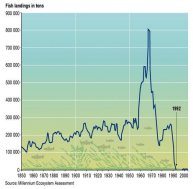
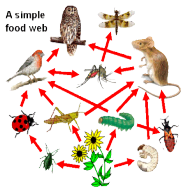
Enjeux Economiques Biodiversité
Scénarios Bio-économiques

Biosena webinar, 2023

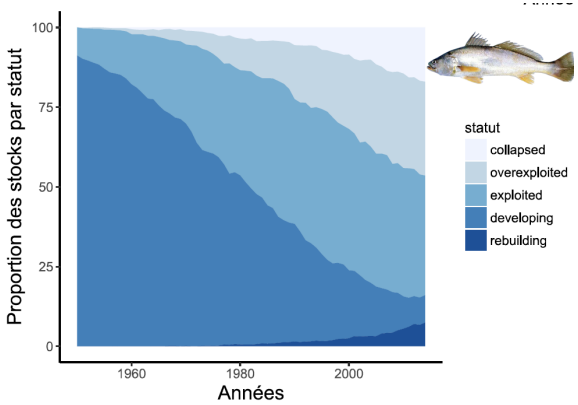
Luc Doyen

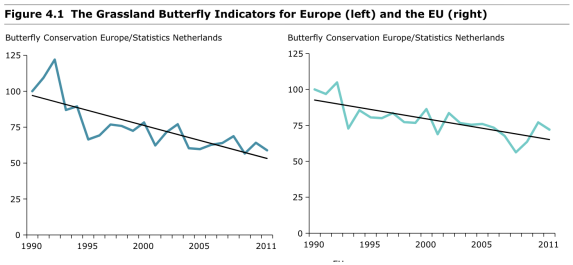


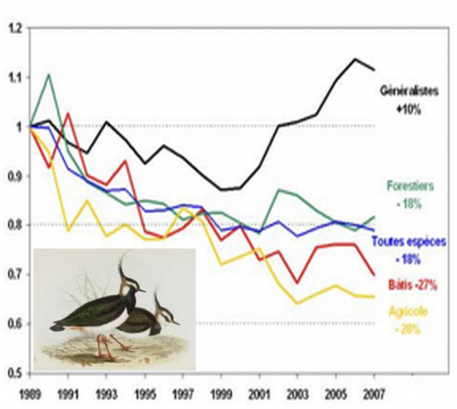





La biodiversité et les services écosystèmiques sous pression







Dommages et vulnérabilités { écologiques / économiques

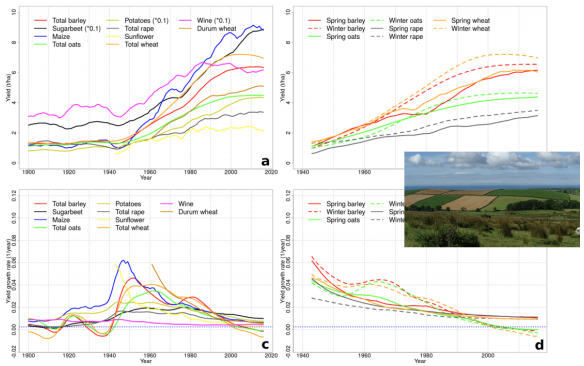
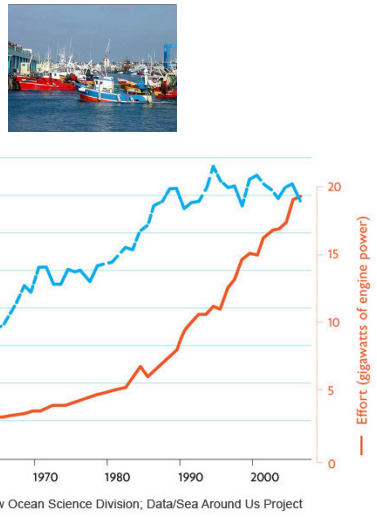
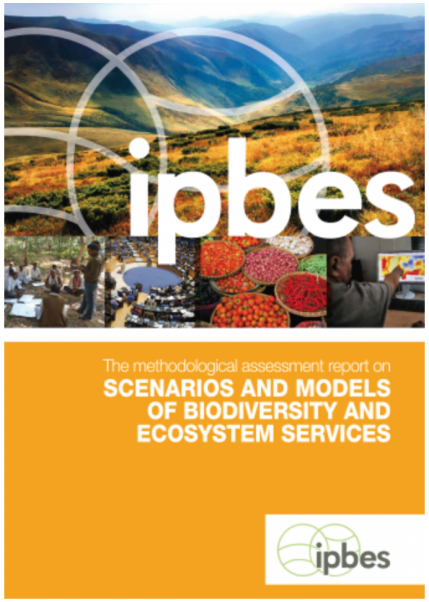


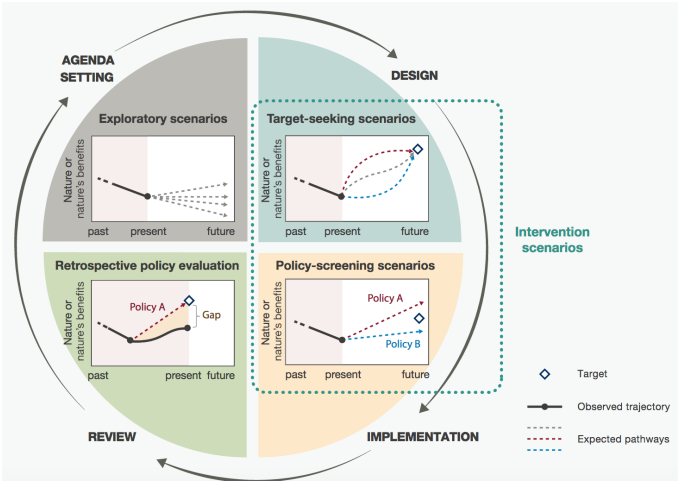
Figure 1. Trends and growth rates for national yields of staple French crops in the 20th and 21st century. (a)



Le besoin d'approches bio-economiques

Le besoin de scénarios bio-economiques





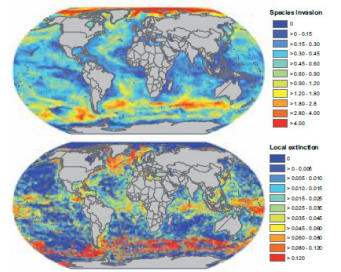
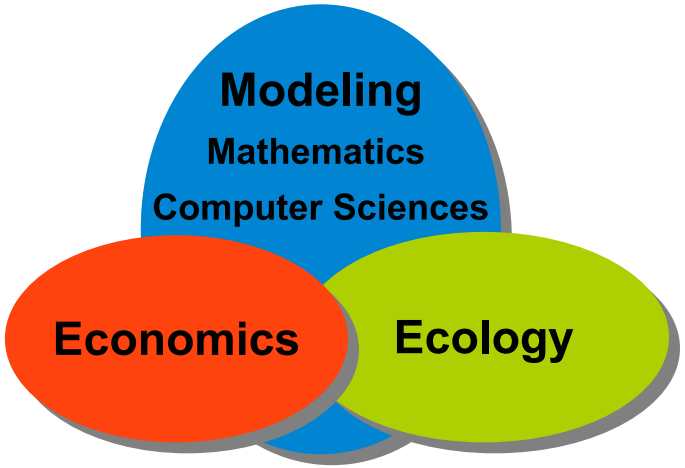


FIGURE 19 PROJECTED CHANGES IN MARINE BIODIVERSITY DUE TO CLIMATE CHANGE.

Biodiversity impact in 2050 under the IPCC SRES A1B scenario expressed in terms of: number of new species moving from other regions (top) and local extinction intensity (bottom). The projections are based on bioclimate envelope models for 1,066 species of fish and invertebrates. Source: redrawn from Cheung et al. 2009.



