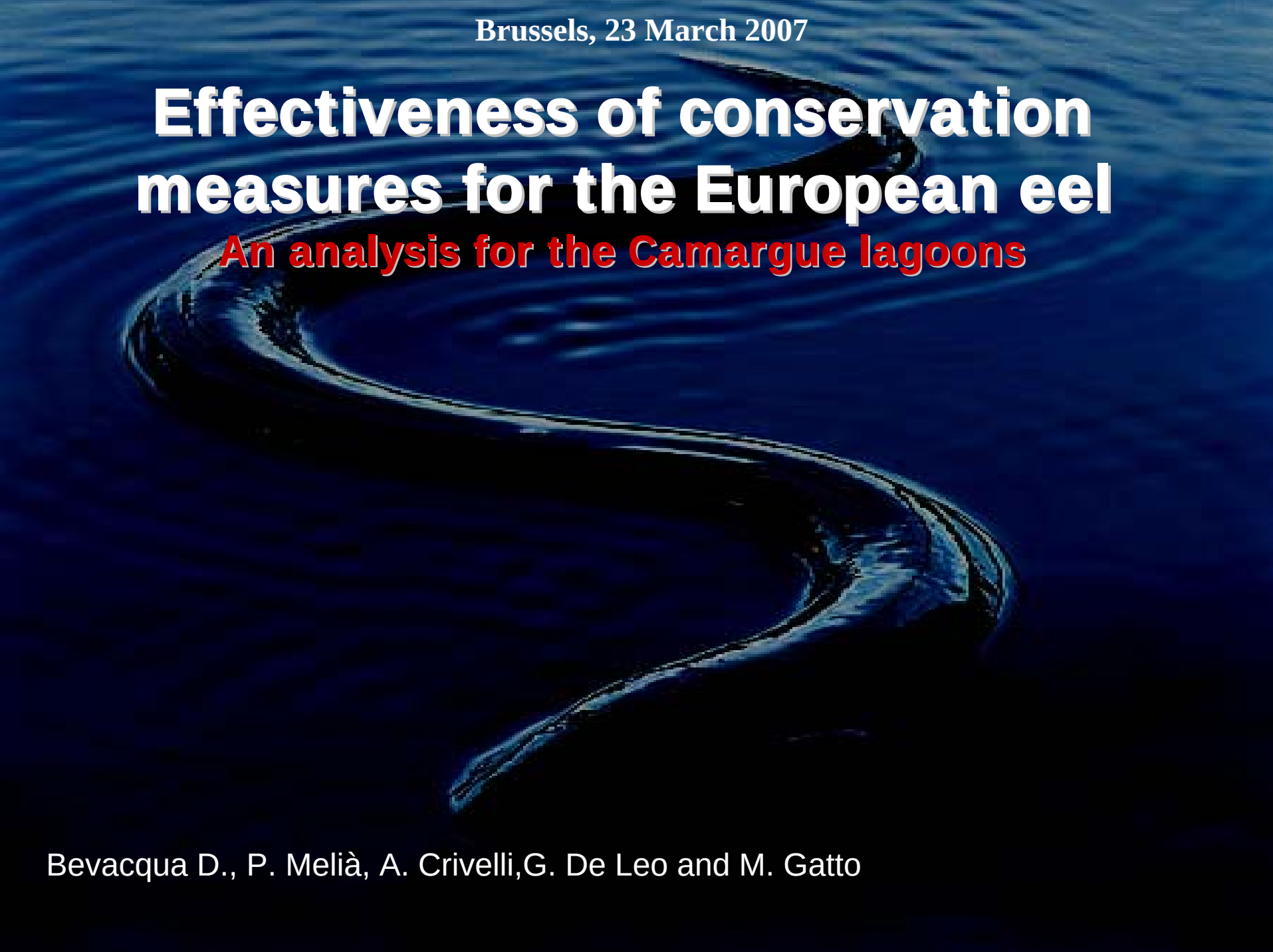
Brussels, 23 March 2007

Effectiveness of conservation measures for the European eel

An analysis for the Camargue lagoons



Bevacqua D., P. Melià, A. Crivelli,G. De Leo and M. Gatto

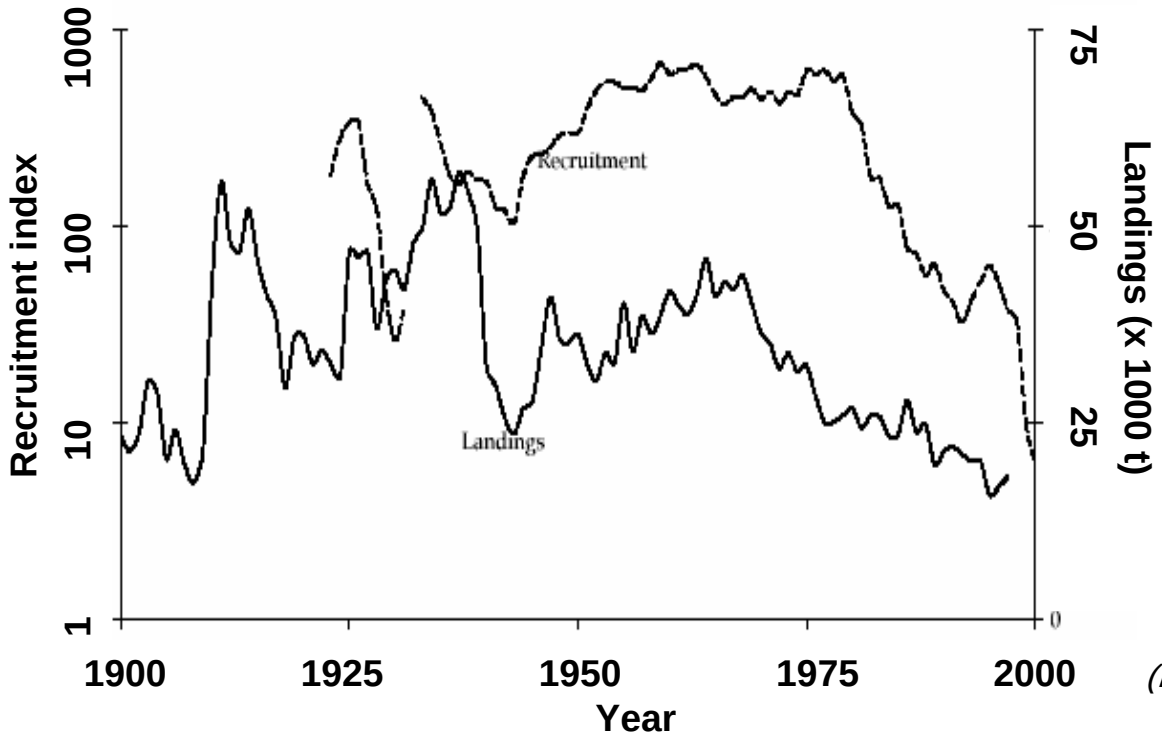
Index of the Presentation

- Introduction
- The demographic model
- The management scenarios
- Results and Conclusions

Introduction:

Dramatic situation

Catches and recruitment collapse



(Dekker, 2004)

Agreement on the collapse…less on the causes:

climate change, pollution, diseases and parasites, habitat loss, overexploitation …

Introduction:

EU actions

- **EU Water Framework Directive (2000/60/EC)**
- **European recovery plan for the eels (COM 2005, 472 final)**

•**Long term target**: "***a recovery of the stock***"

•**Short term target**: "***40 % of the biomass of spawners relative to the best estimate in the absence of human activities"***

•**Short term effective measures: fishing effort reduction**

•**Long term effective measures: implementation of basin management plan approved by STEFC**

(Scientific, Technical and Economic Committee for Fisheries)

Introduction:

Objectives of present work

- To estimate both spawner output and fishermen harvest under different management scenarios in the Camargue lagoons
- To perform a Pareto analysis of alternative strategies

