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Selecting viable recovery paths towards sustainable fisheries

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November 2008

http://www.projet-chaloupe.fr

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Outline

I. Context – structural trends in EU fisheries

II. Recovering sustainable fisheries: a simple bioeconomic model

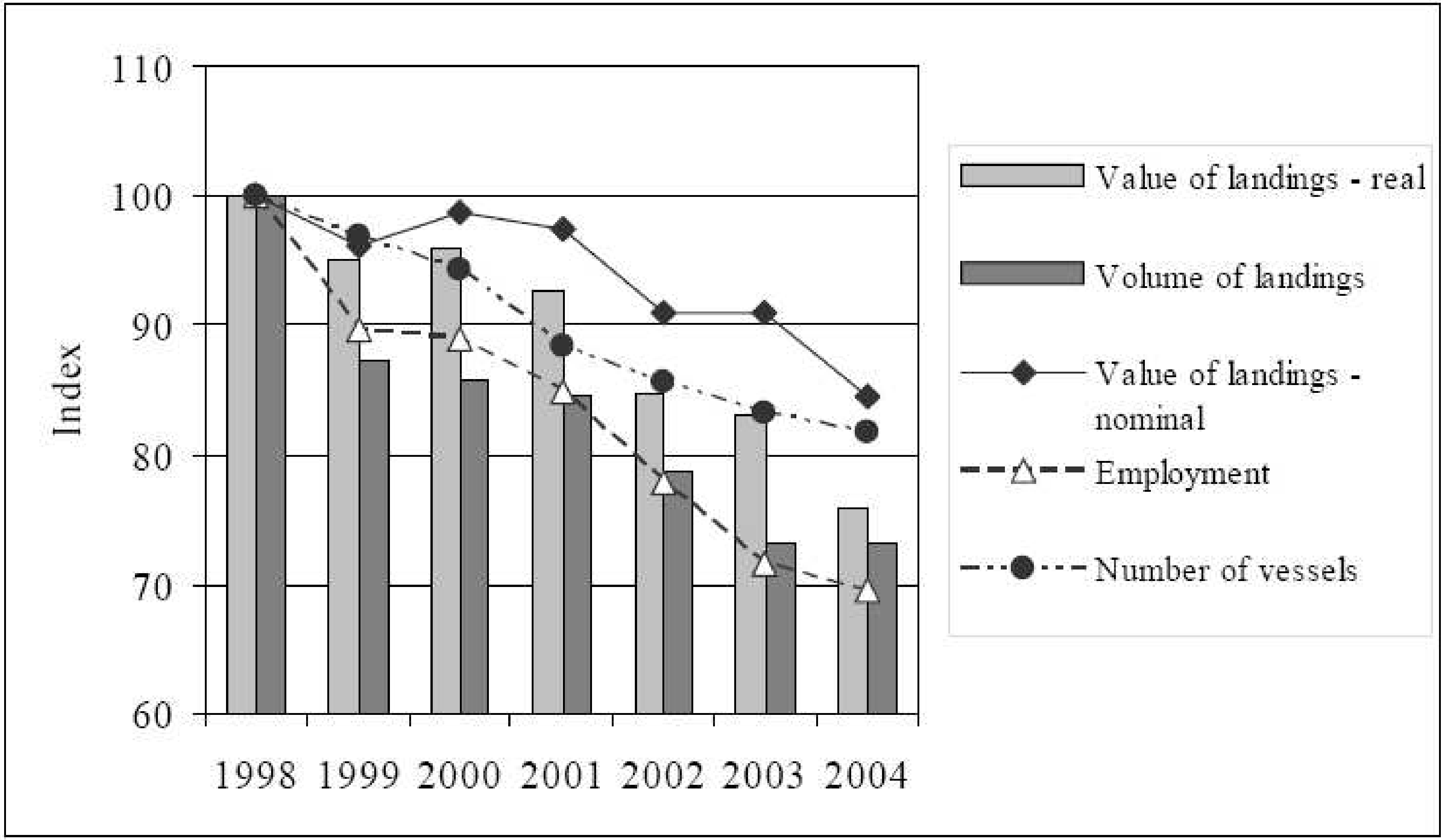
→ The multi-dimensional nature of fisheries viability

→ Application to the Bay of Biscay nephrops fishery

III. Hare or tortoise ? Trade-offs in the selection of recovery strategies

→ Introducing (social / political) acceptability in the formal comparison of alternative recovery strategies

Context: decreasing trends in E.U. fisheries



Source: EAEF Annual Report, 2006, p12

→ decline in production, fleet size and employment: a growing number of fleets are at or below economic viability constraints

