

The restocking of eels from an evolutionary ecological perspective : a review.

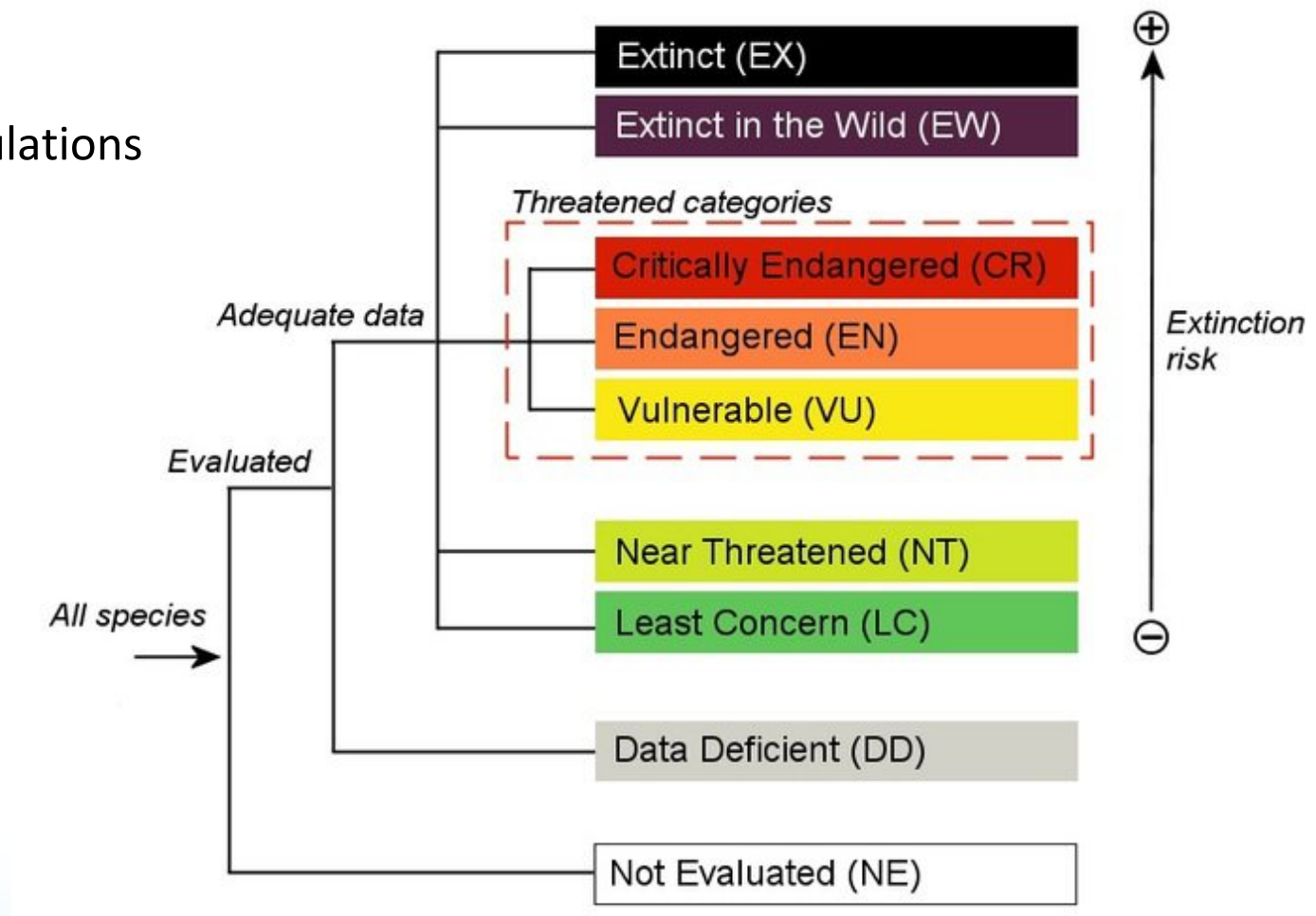
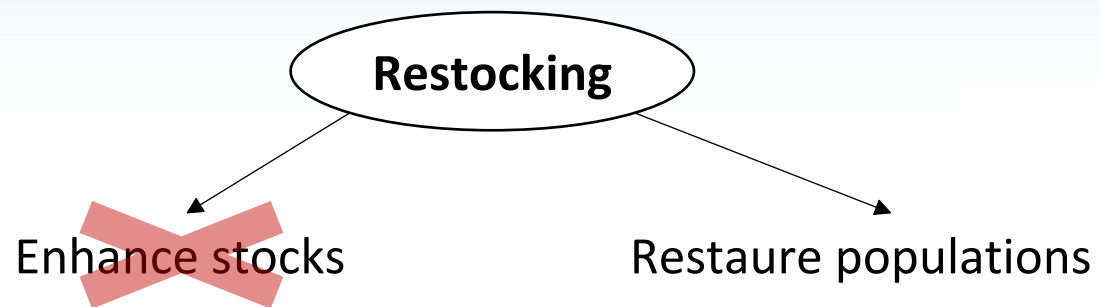
Paper in progress, Froehlicher Hermione, Daverat Françoise, Rambonilaza Tina et al.