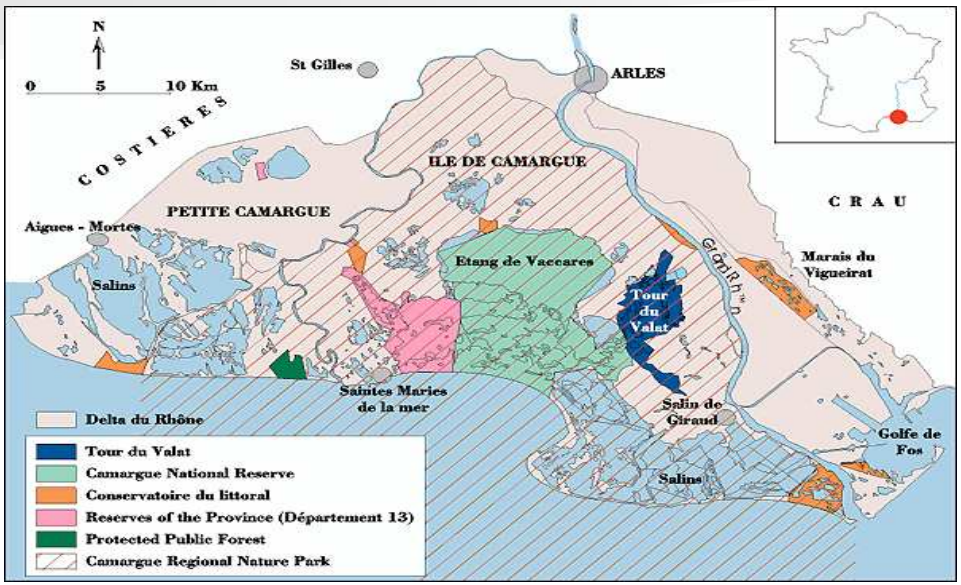
By using a sex, size and age-structured model *(De Leo & Gatto, 1995 CJFAS)*

- updated with recent surveys *(Melià et al., 2006 JFB)*

- adapted to the Camargue lagoons *(Bevacqua et al., 2006 JFB)*

Introduction:

Camargue lagoons



General info

- 11.000 hectares
- 16 fishermen
- Fyke nets
- Yellow and silver fishery

- **Potential spawner output magnitude ?**
- **Does traditional management guarantee a 40% escapement?**

  If not, what needs to be done?

Index of the Presentation

- Introduction
- The demographic model
- The management scenarios
- Results and Conclusions

The demographic model:

Main features

Structure

- **sex, age and length structured**
- **monthly time step**

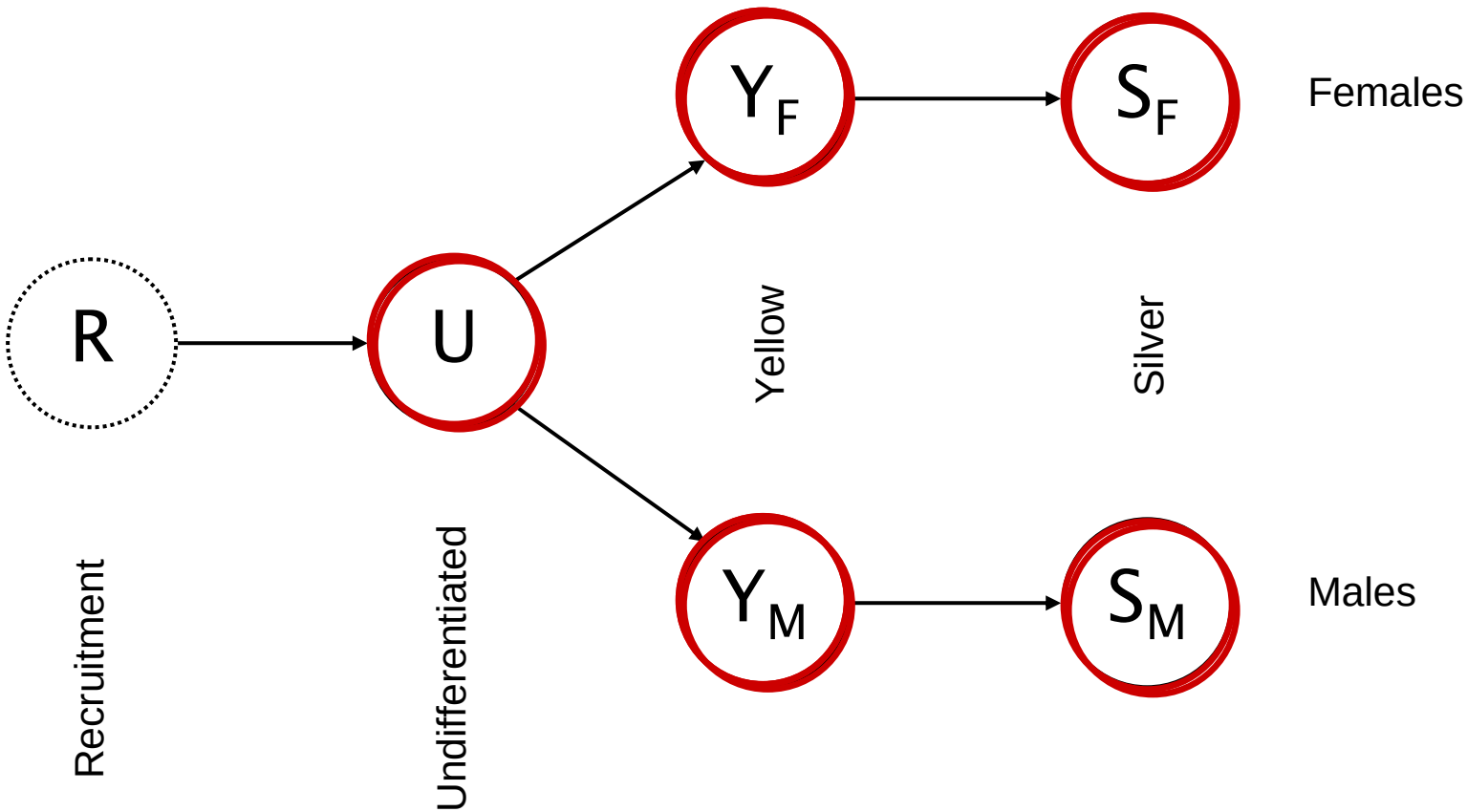
Biological and management aspects

- **annual variable recruitment**
- **specific growth process for undiff., males and females** *(Melià et al.,2006 JFB)*
- **sexual maturation** dep. upon **length and sex** *(Bevacqua et al.,2006 JFB)*
- **juvenile mortality** dep. upon **density**
- **adult mortality** dep. upon **age and season** *(De Leo & Gatto, 1995 CJFAS)*
- **fishing mortality** dep. upon **fishing effort** **and** **mesh size** *(De Leo & Gatto, 1995 CJFAS)*

The demographic model:

Main features (life history traits)

Sexual differentiation (sex ratio 1.56)