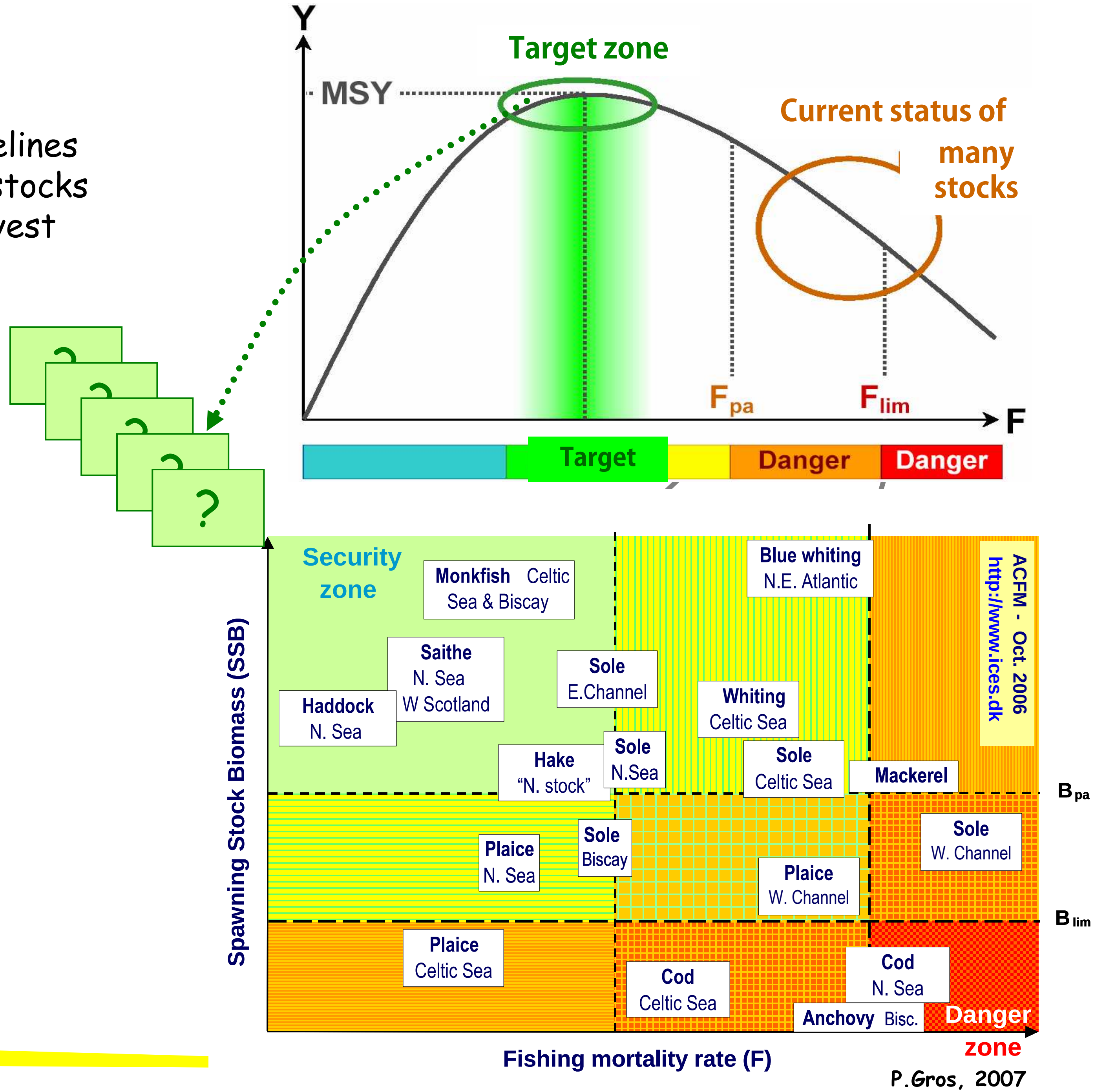
Context: dominated by restoration concerns

Distance between (i) baselines used to assess risks for stocks and (ii) conservation/harvest targets

Key issues:

- costs of transition

- trade-offs (speed of recovery, short-term economic viability, social impacts)