Rendement durable

(Sustainable Yield)

Gordon-Schaefer, 1954; Clark, 1976

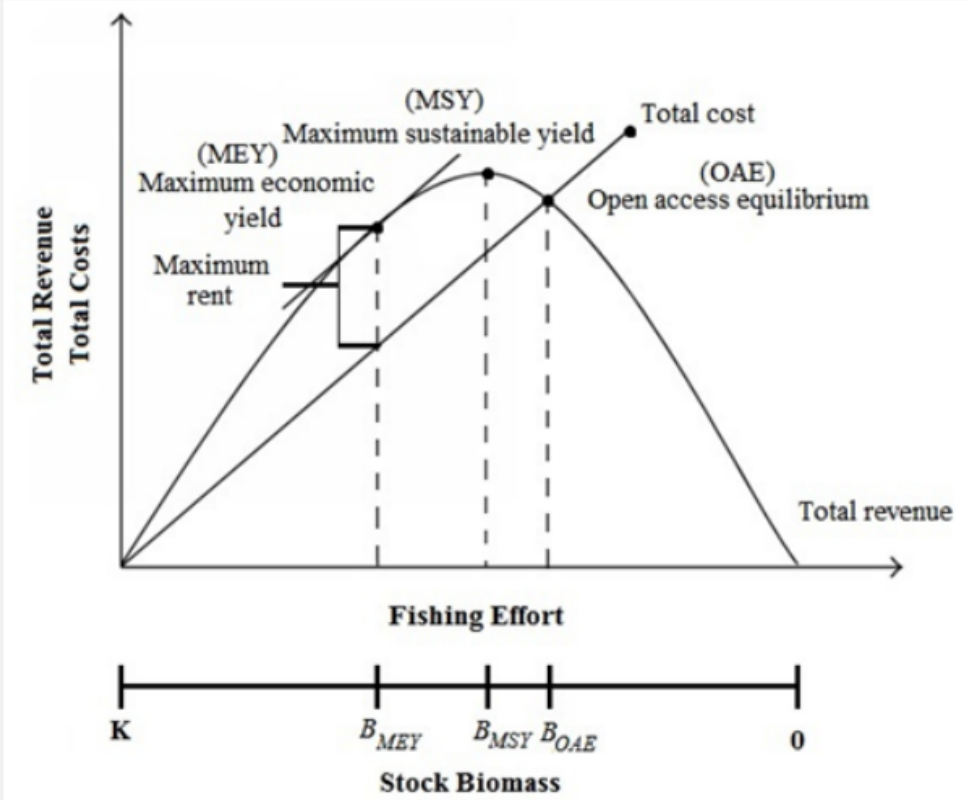


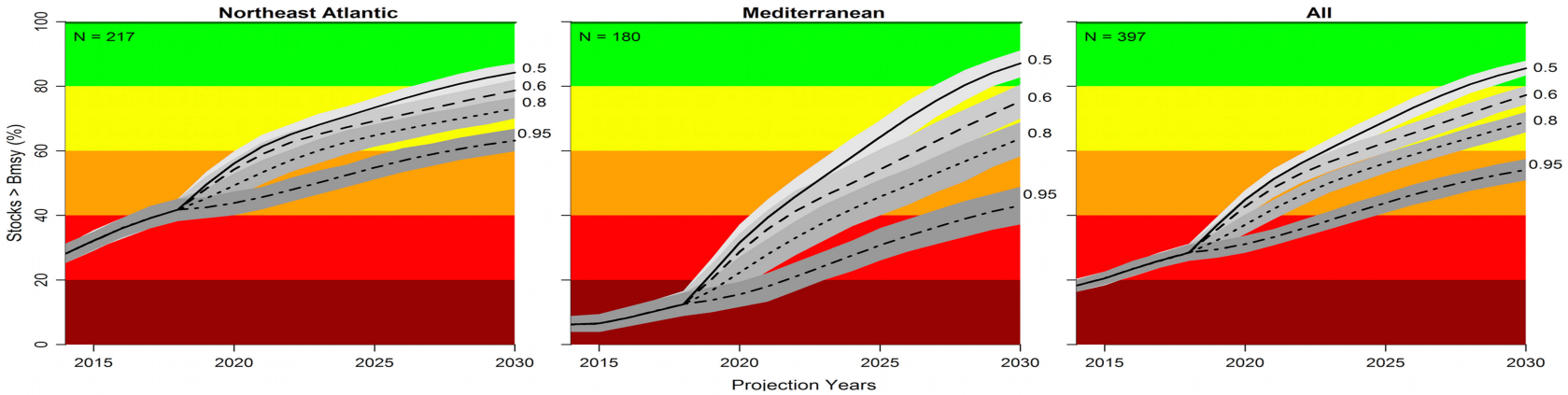
Figure 1: Total revenue of the fishery with constant price.

MSY $\Longrightarrow$ MEY :

Des meilleurs profits,

Des meilleurs stocks !!!

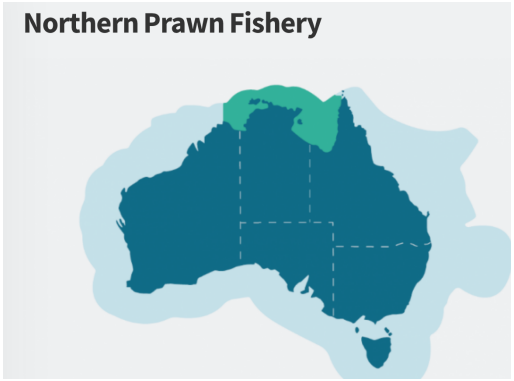
Des succès avec le MSY



Des stocks de poissons européens sous MSY

Froese et al., Marine Policy, 2018

Des succès avec le MEY



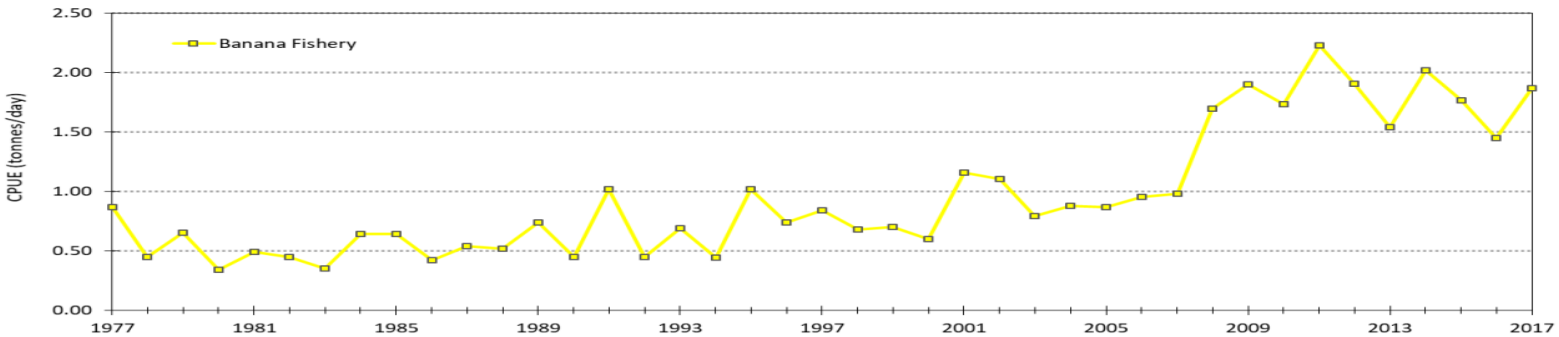


Figure 5a: Catch rate in the banana prawn fishery between 1977 and 2017.