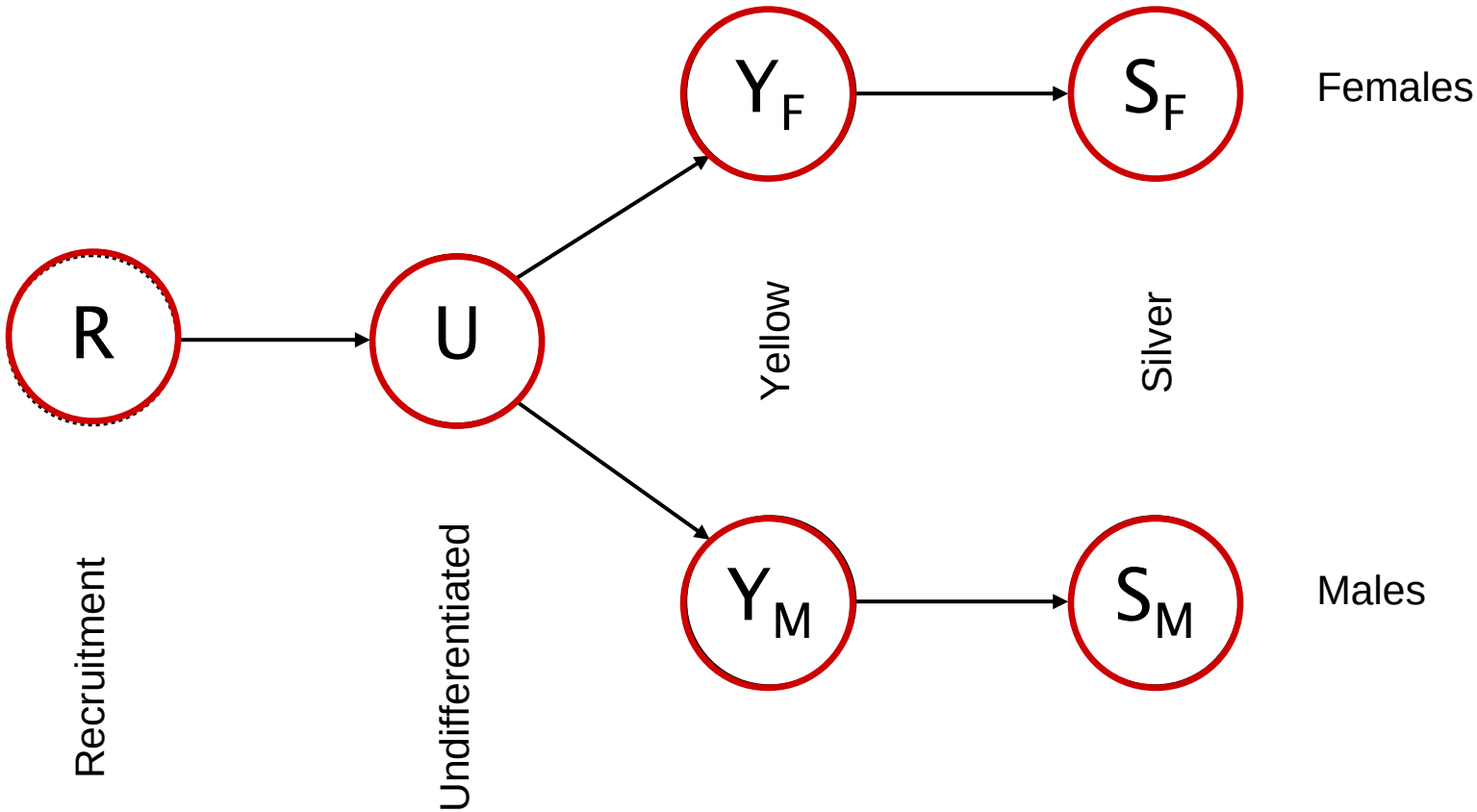
The demographic model:

Main features (life history traits)

(decision variables)

Glass eel: part recruit vs. stocking

Fishing mortality



Index of the Presentation

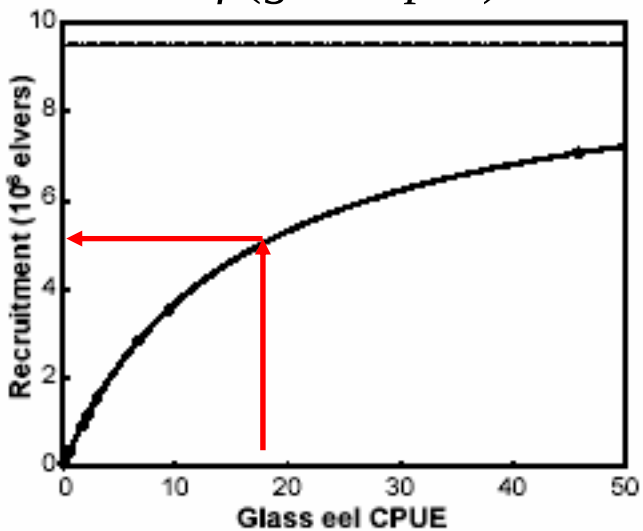
- Introduction
- The demographic model
- The management scenarios
- Results and Conclusions

The management scenarios:

Recruitment (annual)

$$R = f(glass\ cpue)$$

Historical data (1993-2003) have been used to estimate a not linear relationship between annual glass eel cpue and elver recruitment:



however

How large will be the next years glass eel cpue?