LOCAL AND GLOBAL INITIATIVES:

HOW SCIENCE SUPPORTS MANAGEMENT ACTIONS ON DIADROMOUS FISH







Enhance stocks

Restaure populations



Anguilla anguilla

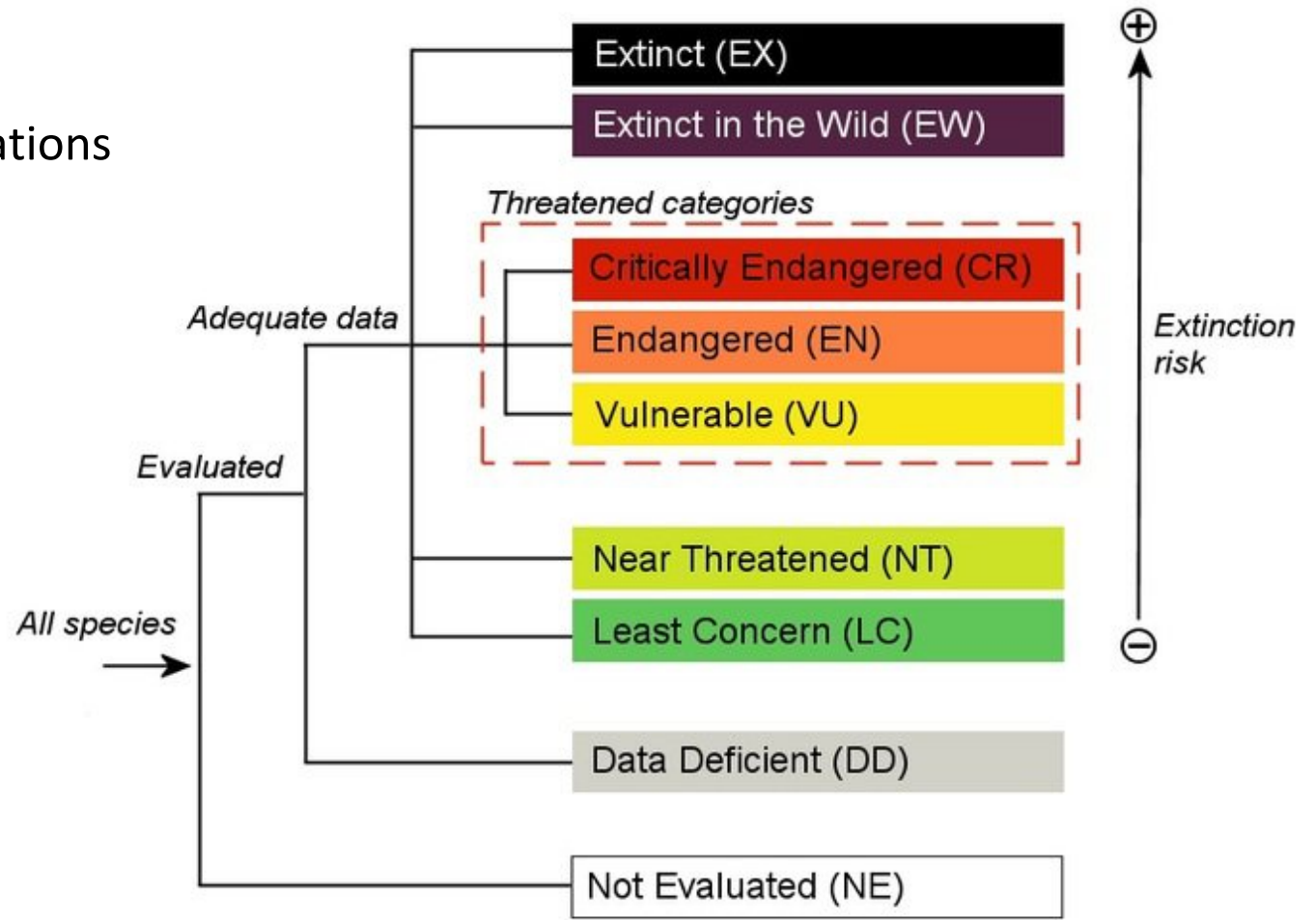