P.Gros, 2007

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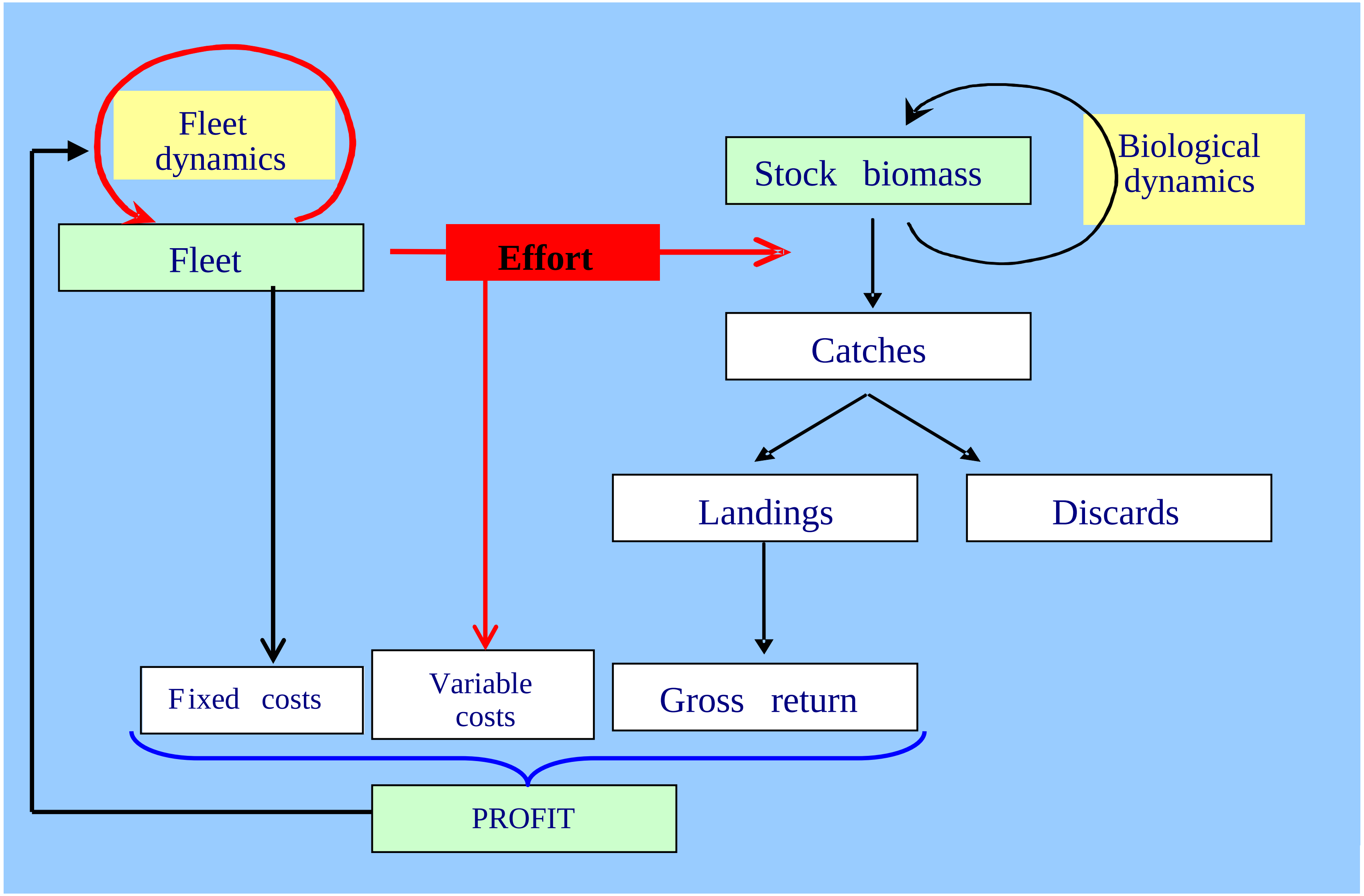
Recovering sustainable fisheries: a simple bio-economic model



Defining fishery viability: a multi-criteria approach

- <u>Biological constraints:</u>
  → often specified as a minimum stock size beyond which stock response to additional harvesting is uncertain, with a risk of stock collapse (e.g. ICES *Blim*)

- <u>Economic constraints:</u>
  → standard definition: the minimum remuneration needed to maintain production factors in the fisheries sector, or a given section of this sector (i.e. comp. to opportunity costs)

- <u>Social constraints:</u>
  → usually less precisely defined: a minimum level of activity required in a sector for the maintenance of coastal communities / acceptable speed of changes in the structure of the fisheries sector

A case study: the Bay of Biscay Nephrops Fishery

- Estimation of a surplus-production model in a first approach
  - Economics: survey based estimations
  - Biology: non-parametric adjustment of CPUE time series (based on ICES Working Group data)

- Historical situations

	2003	1994
Estimated stock biomass (tons)	18,600	14,300
Fleet size (vessels)	235	309
Profit (euros per vessel)	165,000	78,000
Catches (tons)	5,769	5,179

→estimation of K, r, q + economic parameters

(Martinet V., Thébaud O., Doyen L., 2007. Ecological Economics 64 : 411-422).

