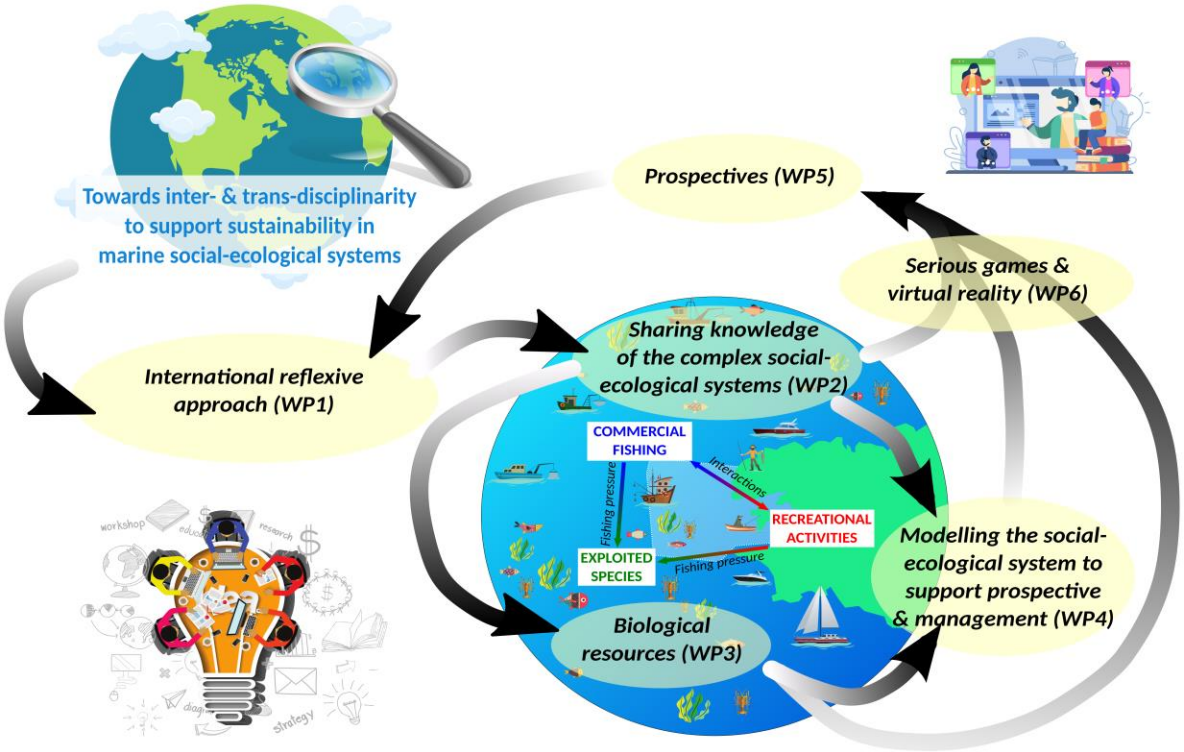


PhD Anton Bommel – Companion Agent-Based Modelling approach to support sustainability in marine social-ecological systems – Irosie Case study

Thank you for your attention

Contact: Claire.macher@ifremer.fr
UMR AMURE - https://www.umr-amure.fr/

- **International reflexive approach**
- **Understanding interactions** within the social-ecological system (SES)
- Co-constructing a **shared representation** of the SES
- Modelling to **explore possible futures & support transitions**



Types de scénarios	Scénarios	Références
Scénarios points de référence, objectifs de gestion et gestion multi-spécifique	Transition vers des objectifs de gestion MSY, MEY, MMSY	Macher et al., 2011
	Nouveaux Plans de gestion, HCR, gestion multi-spécifique Conciliation d'objectifs socio-économiques et de conservation	STECF 2011, 2015 et Macher et al., 2015
	Estimation des points de référence RMD et Rendement Economique Maximum (REM) dans un contexte multi-flottille et multi-espèce	Guillen, Macher et al., 2012, MP
	Ajustement effort de pêche/capacités de pêche GG, GL, M	Macher et al., 2011
	Impact TAC	Marre et al., 2015
Scénario sélectivité et obligation de débarquement	Impact Obligation de débarquement	Macher et al. 2015
	Arbitrages entre réduction de l'effort de pêche et amélioration de la sélectivité	Macher et Boncoeur, 2010, MRE
	Scénarios d'amélioration de la sélectivité des engins de pêche et de réduction des rejets	Raveau, Macher et al., 2012, ALR
Scénarios de gouvernance	Arrangements institutionnels/gestion des quotas - Comparaison de différents mécanismes d'allocation des droits de pêche et de régulation des capacités	SOCIOEC, 2015 ; Macher et al., 2013 ; Macher et al., 2015 ; Bellanger et al., 2018, CJFAS
Scénarios rémunération équipage	Analyse des impacts du mode de rémunération des équipages sur la répartition de la rente	Guillen et al., 2015 MRE