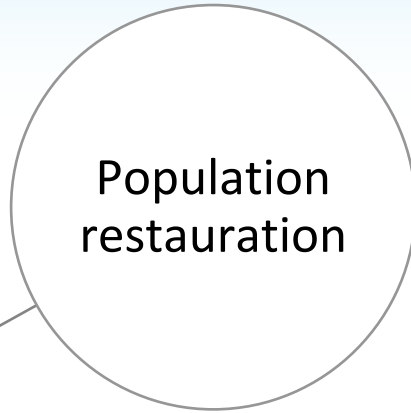
Anguilla rostrata



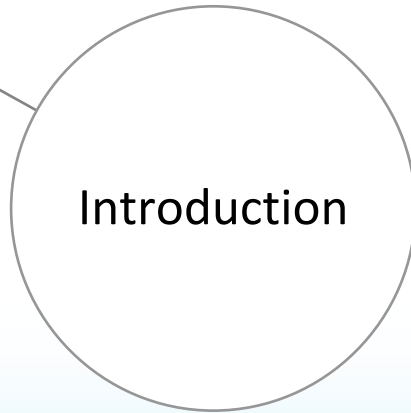
Anguilla japonica

Images from FishBase

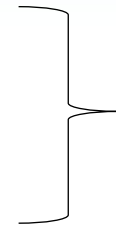
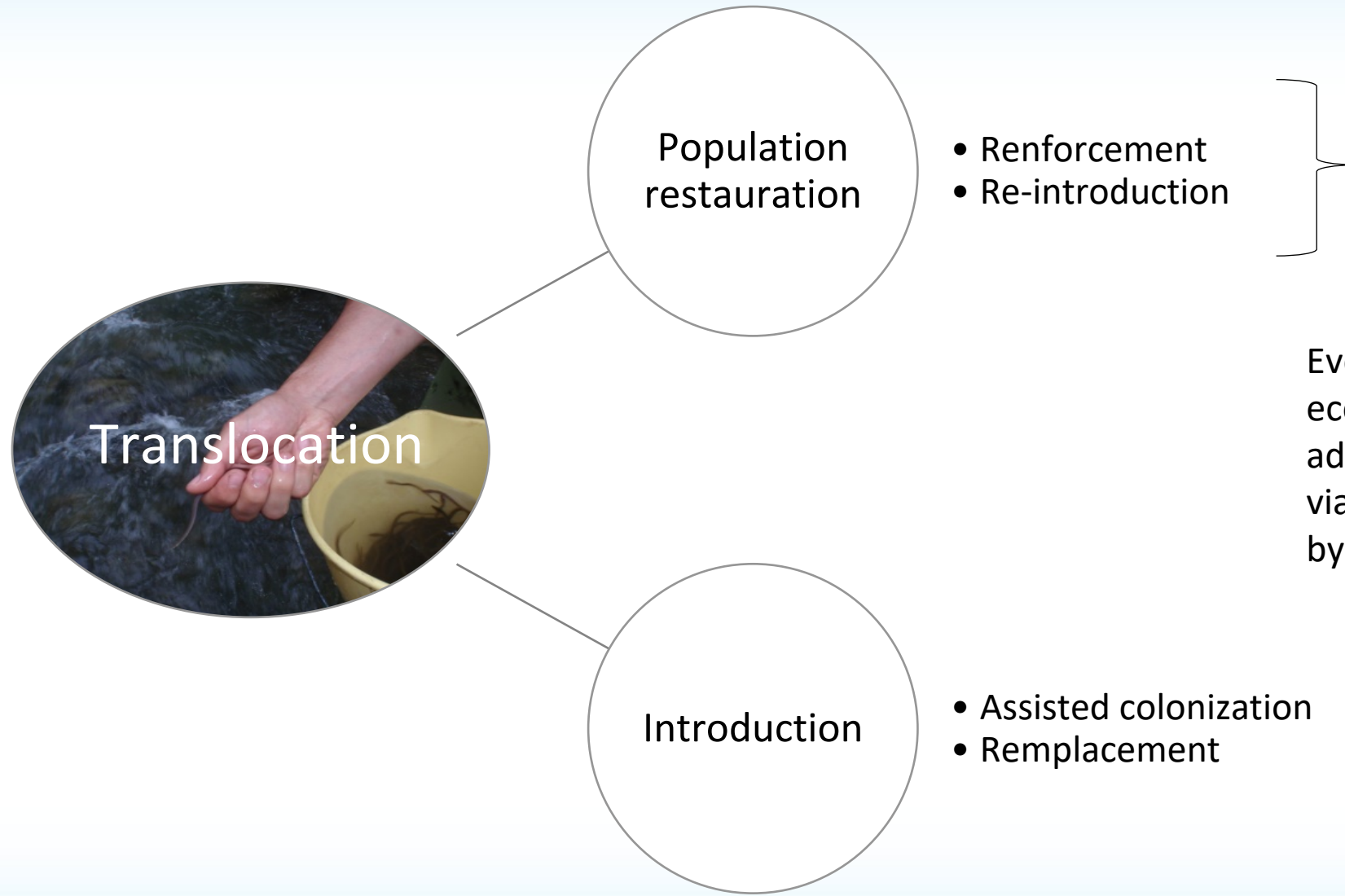