Scenario for sustainability constraints

- <u>Biological constraint:</u>
  Minimum stock biomass : 5,000 tons

- <u>Economic constraint:</u>
  Minimum annual profit per vessel: 130,000 euros

  → Induces stock and effort-per-vessel constraint for a given fleet size

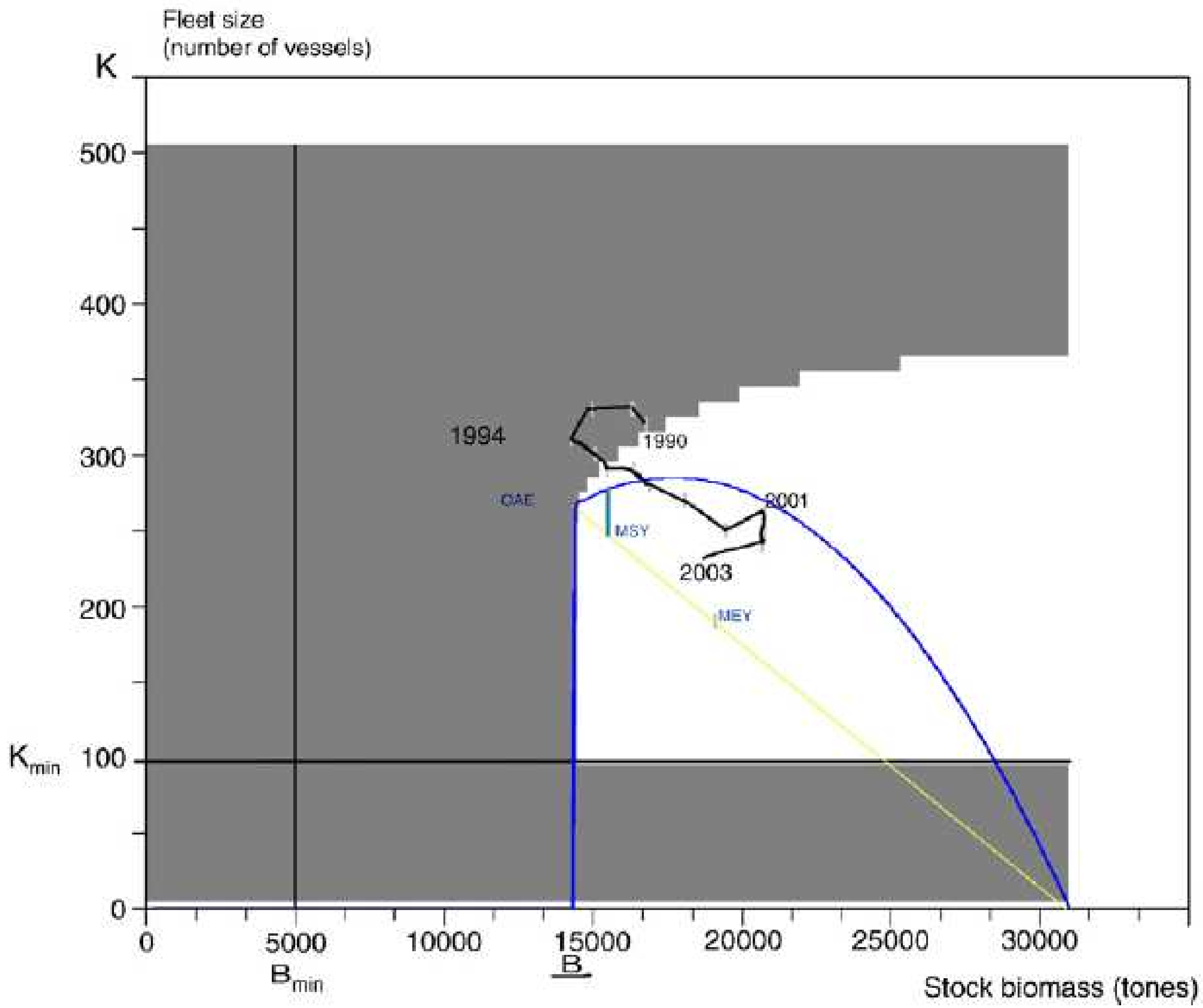
- <u>Social constraints:</u>
  Minimum fleet size: 100 vessels
  Maximum fleet adjustment speed: 10 vessels per year

Application of the viability approach

- Determine bioeconomic configurations making it possible to satisfy a given set of constraints at all times, given specification of the dynamics of the bio-economic system

- Determine viable decisions: in the case considered, fishing effort and adjustment of fleet size

Viability kernel



- Viability kernel (in white), stationary states, and historical dynamics of the fishery as estimated via the model → 1994 not viable