Crevette en Australie (Northern Prawn fishery)

Dichmont et al., PNAS 2009

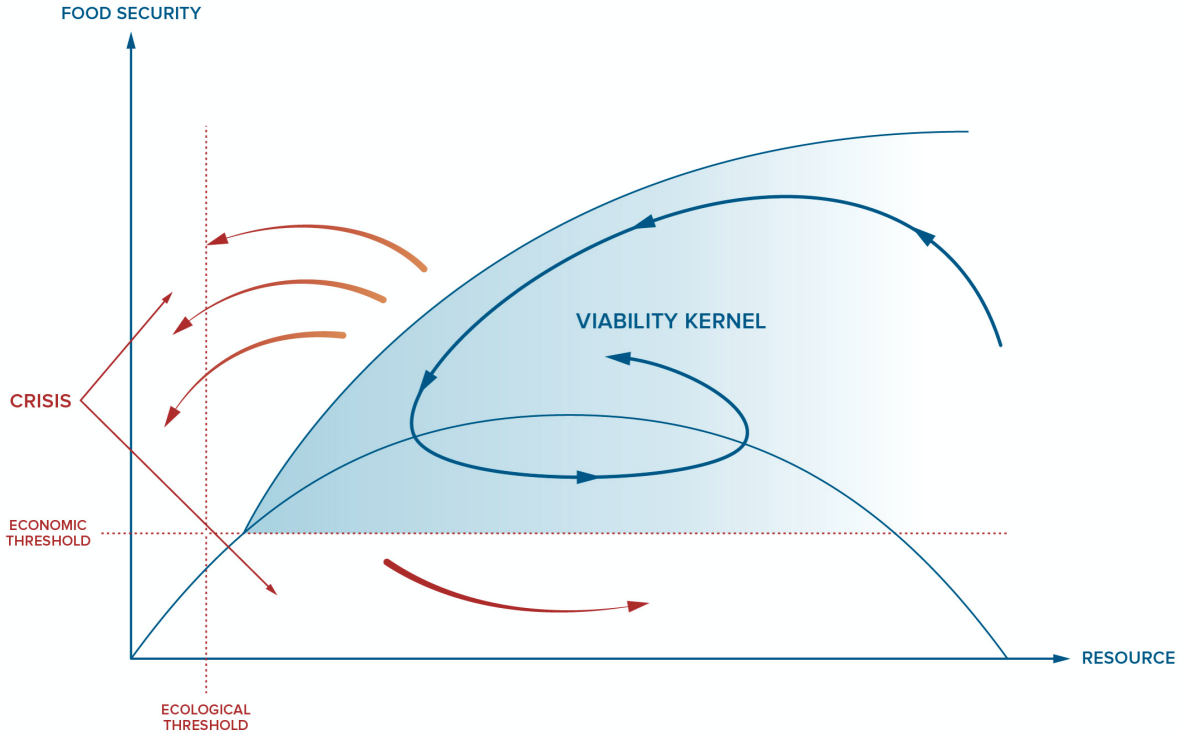
Nouveaux défis bio-économiques

- Comment opérationnaliser l'approche éco-systémique?
- Comment opérationnaliser la durabilité bioéconomique ?
- Comment opérationnaliser la résilience bioéconomique?
- Quelle gouvernance pour les politiques bio-économiques ?

Eco-viabilité: une approche originale and prometteuse

Bene, Doyen et al., Ecological Economics (EE), 2001
Baumgartner, Quaas, EE, 2009
Cury et al., NRM, 2005
Schuhbauer & Sumaila, EE, 2016

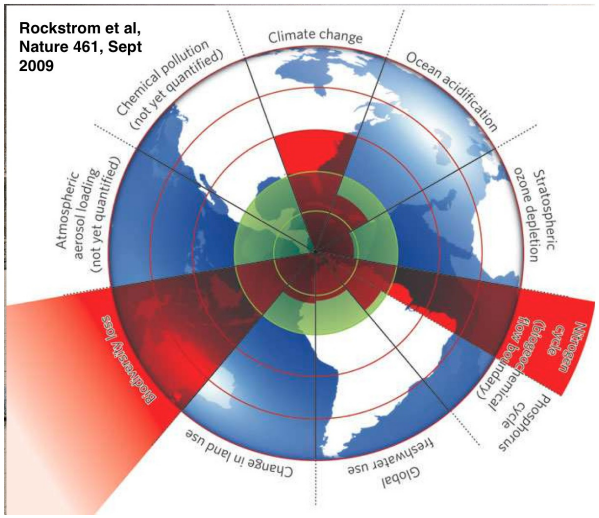
Eco-viabilité: Bonne santé, durabilité des systèmes via des **seuils** bio-économiques