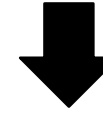
- Reinforcement
- Re-introduction



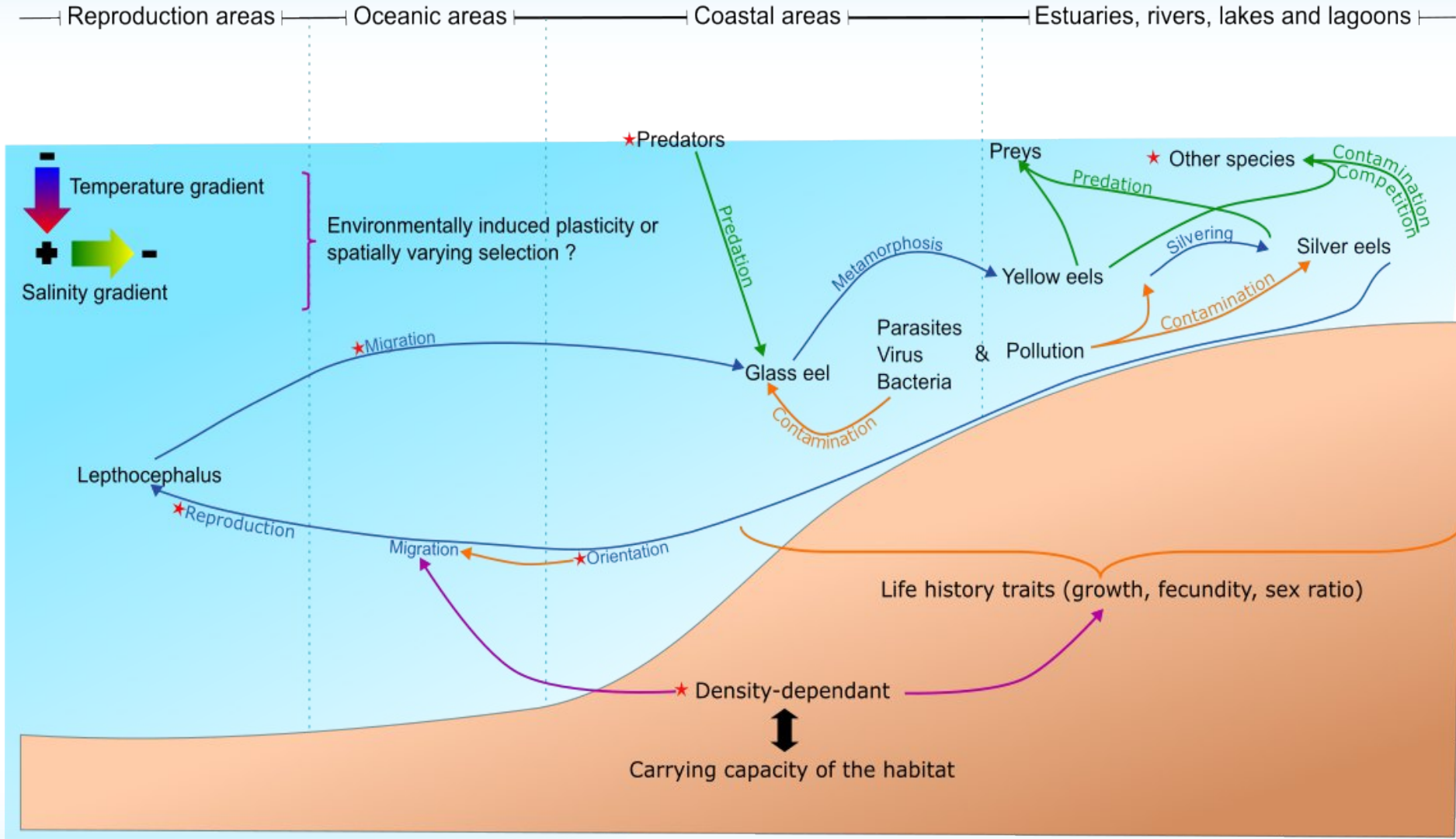
- Assisted colonization
- Remplacement



Efficiency ?



Evolutionary ecology and functional ecology appear as relevant frameworks to address individual eel fitness, population viability and ecological integrity provided by eel restocking.



Legend :

- ▶ Life cycle of the European eel
- Possible effects of the restocking
 - ▶ Individual scale
 - ▶ Population scale
 - ▶ Community scale
- ★ No strong consensus

Preliminary literature analysis



Research questions in the conceptual framework of Evolutionary and functional ecology