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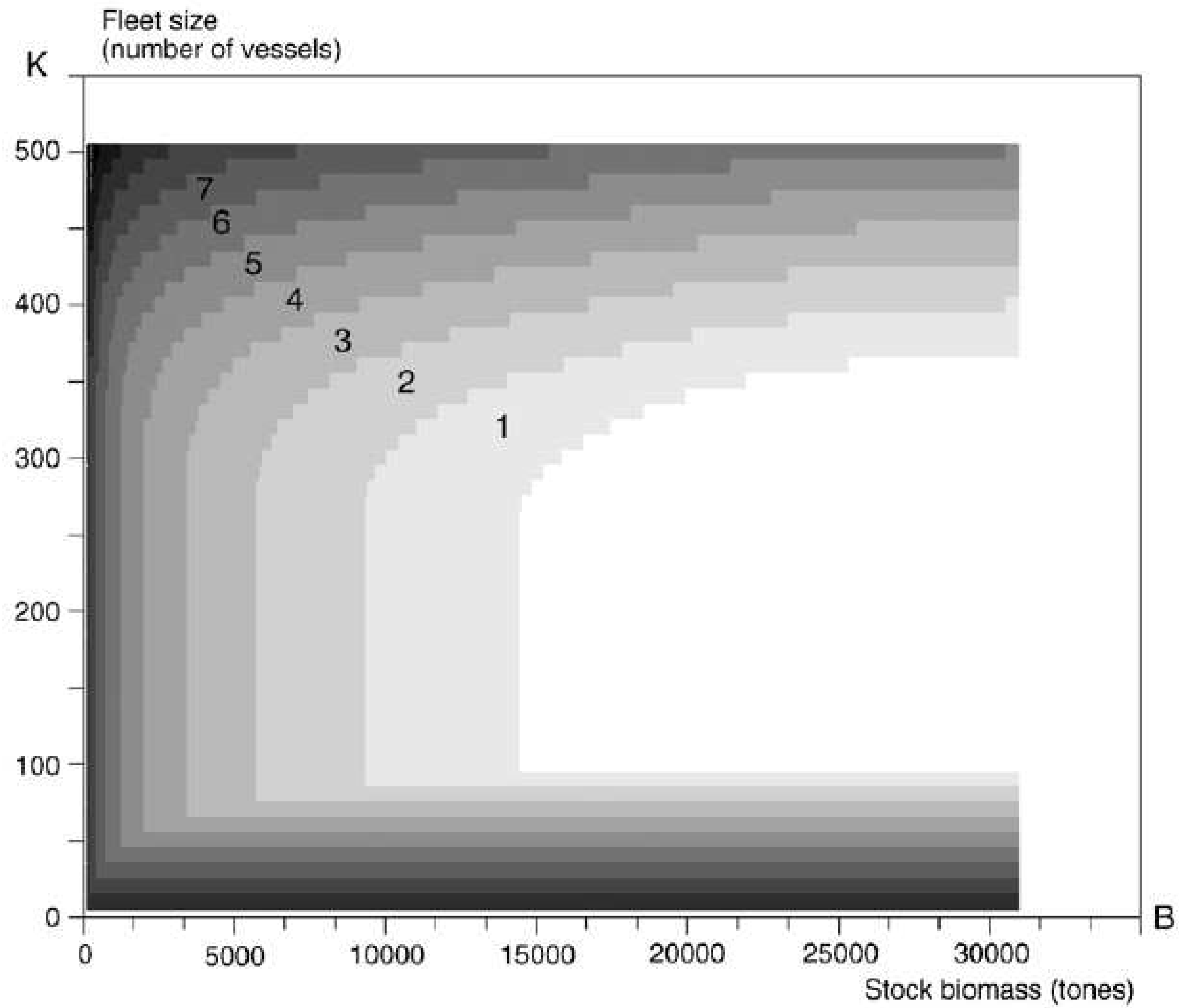
Defining recovery strategies: the minimum time of crisis approach

Recovery = transition from non-viable (crisis) to viable states

→ one possible approach = minimize the "time of crisis", i.e. the time spent outside the viability constraints by a trajectory



