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Development and application of a generic method to assess species exploratory potential under climate change: focus on the exploration phase of anadromous fish

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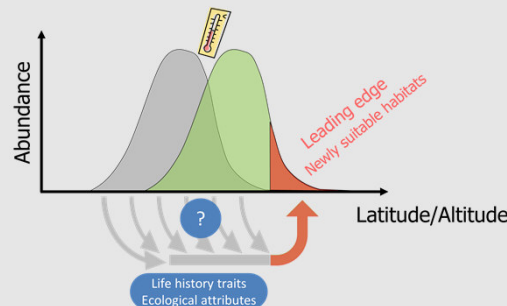
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INTRODUCTION

- ✓ In response to climate change, some species have shifted their **latitudinal and elevational distributions** by exploiting **new suitable habitats** outside of their ranges (Thomas and Lennon, 1999; Parmesan and Yohe, 2003; Cheung et al., 2015)
- ✓ Various studies have demonstrated that species' traits can be important predictors of the type and intensity of responses to climate change (Jiguet et al., 2007; Diamond et al., 2011; Chessman et al., 2013)
- ✓ Based on these conclusions, how can be easily assessed the **exploratory potential** of **species** in order to provide insights for **biological conservation**?



A generic and collaborative approach

Exploratory potential index

- ✓ Exploratory potential is there restricted to the capacity of species to **reach new suitable habitats**, beyond current ranges, under climate change
- ✓ Analytical Hierarchy Process (Saaty, 1980, 2008)
 - ✓ Breaks a **complex problem** down into **simplest issues to get relevant experts' opinions**
 - ✓ Combines **experts' opinions and observed data into a synthetic metric**

Work plan assigned to taxonomic group of 15 experts

- 1 Determine the weight of the 3 main criteria (Level II) related to exploration ability using pairwise comparison matrices
- 2 Determine key life-history traits and ecological attributes (Sub-criteria in level III) relevant for each criterion (e.g. body size at maturity, number of reproduction events, homing, distance covered to access feeding grounds, earliness of first maturity...)
- 3 Derive weights of each criteria from pairwise comparison matrices

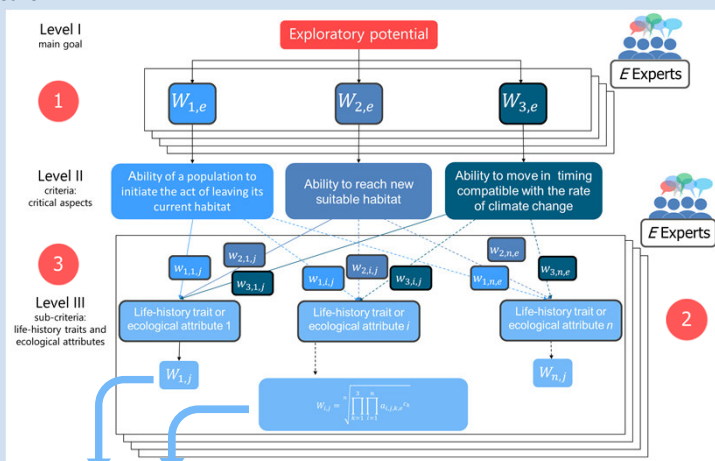
- 1 Equal importance
- 3 Slightly more important
- 5 More important
- 7 Strongly more important
- 9 Absolutely more important

	Life history trait 1	-----	Life history trait n
Life history trait 1	1		$a_{1,n}$

Life history trait n	$a_{n,1}$		1

Data sources

- ✓ Behavioral, morphological and physiological traits databases coded into ordinal modalities
- ✓ 1st case study: diadromous fish species of the Northern Atlantic
Database regarding 20 diadromous fish species
 - ✓ TraitDiad (Irstea)
 - ✓ FishTraits (Frimpong and Angermeier, 2009)

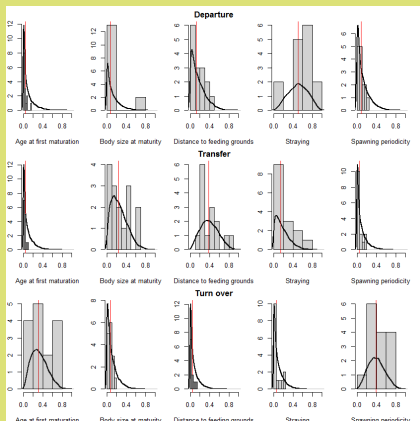
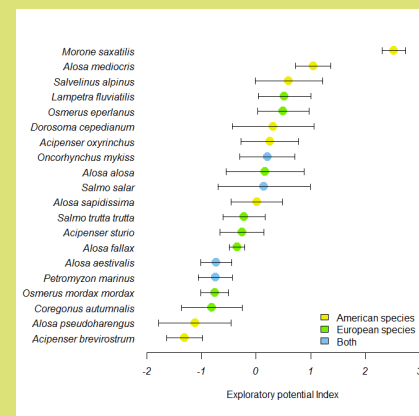


$$(W_{1,j}, \dots, W_{n,j}) \sim \text{Dirichlet}(W_1, \dots, W_n)$$

$$\text{Exploratory Potential Index} = \sum_{i=1}^n w_i \times \text{Trait}_i$$

Exploratory potential index

- ✓ **Consensus among the 15 experts** concerning the life traits impacting the phases of the exploration process
- ✓ **Two visions** among experts concerning the phases of the exploration process
 - ✓ Capital breeding strategy and income-breeding strategy (Jager et al., 2008)
 - ✓ Major importance of the departure phase (irruptive migration)
- ✓ An index globally consistent with the literature that allows to identify and "rate" **different dispersal strategies** and **support strong discrepancies** in the ability of anadromous fish of northern Atlantic to explore potential suitable habitat



Validation

- ✓ Compare the species ranking obtained with the exploratory potential index to mono-specific model simulations (Lassalle et al., 2008; Rougier et al., 2014)
 - Hypothesis:* species showing good repositioning capabilities in simulation model should get a high value of exploratory potential index
- ✓ Compare the species ranking obtained with the exploratory potential index to empirical data, e.g. the range of their (historical) distribution area
 - Hypothesis:* species with a large range that testified of a good post-glacial re-colonization should get a high value of exploratory potential index

Perspectives

- ✓ Characterize geographic areas in terms of the exploratory potential of their fish assemblages
- ✓ Identify geographic areas hosting species with high or low (extreme) values of exploratory potential and thus of priority for biological conservation and management
- ✓ A generic tool that could be applied to other taxonomic groups of interest (e.g. micro-organisms, amphibians, birds...)