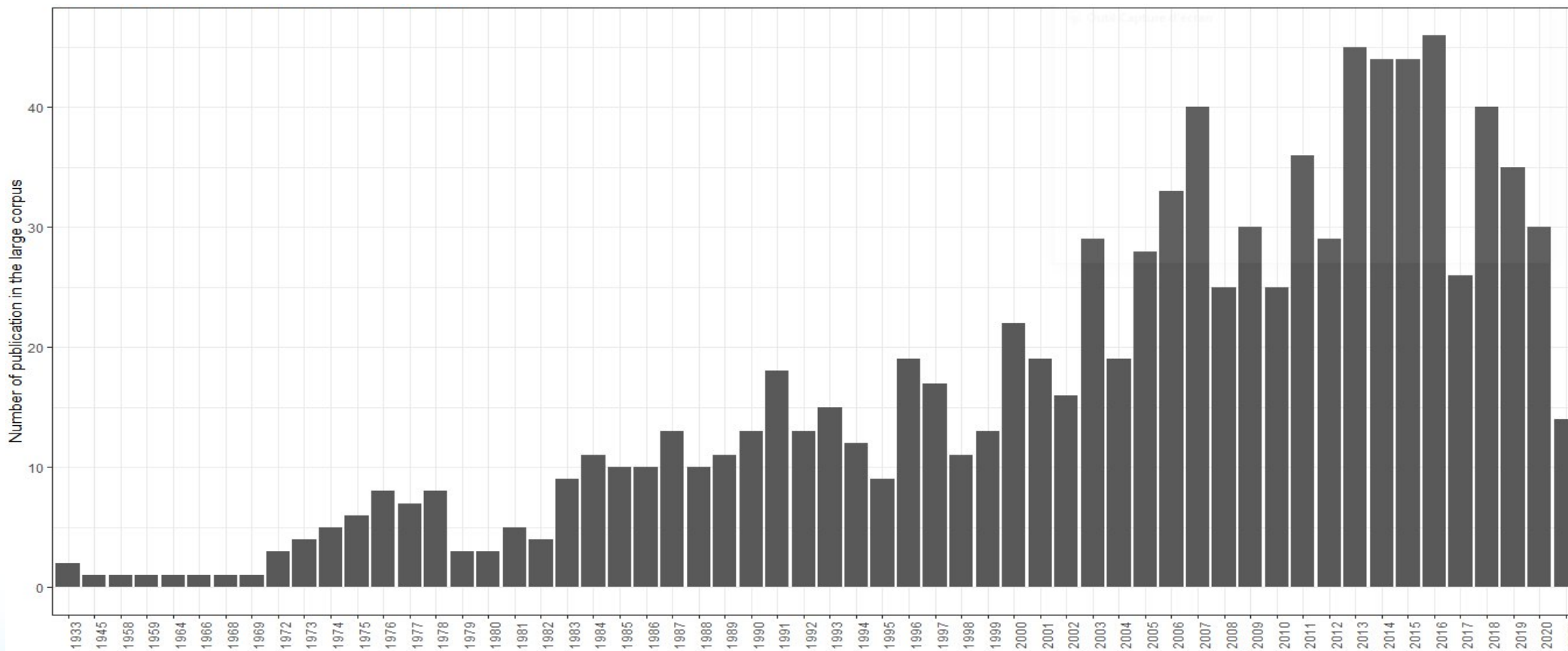
- 1) Which of the ecological processes described at the end of the introduction that interact with restocking have been addressed in the literature?
- 2) What have been their main lessons?

Preliminary literature analysis



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Preliminary literature analysis

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Method

Quantitative analysis

1) Studies selection

- Data delimitation : scientific articles, concerning one of the three temperate eel species, in English, without condition on the location and date, 4 search engines (ScienceDirect, Web of Science, Springer, Google Scholar)
- Query elaboration :
 ("Anguilla anguilla" OR "Anguilla japonica" OR "Anquilla rostrata") AND
 (genetic OR survival OR mortality OR growth OR "sex ratio" OR fecundity
 OR
 density OR trophic OR migration OR orientation) AND (restocking OR
 translocation)
- Sorting : duplicates, off-topic articles, non-English articles and grey literature

2) Systematic review : automated content analysis on 956 full scientific articles (tool : Leximancer)

- + Quick and objective analysis of a large corpus of articles
- + Visualization of the most studied concepts
- + Identification of research gaps
- Paid software
- Impossibility to identify the answers given to the controversies