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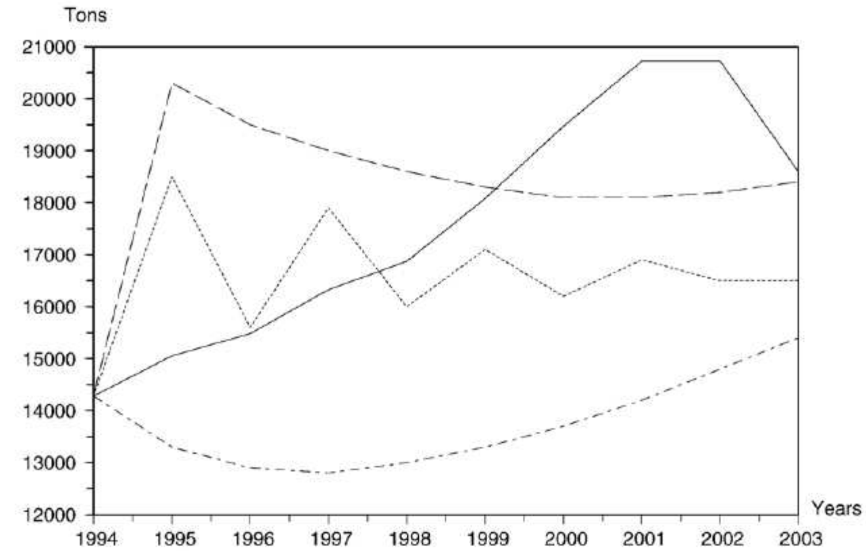
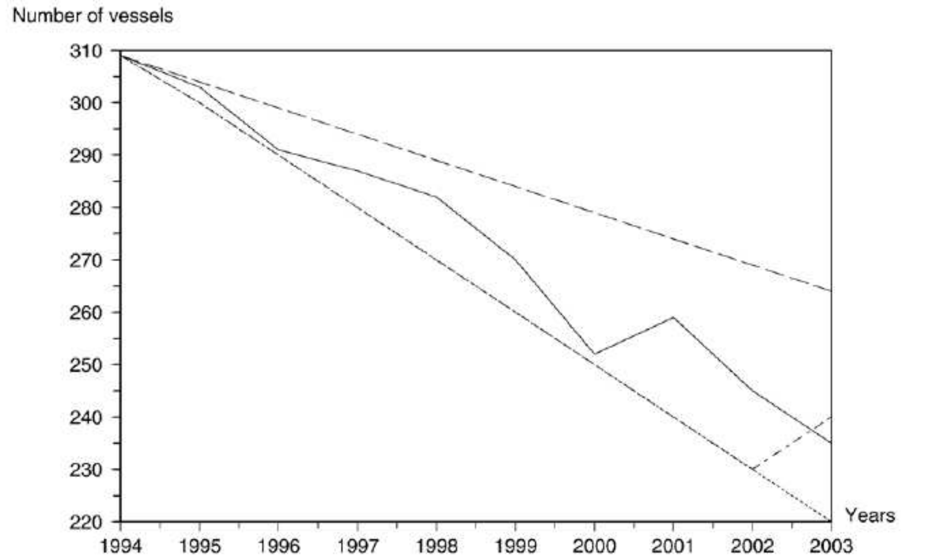
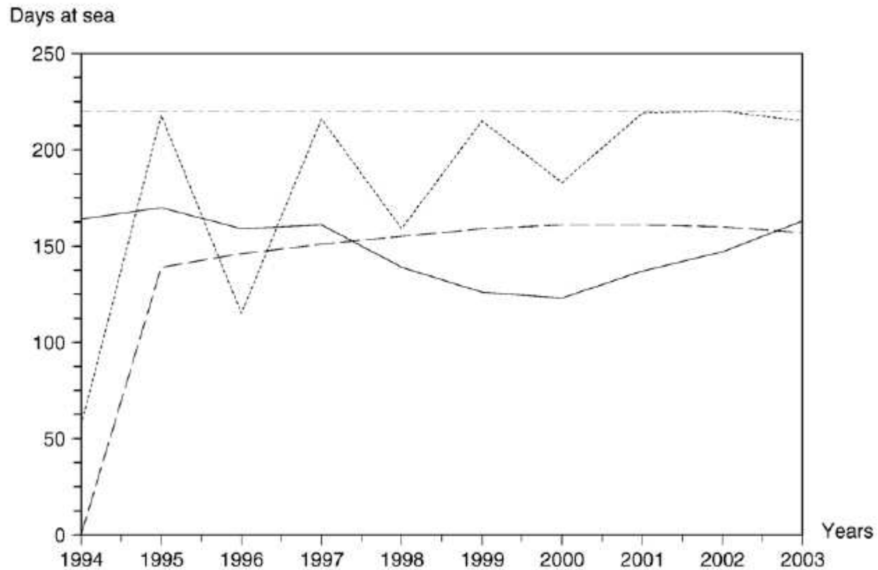
Recovering from 1994 crisis situation



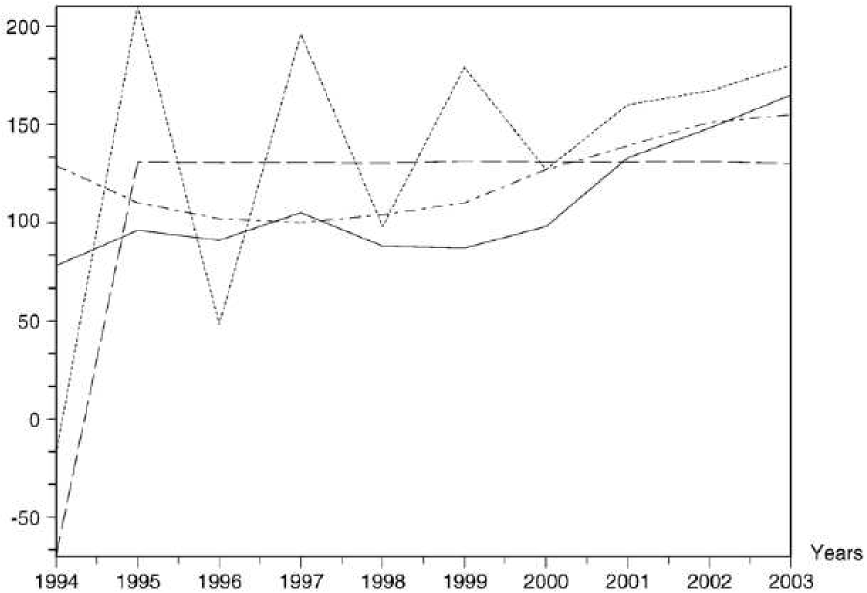
(a) Resource stock biomass B_t



(b) Fleetsize K_t



(a) Per vessel effort e_t



(b) Per vessel profit π_t

Fig. 3 – Recovery trajectories and the historical path from the estimated 1994 crisis situation. Historical path (—), Open Access regime (– - – -), Optimal Economic Intertemporal path (- - - -), and Minimal Time of Crisis (– – –).