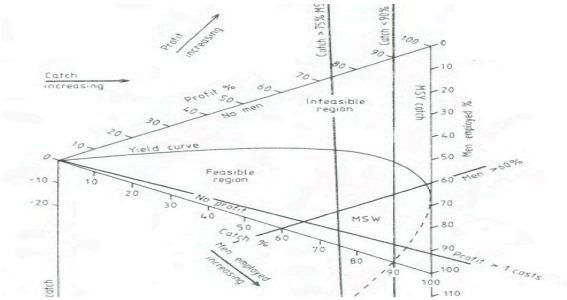
Links with many approaches

Doyen et al., Ecological Economics, 2019

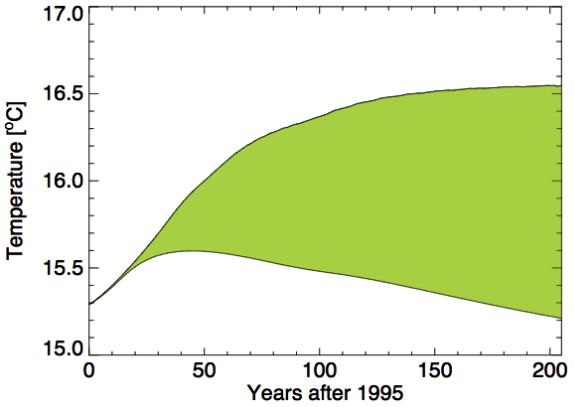
SOS



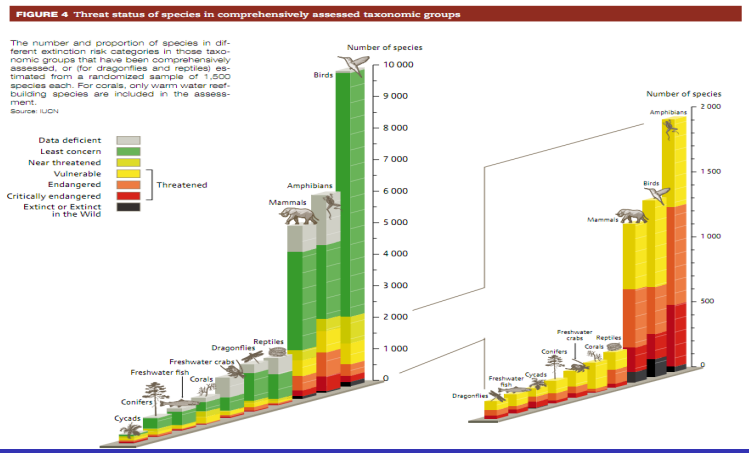
Minimal Sustainable Whinge



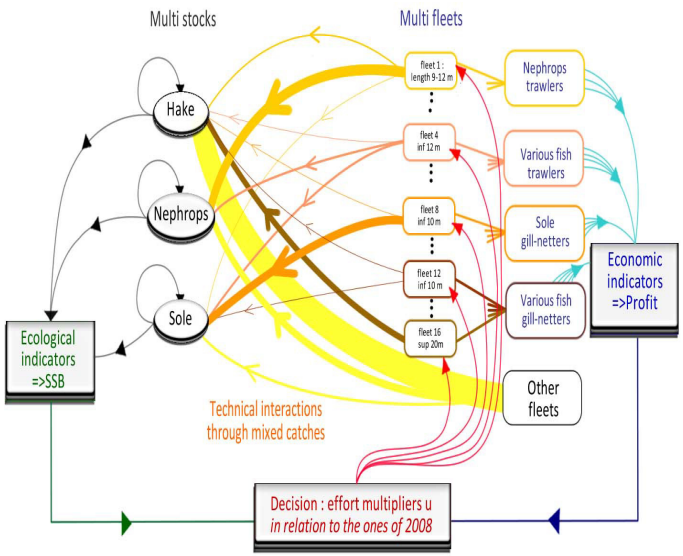
TWA



PVA



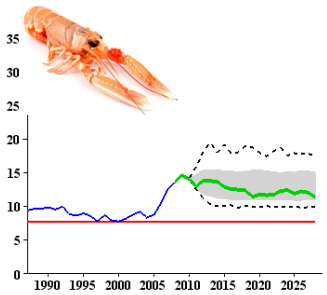
Exemple: pêcheries mixtes du Golfe de Gascogne

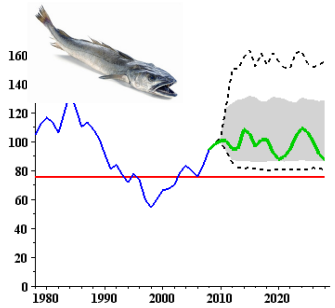


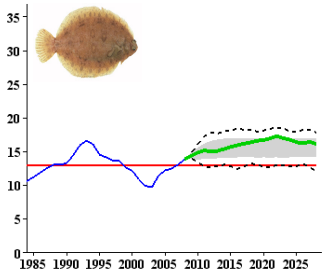
Ifremer

Gourguet et al., Fisheries Research, 2013

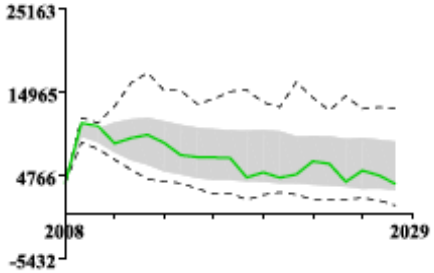
Doyen et al., Ecological Economics, 2012



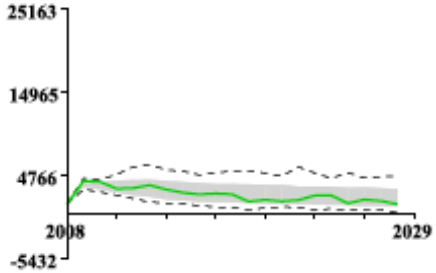




Nephrops trawl 12-16 m

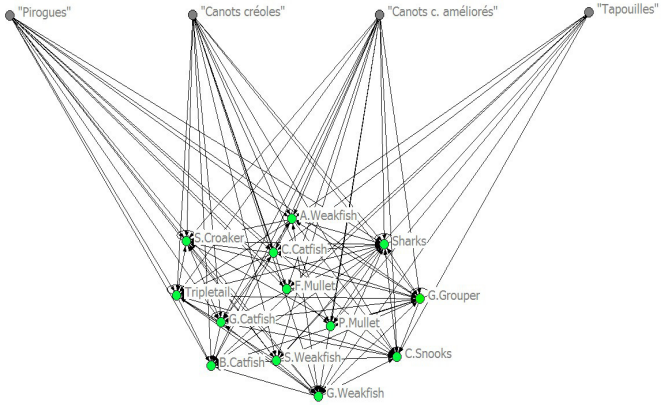


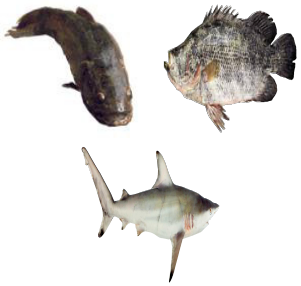
Nephrops trawl 16-20 m



Exemple: pêches côtières en Guyane

Biodiversité forte

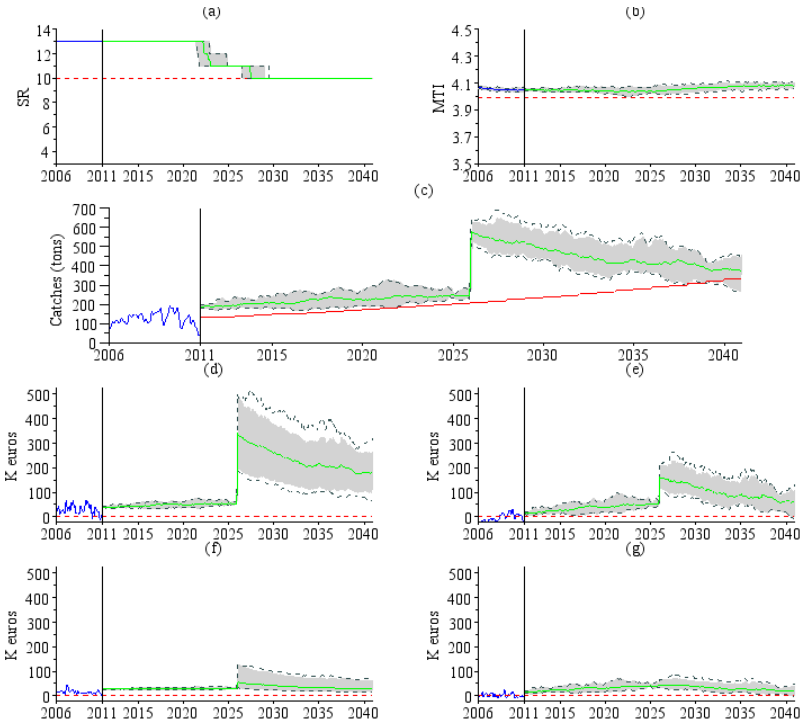




Sécurité alimentaire

€

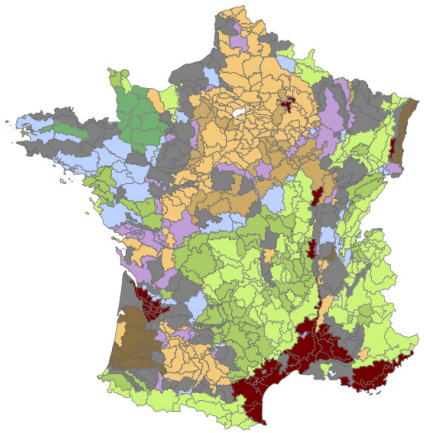
Cissé et al., Envir. Development Economics, 2013
Gomes et al., ENMO, 2021

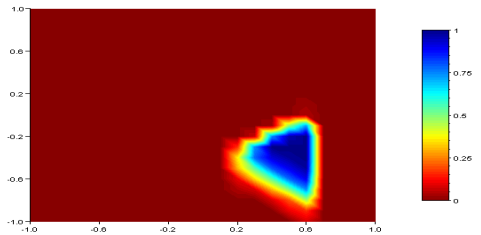


Exemple: Occupations des sols et biodiversité oiseau

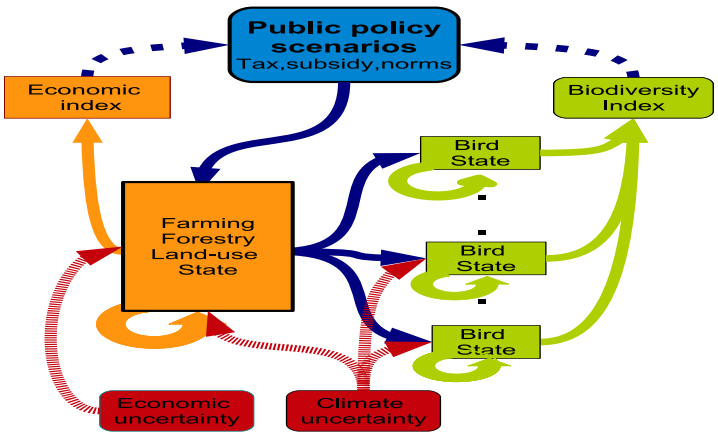
Mouysset et al., Biological Conservation, 2015