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Qualitative analysis

1) Studies selection

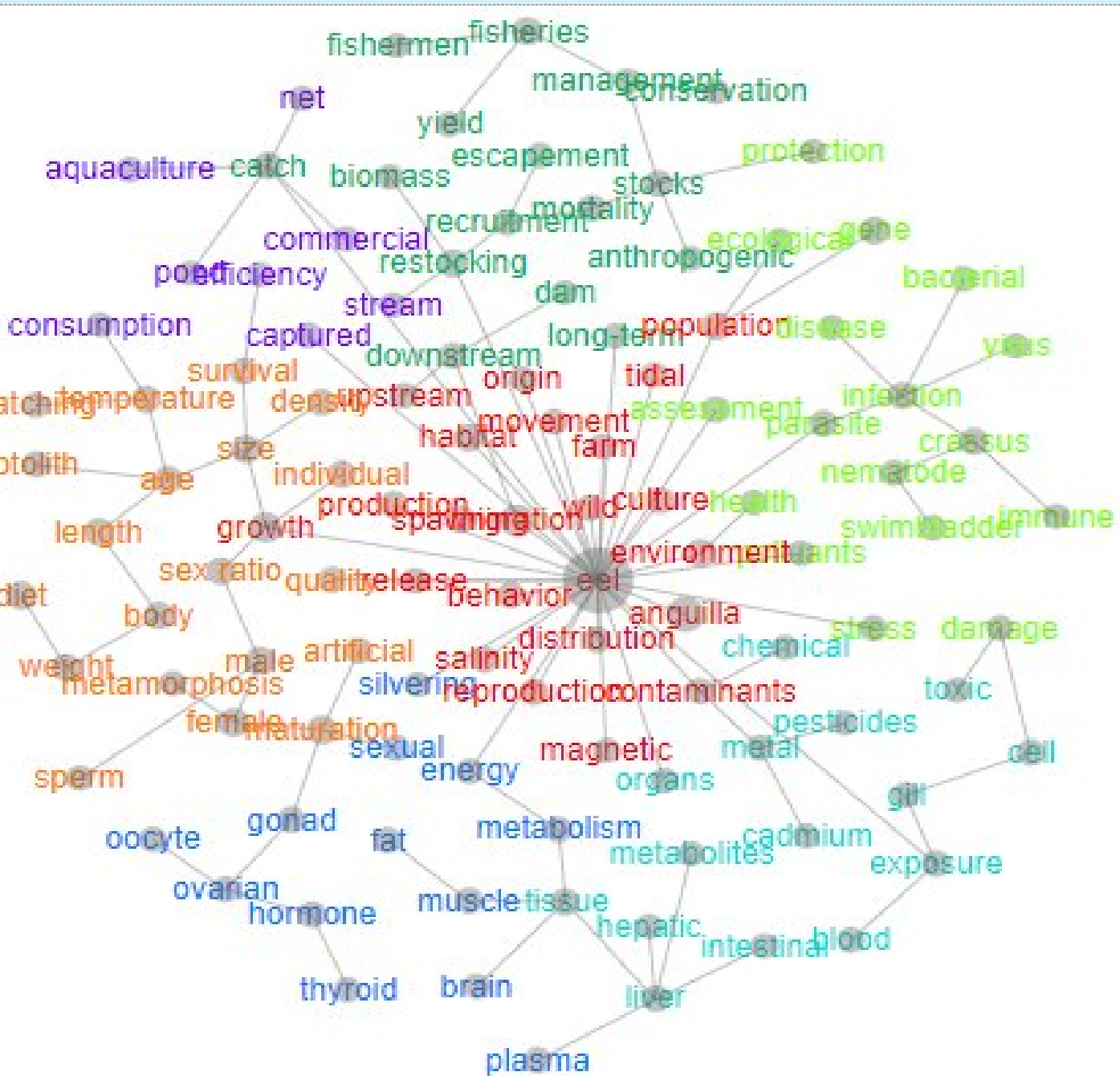
- ✓ Dealing with issues related to the main concepts in the ACA
- ✓ Mentioning restocking actions in the title or abstract OR an entire part of the article is dedicated to implication of the results on eel management policies
- ✓ Approaching restocking from a conservation perspective
- ✓ At least one of the article's authors is one of the main authors of the corpus for publications older than 5 years (before 2016)
- ✓ No more than two articles published in the same journal

2) Narrative review

- + Possibility to identify the answers given in the litterature
- Longer and less exhaustive analysis



Coupling



Eel has been studied under several aspects :

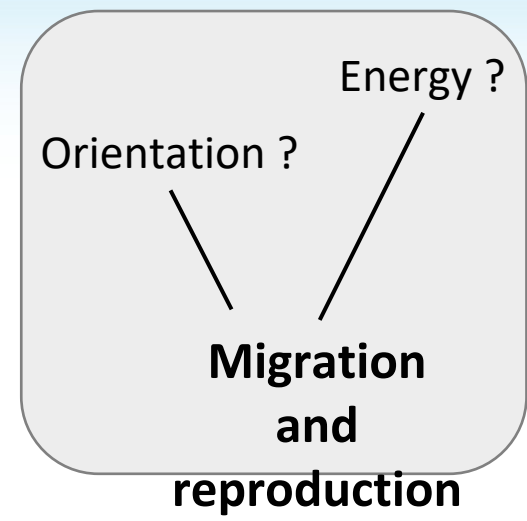
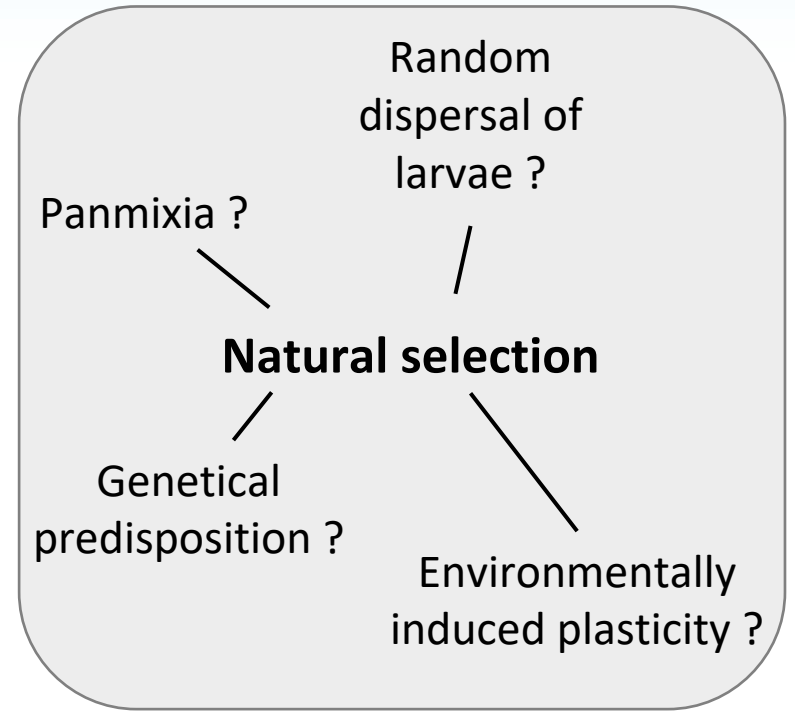
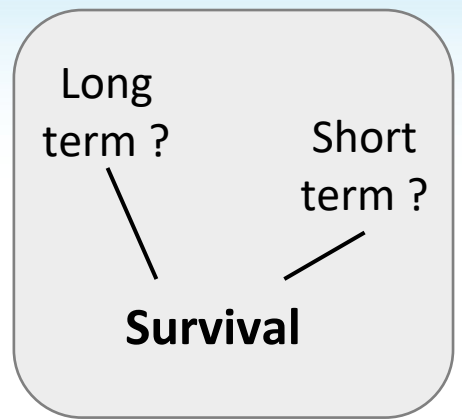
- Key stages of its life cycle
→ migration / reproduction
- Life history traits
→ growth / sex ratio
- Quality of its living environment
→ contamination / infections