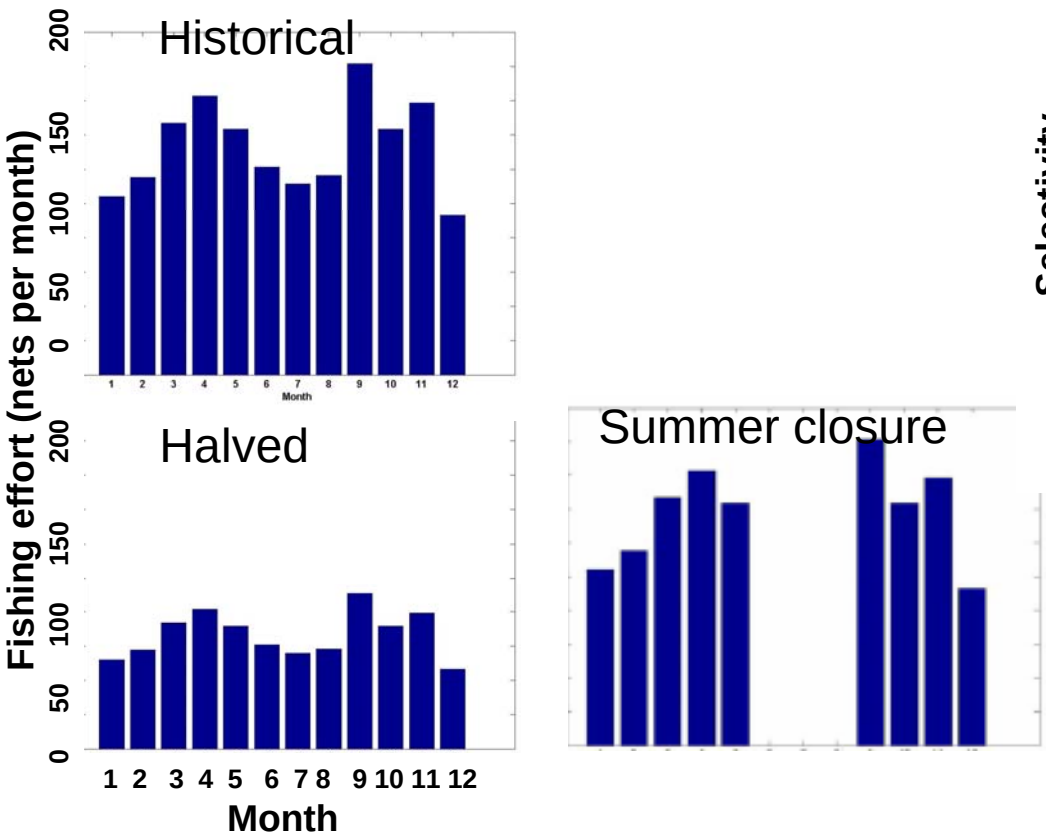
Glass eel CPUE	→	Recruitment
median = 1,7		958.000
low = 0,17		106.000
high = 17		4.880.000

The management scenarios:

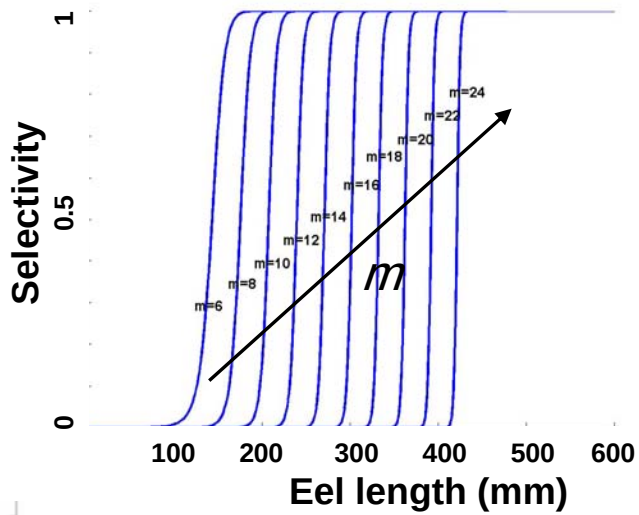
Fishing mortality rate (F)

$$M(t,l,m) = q \times E(t) \times \varphi(m,l)$$ *from De Leo & Gatto, 1995 CJFAS*