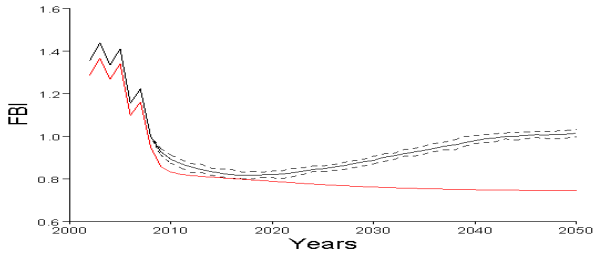
Doyen, Environmental Modeling and Assessment, 2018

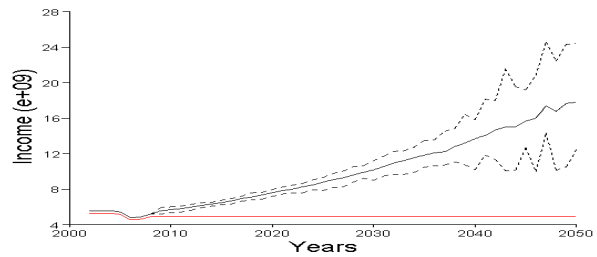




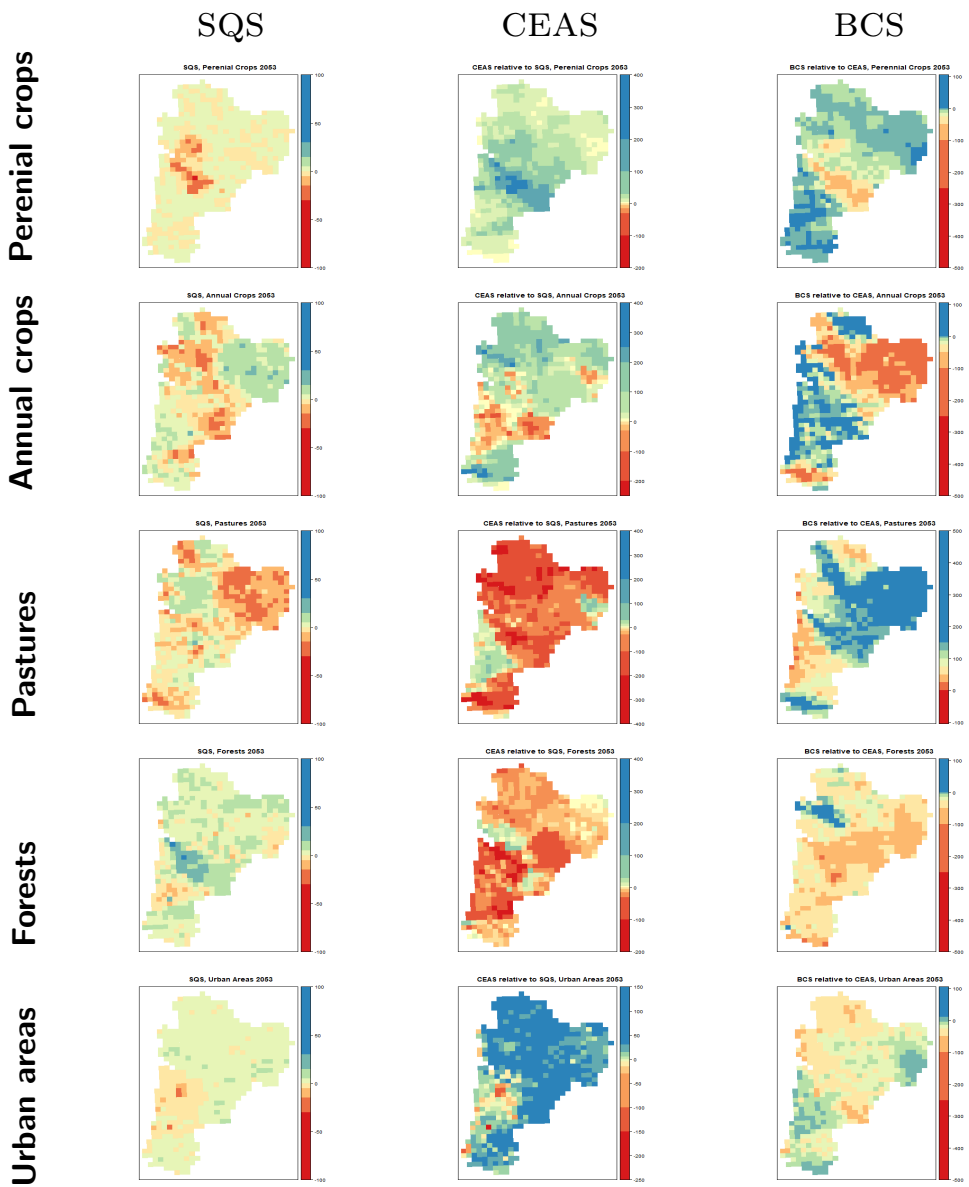
Bio-economic viability probability



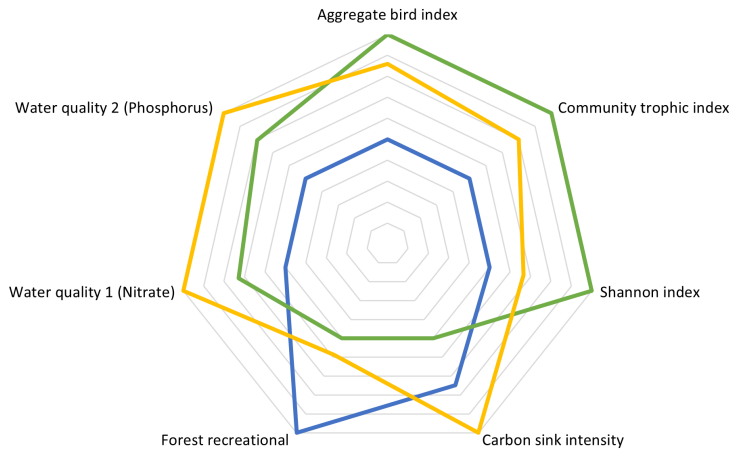




Services écosystémiques et climat en Nouvelle Aquitaine



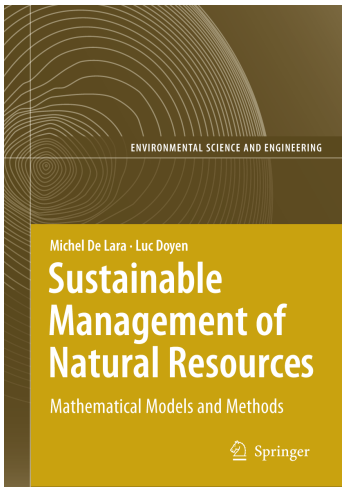
Ay et al., Climate Change., 2014,
Andiamanantena et al., Reg. Env. Change, 2022



Pour conclure

- L'économie nous permet de penser la biodiversité
- En termes de **concepts, processus, évaluation, objectifs, gouvernance**
- Synergies bio-économiques possibles mais
  - penser le long terme et les transitions
  - penser les dynamiques complexes
  - penser multi-critères
  - penser les incertitudes