III

Formalizing trade-offs in the selection of recovery strategies

Minimum time of crisis strategy requires shut down of the fishery (with a negative profit) in order to restore the stock, followed by an exploitation pattern entailing minimum profit for the fleet

→ weak acceptability / political feasibility = strong chances of failure

Introduction of a minimum transition profit to represent this aspect of restoration trade-offs

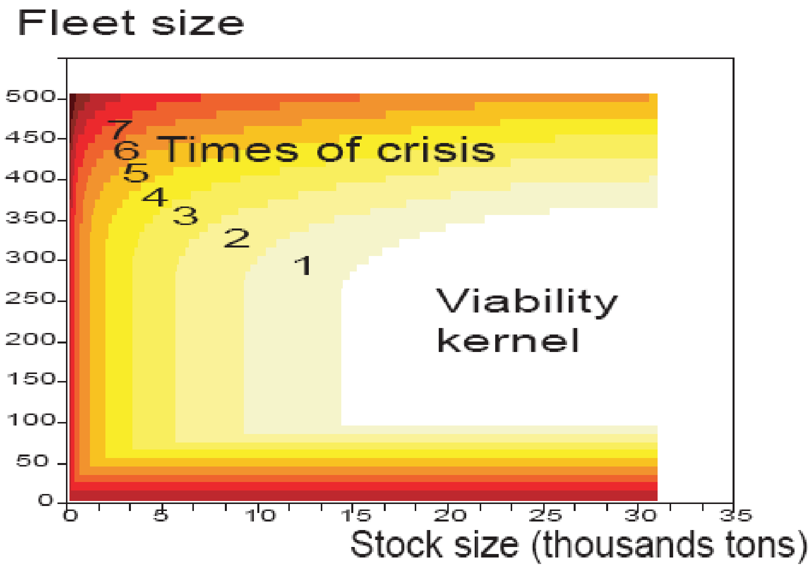
$$\pi_{trans} < \pi_{min}$$

→ sensitivity analysis on the level of the minimum transition profit

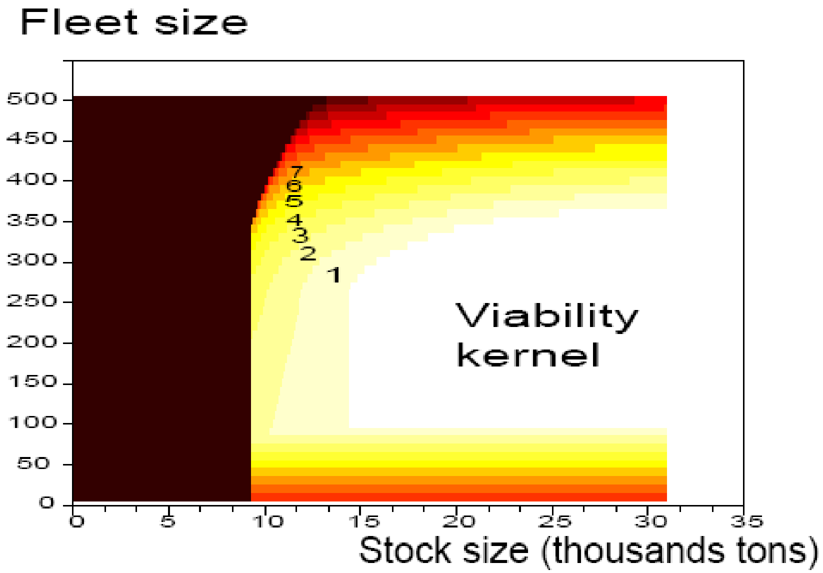
(Martinet V., Thébaud O., Rappaport A., 2008. IIFET conference).

III

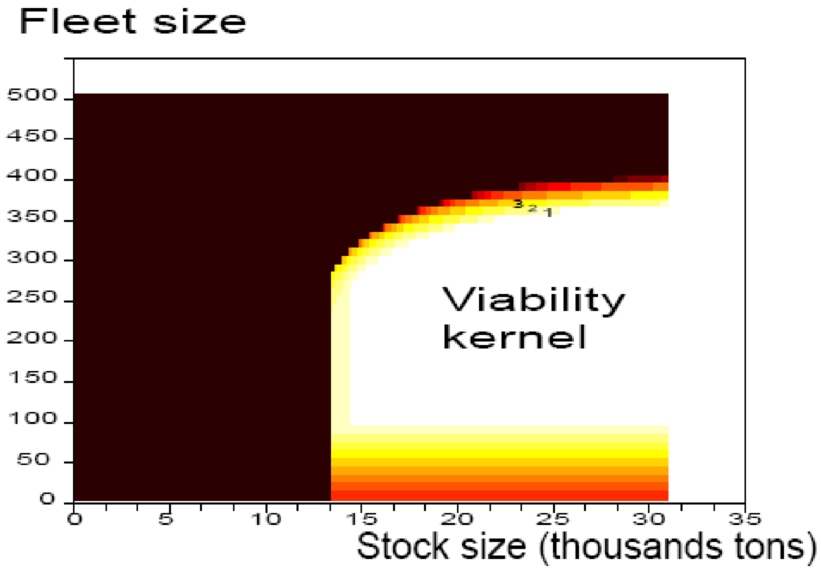
Consequences in terms of recovery possibilities