- ***q*** **catchability coefficient**
- ***E*(t)** **monthly effort (# nets per month)**



- ***φ*** **(*l*) mesh selectivity**



$$\varphi(l) = \frac{1}{1 + e^{\left(\frac{\Phi_{med} - \rho^{-1} e^{\alpha} l^{\beta - 1}}{\upsilon}\right)}}$$

The management scenarios:

Management scenarios

3 recruitment levels:
- low
- historical
- high

6 fishing efforts:
- no exploitation
- historical
- halved
- summer closure
- autumn closure
- winter closure

10 mesh sizes:
- 6 mm
- 8 mm
- 10 mm
- ….
- 24 mm

→ 3 x 6 x 10 = 180

For each scenario we run the model from 2003 to 2010 and estimated:
- annual spawner output biomass (F and M+F)
- annual fishermen harvest

Pareto approach : a scenario is dominated if exists at least another feasible scenario ensuring both a higher harvest and a higher spawner output

Index of the Presentation

- Introduction
- The demographic model
- The management scenarios
- Results and Conclusions

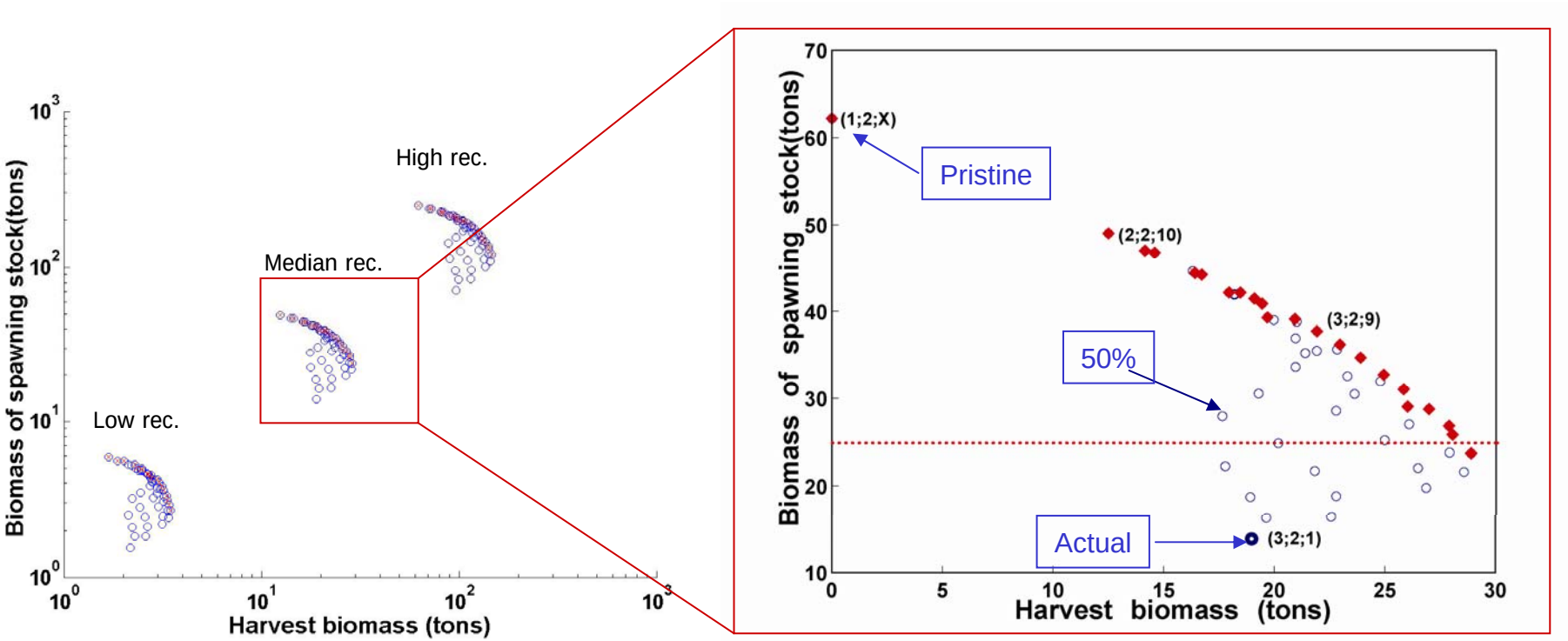
Results and conclusions

Multi-objective analysis

Maximize spawner output **(conservation objective)**

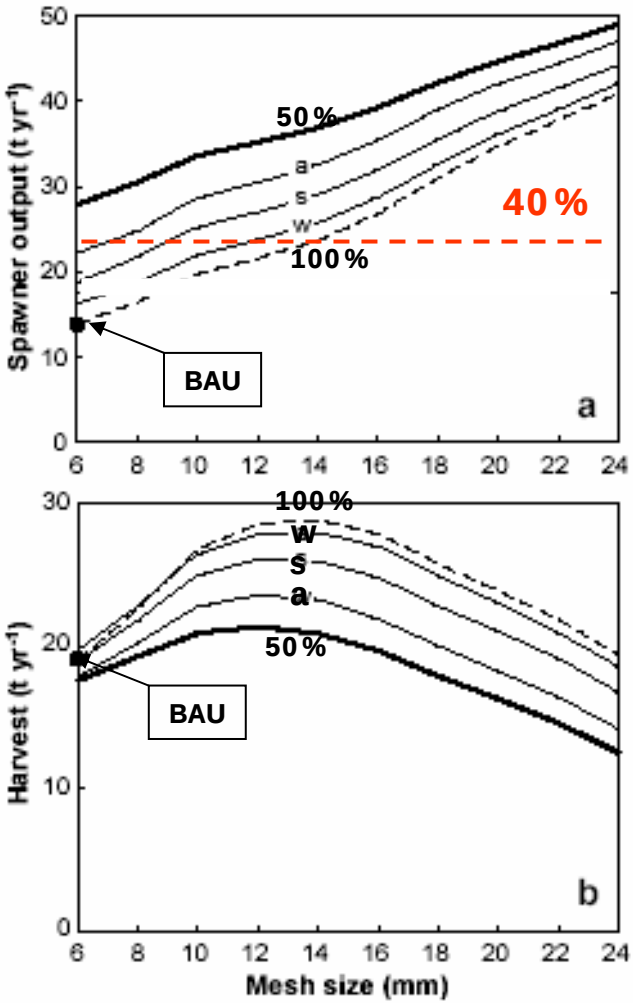
Maximize fishermen harvest **(socio – economic objective)**

} **potential conflict**



Results and conclusions:

The separate role of mesh size and fishing effort (historical recruitment scenario)



Spawner output

- 40% of the unexploited scenario equals 25 tons
- BAU does not guarantee 25 tons
- present effort scenario needs a 16 mm mesh size
- halving the effort alone could guarantee the 40%
- many intermediate and effective options

Harvest

- present harvest is inefficient
- 12-14 mm mesh size turns out to be optimal for all the analyzed scenarios

Results and conclusions:

Conclusions:

- **Present management is inefficient** (fishermen dilemma? alternative hypotheses?)
- **Measures on mesh size and fishing effort can improve fishermen harvest and guarantee a 40% of SSB**
- **Several optimal scenario exists** (last word to policy makers)
- **Any policy gives results after 5-7 years** (eel life span in Mediterranean regions)
- **Our results are site-specific** (lagoon context)
- **40% of what?** (males plus females; pristine conditions)

Further improvements

- Consider costs and revenues
- Consider density-dependent effects on body growth, mortality rates and sex ratio
- Apply this approach to other populations

Dipartimento di Scienze Ambientali
Università degli studi di Parma, Italy

Dipartimento di Elettronica e Informazione
Politecnico di Milano, Italy

Station Biologique de la Tour du Valat,
Le Sambuc, Arles, France

Contacts : **bevacqua@dsa.unipr.it**