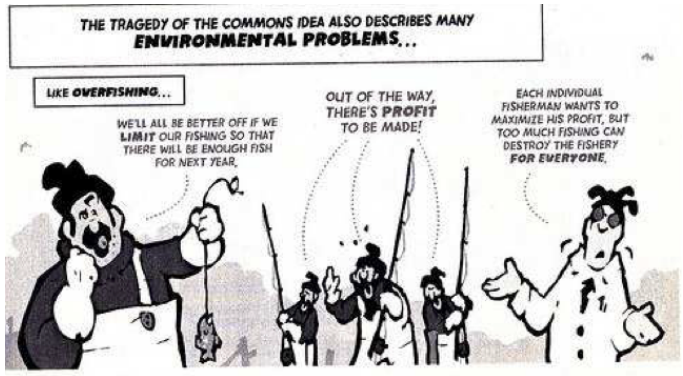
Quelques références



- Clark C.W., (1982), *Mathematical Bio-economics: The Optimal Management of Renewable Resource*, J. Wiley & Sons, New York
- Baumgartner S., Quaas M.F., 2009, Ecological-economic viability as a criterion of strong sustainability under uncertainty, Ecological Economics, 68 (7), 2008.
- Doyen, L., Cissé, A., Gourguet, S. et al. (2013) Ecological-economic modelling for the sustainable management of biodiversity. Comput Manag Sci. Online
- Doyen (2018). Mathematics for scenarios of biodiversity and ecosystem services, Environmental Modeling and Assessment. Online
- Leclère, D., Obersteiner, M., Barrett, M. et al. Bending the curve of terrestrial biodiversity needs an integrated strategy. Nature 585, 551– 556 (2020).Online
- Doyen L., et al. (2017) Ecoviability for Ecosystem Based Fisheries Management, Fish and Fisheries.Online
- Doyen L. , Armstrong C., Baumgärtner S. et al. (2019) From no whinge scenarios to viability tree, Ecological Economics. Online
- Mouysset et al (2014), Co-viability of farmland biodiversity and agriculture, Conservation Biology.
- Gourguet S. et al., 2013, Managing mixed fisheries for bio-economic viability, Fisheries Research, 140, 46-62.
- Doyen L. et al. 2012, A stochastic viability approach to ecosystem-based fisheries management, Ecological Economics
- Grafton, Doyen, Bene C., . . . , Villassante et al., 2019, Realizing Resilience for Decision-making, Nature Sustainability. Online

Diapos complémentaires

Quelle governance pour les politiques bio-économiques ?

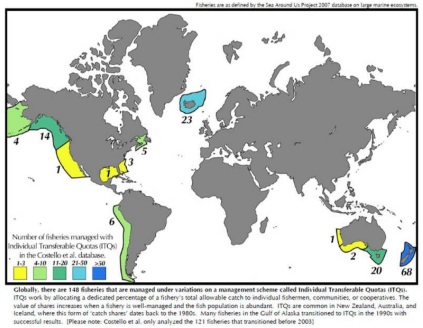


Tragedy of the commons

Quotas
sur les captures
sur les efforts

Instruments monétaires
Taxes,
Subvention

Marché de droits:
cooperation par les prix



Coopérative
RFMO
(Regional organizations)

Interêt de la théorie des jeux
Coopératifs ou non coopératifs

Which bio-economic governance ?

Doyen et al., Dyn. Games and App., 2018

Springer Link

Dynamic Games and Applications

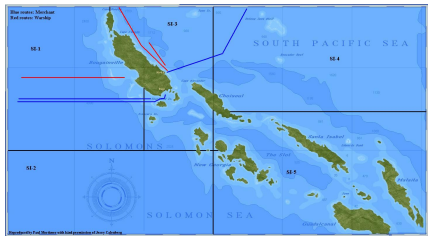
pp 1–24

The Tragedy of Open Ecosystems

Authors | Authors and affiliations

L. Doyen ✉, A. A. Cissé, N. Sanz, F. Blanchard, J.-C. Pereau

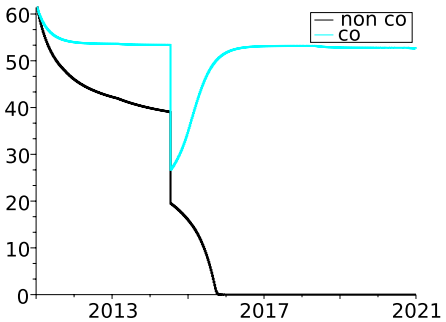
Gains of cooperation



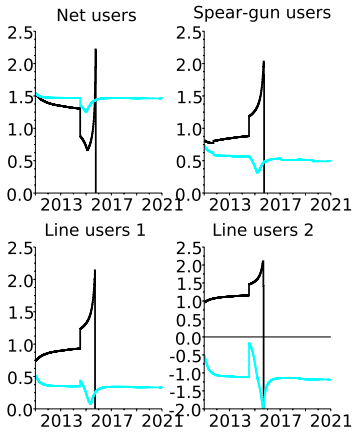
Solomon Islands

Hardy et al., Environmental Development Economics , 2015

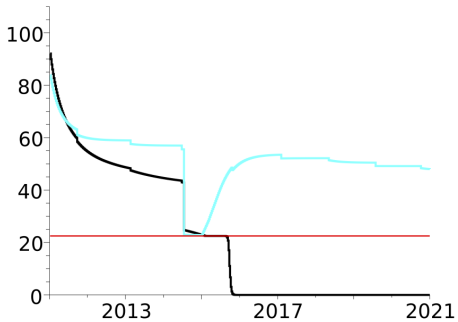
Catch



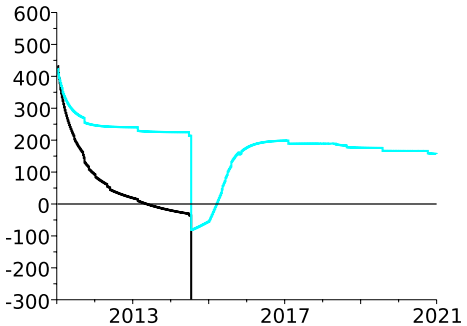
Efforts of heterogeneous agents



Biomass



Profit



Viability of ITQs

The triple bottom line: Meeting ecological, economic and social goals with individual transferable quotas

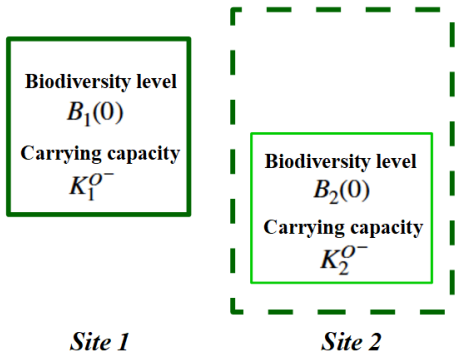
J.-C. Péreau [a,*], L. Doyen [b], L.R. Little [c], O. Thébaud [d]

A viable TQ management system requires

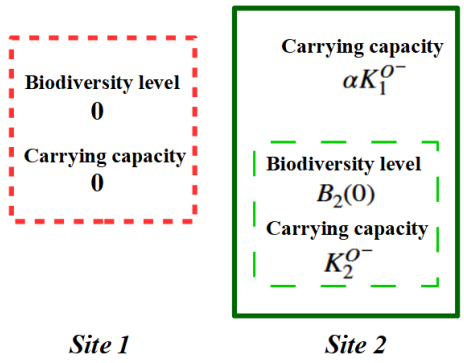
- to manage the resource stock above a safety level
- to select a quota within a precautionary corridor
- a relative homogeneity of users

