



**HAL**  
open science

# Genetics and Evolutionary Ecology-based model for eel: GenEveel

M. Mateo, Patrick Lambert, S. Tétard, Hilaire Drouineau

► **To cite this version:**

M. Mateo, Patrick Lambert, S. Tétard, Hilaire Drouineau. Genetics and Evolutionary Ecology-based model for eel: GenEveel. Life History Theory (summer school), Sep 2015, Schiermonnikoog, Netherlands. pp.1, 2015. hal-02605054

**HAL Id: hal-02605054**

**<https://hal.inrae.fr/hal-02605054v1>**

Submitted on 16 May 2020

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



# Genetics & Evolutionary Ecology-based model for Eel: GenEvEel



## Consequences of adaptive plasticity and spatially variable selection in the European eel



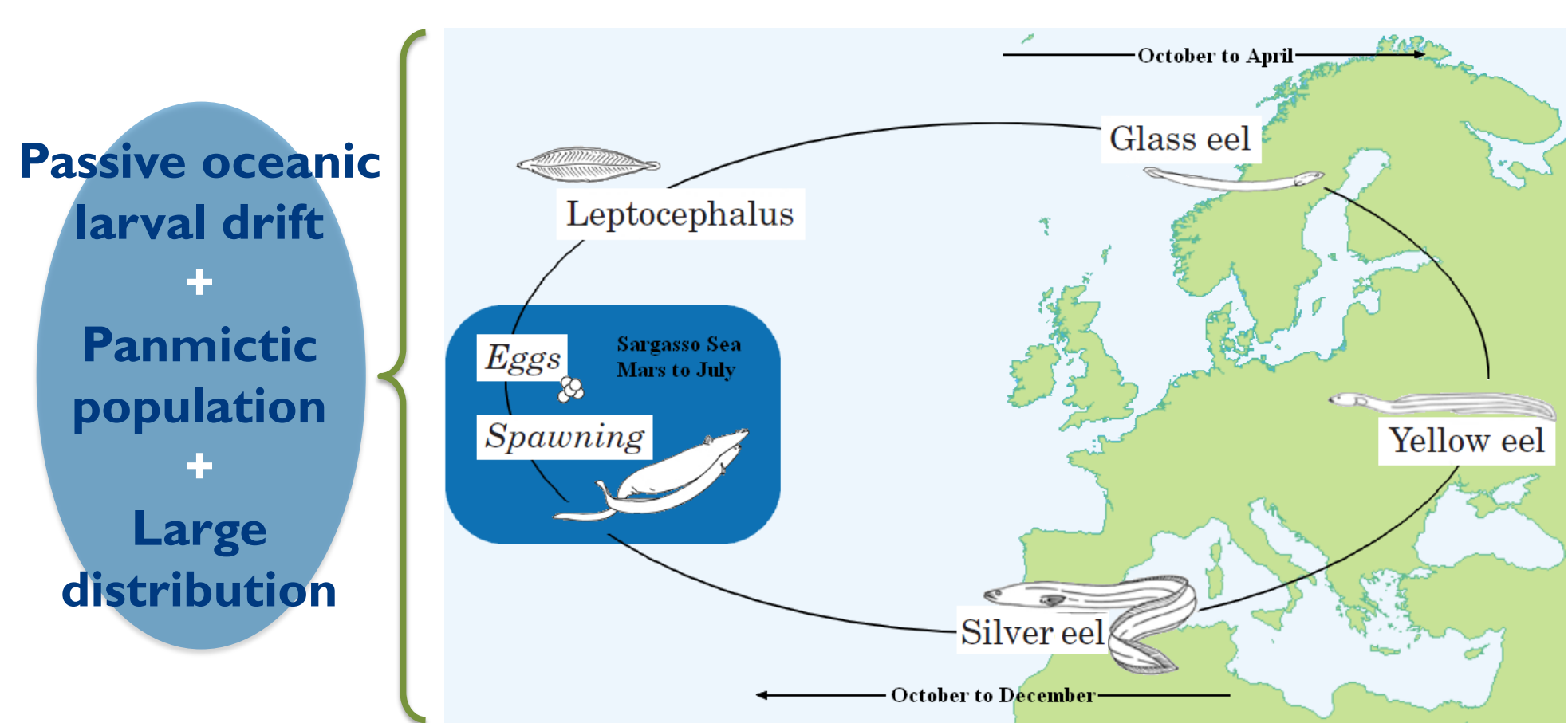
M. Mateo\*, P. Lambert\*, S. Tétard\* and H. Drouineau \*