(a) Minimal time of crisis without transition profit constraint

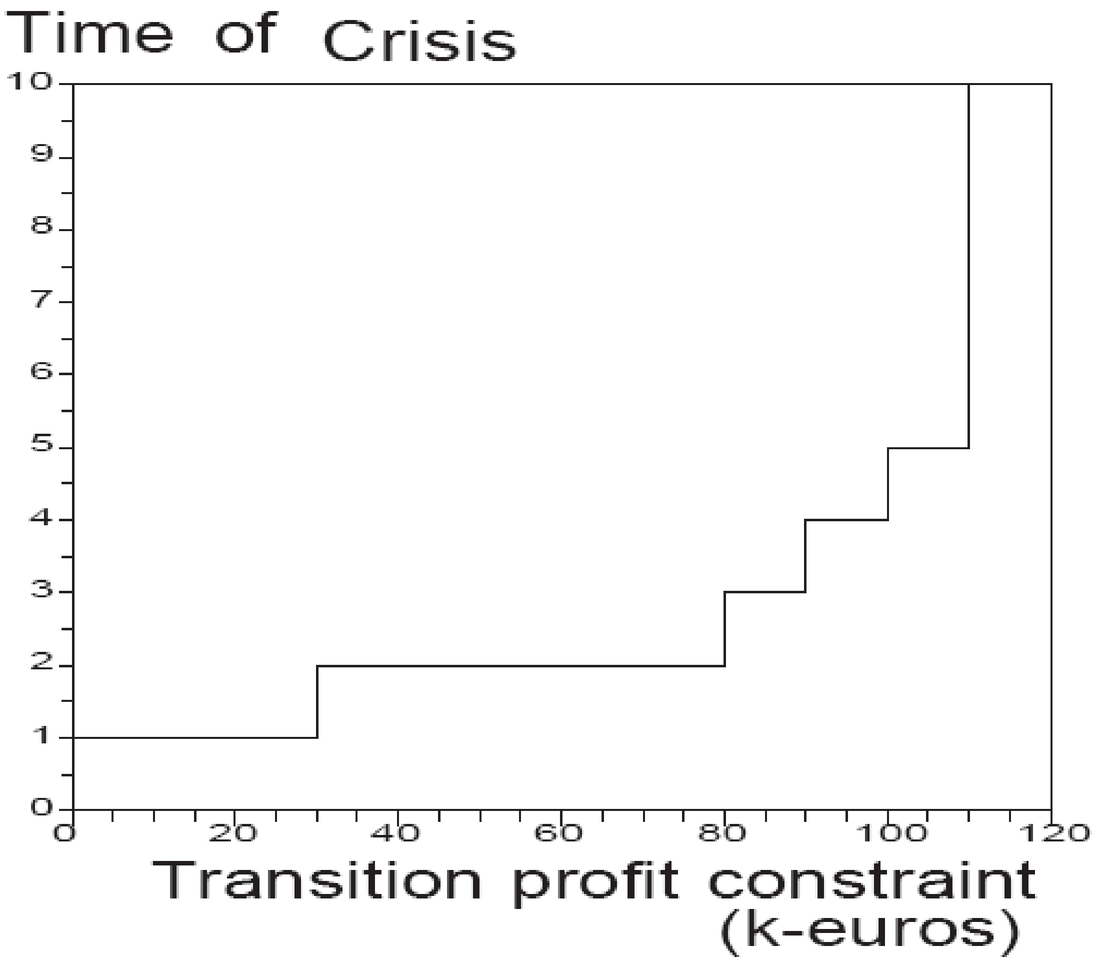


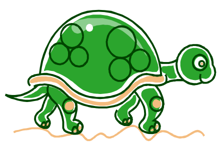
(b) Minimal time of crisis with $\pi_{\text{trans}} = 30$



(c) Minimal time of crisis with $\pi_{\text{trans}} = 110$

Trade-offs between short term acceptability and speed of recovery





Conclusions / Directions for further research

Approach allows to identify a set of sustainable states for a fishery in a multi-objective perspective, and to examine possible transition phases from unsustainable to sustainable states.

Further developments:

→ cost-benefit analysis of restoration plans (including implementation costs and their allocation)

→ impacts of uncertainty on trade-offs between speed and cost of recovery

→ application to analytical models of resource dynamics

→ inclusion of additional ecological viability constraints

Thank you for your attention !

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