Related Concept to « restocking »	Count	Likelihood (%)
yield	158	23
farm	344	19
biomass	94	17
recruitment	548	16
origin	200	16
pond	122	16
density	348	16
stocks	444	13
escapement	159	13
release	235	12
wild	240	11
conservation	131	11
commercial	112	10
captured	136	9
catch	376	9
survival	176	9
management	224	9
assessment	222	8
fisheries	470	8
habitat	297	8
mortality	205	8
anthropogenic	38	8
stream	100	8

Related Concept to « restocking »	Count	Likelihood (%)
individual	286	7
long-term	51	7
growth	532	6
otolith	218	6
size	301	6
culture	125	6
net	87	6
age	201	5
upstream	95	5
spawning	187	5
migration	526	5
protection	36	5
fishermen	26	5
health	32	5
length	235	5
eel	4144	5
downstream	81	5
sex ratio	186	5

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Communities in recipient waters

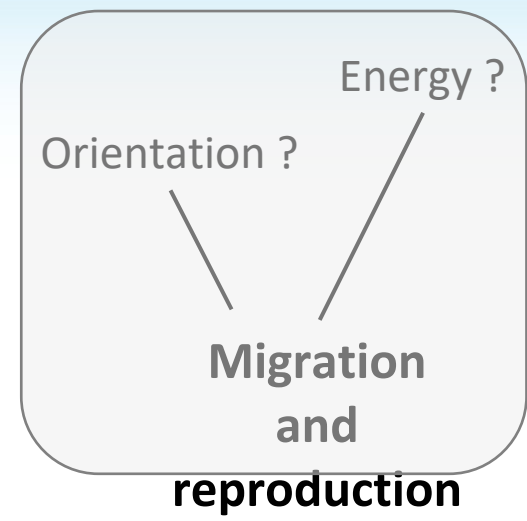
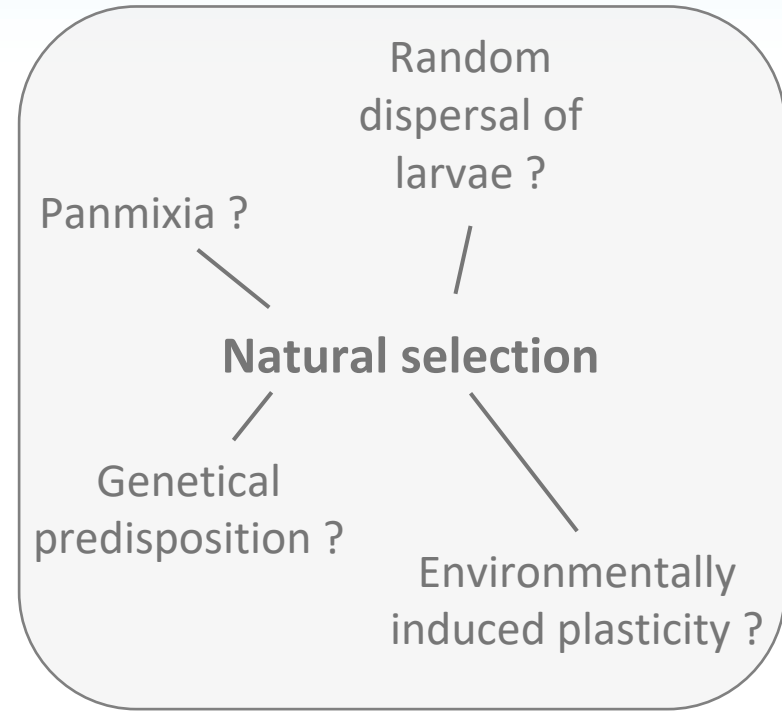
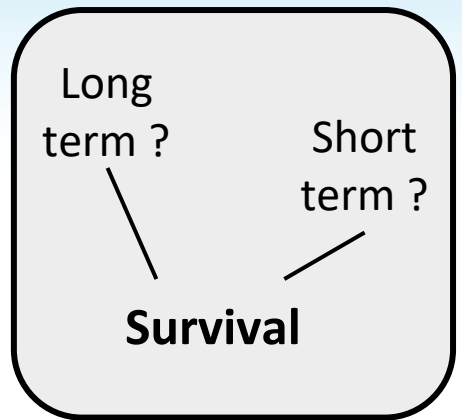
Publications