Sustainability of biodiversity offsets

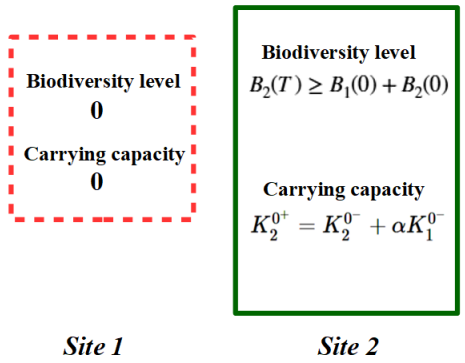
Huber, Doyen, Ferrari, WP BSE, 2021



Before development



Start development-offset



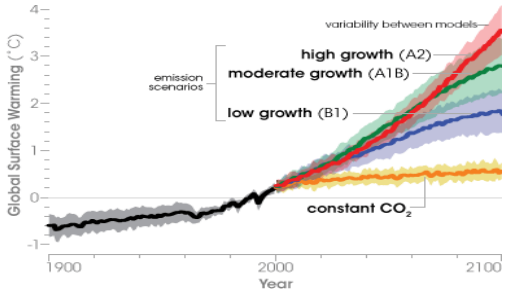
No Net Loss after T perio

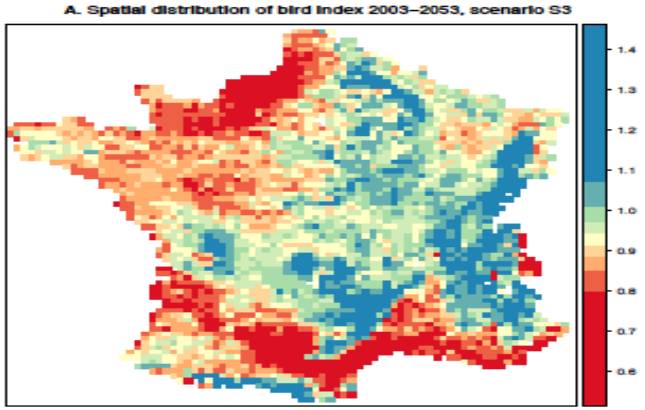
A viable BO management system requires

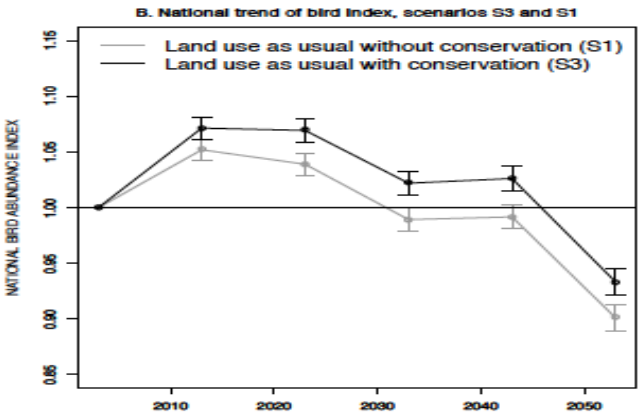
- to account for time $--> $ high price

Exemple: Occupations des sols, oiseaux et climat

Ay et al., Climate change, 2014







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http://dentafas.free.fr/MOBILIS/output/AGGINDS4/AGGINDS4.html

nature sustainability

PERSPECTIVE

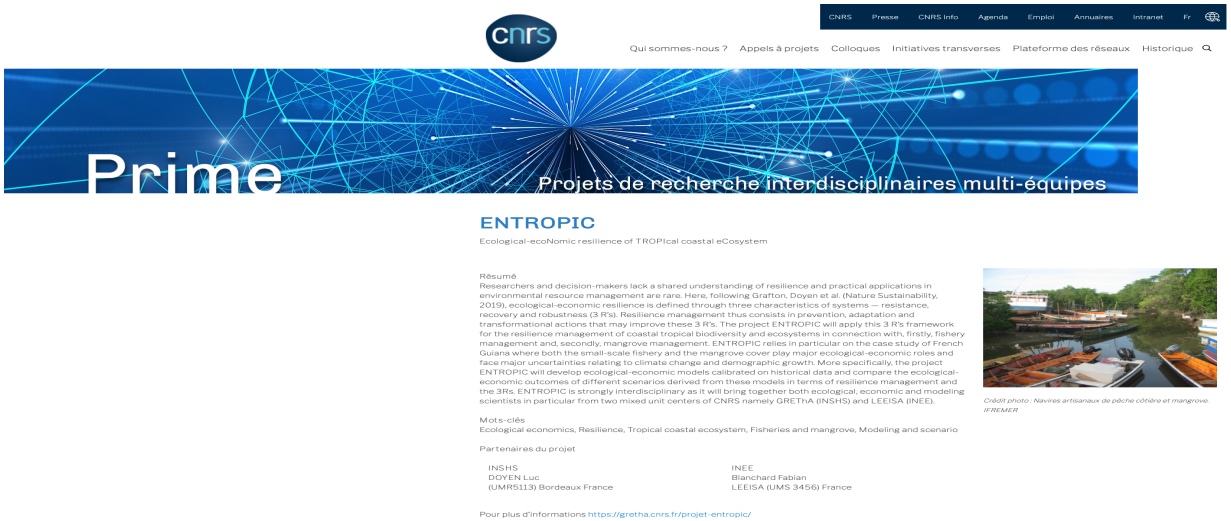
https://doi.org/10.1038/s41893-019-0376-1

Realizing resilience for decision-making

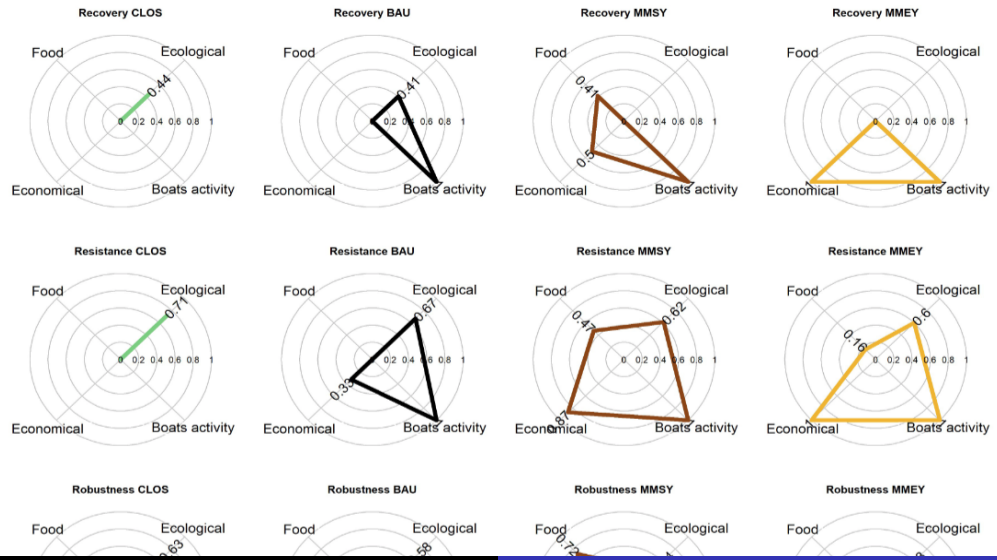
R. Quentin Grafton[1,2*], Luc Doyen[2,3], Christophe Béné[4], Edoardo Borgomeo[5], Kate Brooks[6], Long Chu[1], Graeme S. Cumming[7], John Dixon[1], Stephen Dovers[8], Dustin Garrick[9], Ariella Helfgott[5], Qiang Jiang[10], Pamela Katic[11], Tom Kompas[12], L. Richard Little[13], Nathanial Matthews[14], Claudia Ringler[15], Dale Squires[16], Stein Ivar Steinshamn[17], Sebastián Villasante[18], Sarah Wheeler[19], John Williams[1] and Paul R. Wyrwoll[1]