Félix et al., 2021
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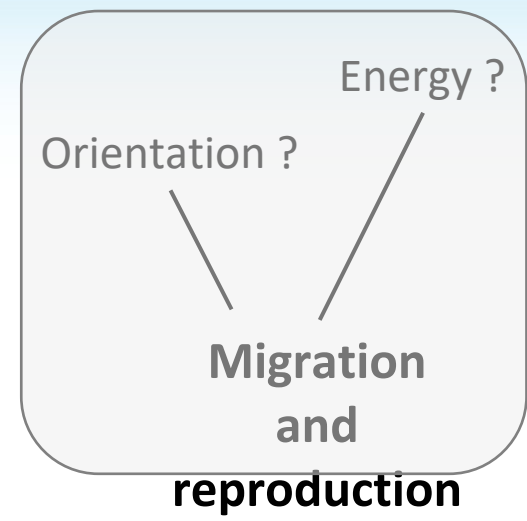
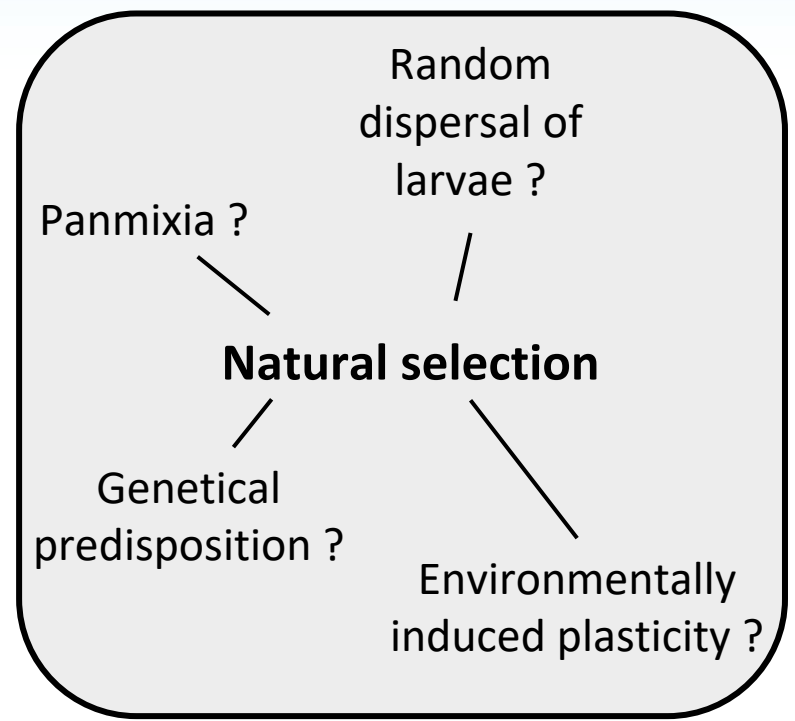
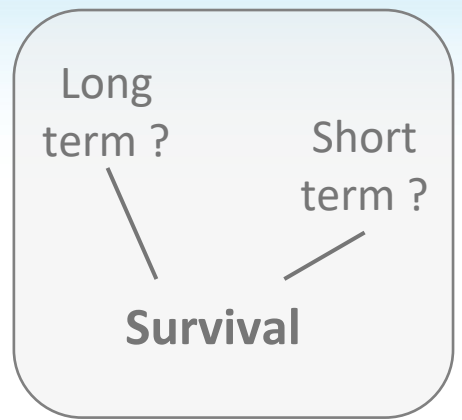
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1) Is eel translocation an efficient conservation measure ?

Consensus

Individual scale

- Short and mid-term monitoring
- Restocking interferes with natural selection processes
- Individuals manage to escape

Population scale

- No depletion of the gene pool (panmixia)
- Random dispersal of larvae

Community scale (emerging controversy)

Research gap

- Long term survival
- Survival compared to wild eels
- Post-escapement migration
- Impact of delayed migration on reproduction
- Fecundity of restocked females

- Influence of density on traits, including sex ratio

- Predation of restocked glass eels
- Evolution of communities after restocking

- 1) Is eel translocation an efficient conservation measure ?
- 2) From a productive to a conservation perspective

1) Is eel translocation an efficient conservation measure ?

2) From a productive to a conservation perspective

What if we include socio-economical aspects in the analysis ?

To be continued...