Applying the 3Rs for the coastal fishery in Guiana

Cuilleret et al., 2022, Economic Analysis and Policy

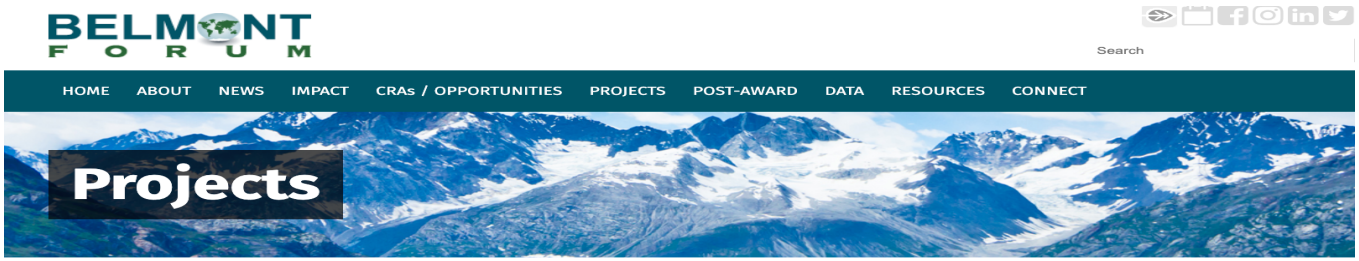


3Rs vs. 4 fishing strategies versus 4 criteria



Applying the 3Rs in Cameroon and Central Africa

projects ERICA (DERCI CNRS) and Belmont Forum COVPATH



Project Profile: COVPATH

Coviability Path, a New Framework to Sustainably Link Mankind and Biosphere

Who?

Principal Investigators: Olivier Barriere, Research Institute for Development, France

Partners:
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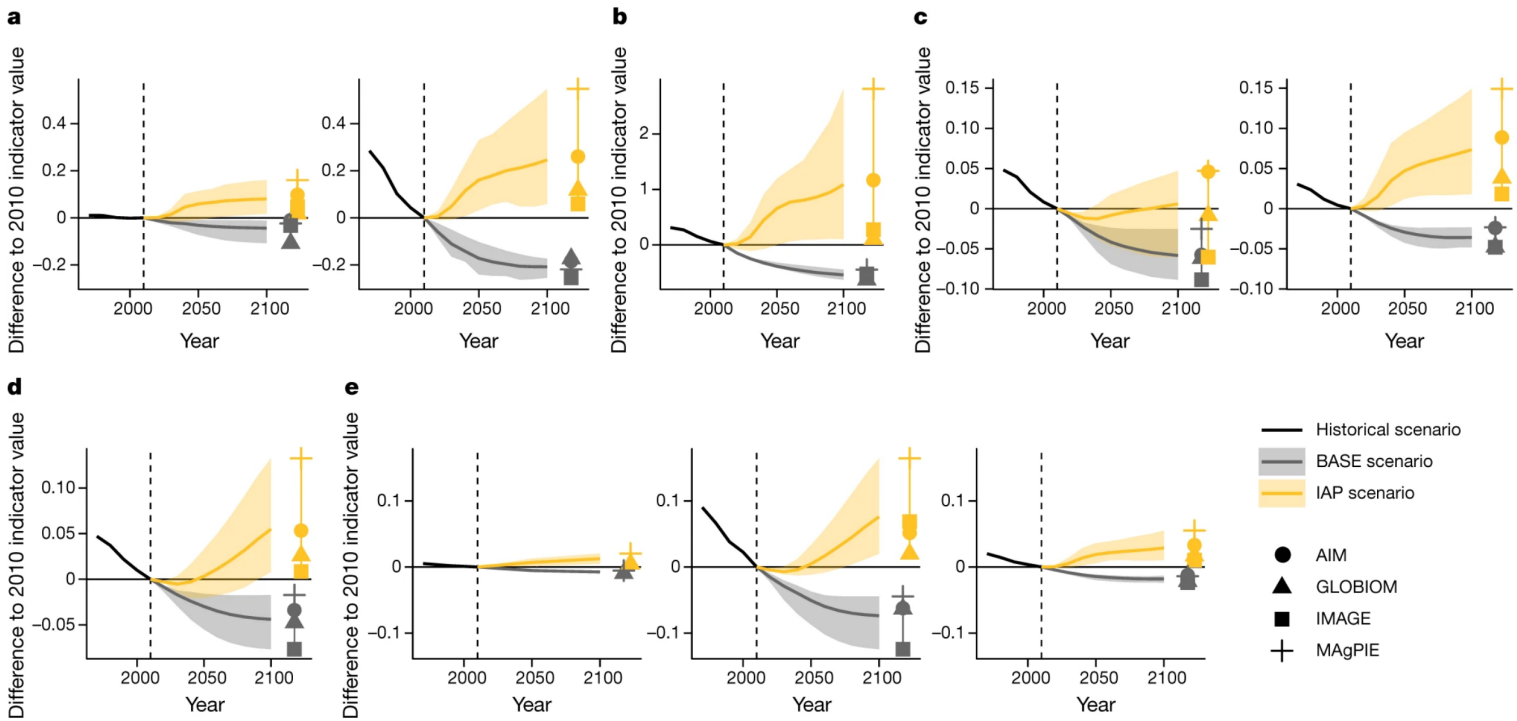
Martha Vogel, UNESCO Man and the Biosphere Programme, Brazil
Hervé Théry, University of São Paulo, Brazil

Scenarios at global scale

Leclère, D., Obersteiner, M., Barrett, M. et al. Nature (2020).

Fig. 1: Estimated recent and future global biodiversity trends resulting from land-use change, with and without coordinated efforts to reverse trends.

From: Bending the curve of terrestrial biodiversity needs an integrated strategy



a–e, The trends for the five aspects of biodiversity that result from changes in nine BDIs (Table 2). BDI values are shown as differences from the 2010 value

Scenarios at global scale

Leclère, D., Obersteiner, M., Barrett, M. et al. Nature (2020).

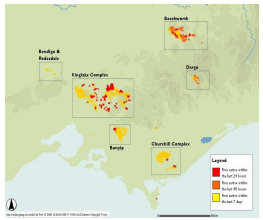
From: Bending the curve of terrestrial biodiversity needs an integrated strategy

Scenarios	Additional efforts to reverse trends in biodiversity					
	Supply side		Demand side		Increased conservation	
	Sustainably increased crop yields	Increased trade of agricultural goods	Reduced waste of agricultural goods from field to fork	Diet shift to a lower share of animal calories	Increased extent and management of protected areas	Increased restoration and landscape-level conservation planning
Baseline scenario						
BASE scenario	–	–	–	–	–	–
Single-action scenarios						
SS scenario	x	x	–	–	–	–
DS scenario	–	–	x	x	–	–
C scenario	–	–	–	–	x	x
Combined-action scenarios						
C + SS scenario	x	x	–	–	x	x
C + DS scenario	–	–	x	x	x	x
IAP scenario	x	x	x	x	x	x

In addition to the BASE scenario, we considered three scenarios that each comprised a single type of action aimed to reverse biodiversity trends due to future habitat loss (indicated by an 'x') and three scenarios in which actions were combined.

Ex5: Forest, bush, biodiversity vs fire risks

GEO-SAFE



Cost		Nb of risky cells	Nb of connected components	Shape of the main connected component
1		7	1	Corridor
2		5	3	Corridor
3		3,5	2,5	Corridor