\* Research Unit EABX (IRSTEA): 50 avenue de Verdun, 33612 Cestas ; \* EDF R&D: 6 quai Watier, 78401 Chatou. Corresponding author: M. Mateo (Maria.Mateo@irstea.fr)

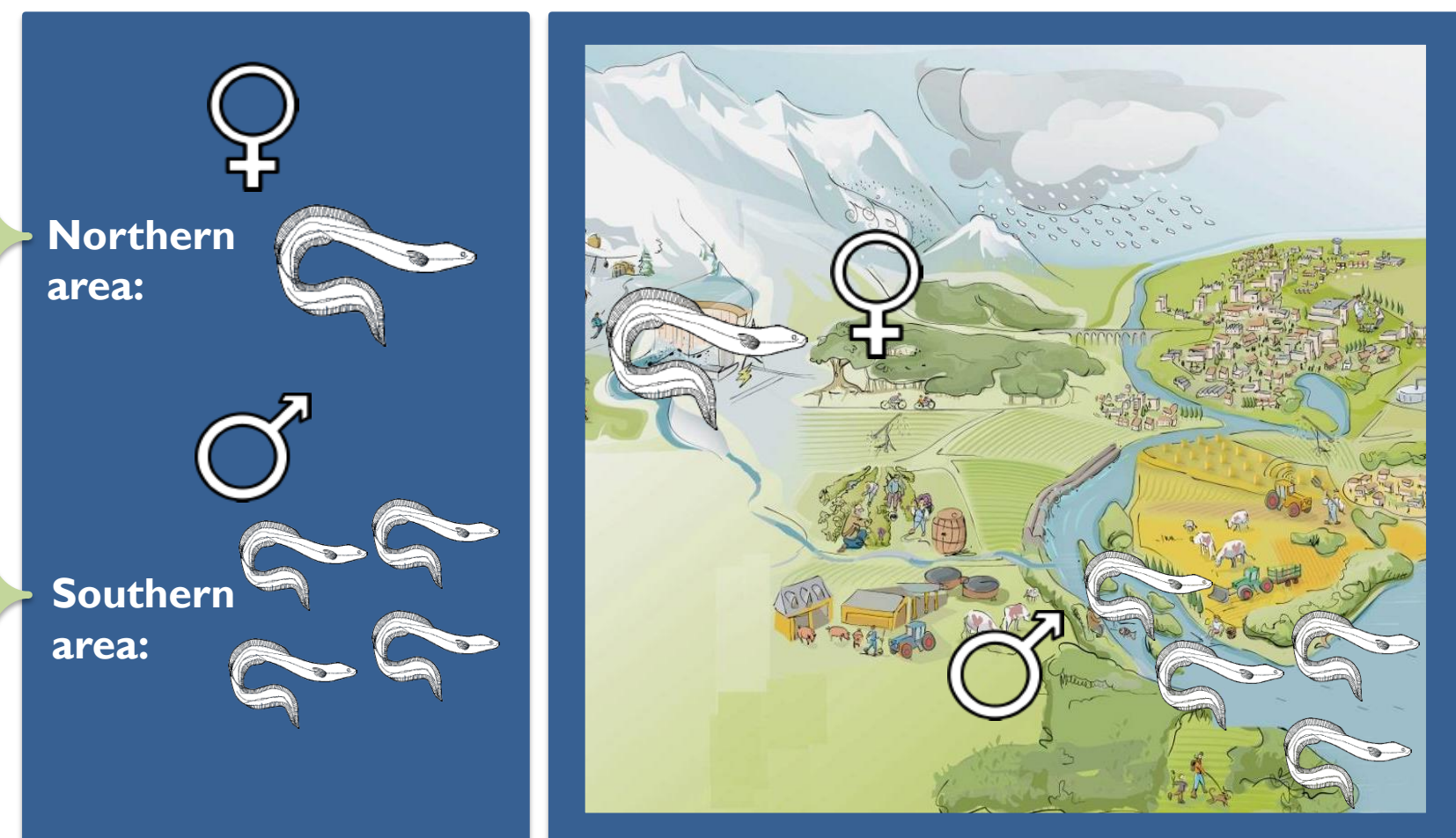
### 1. European eel: Features and distribution

- Features such as a complex life history (A), the controversy about genetic structure and an important interest for conservation make European eel (*Anguilla anguilla*) an interesting species to study!
- European eel displays a large phenotypic and tactical variability at different spatial scales (B).

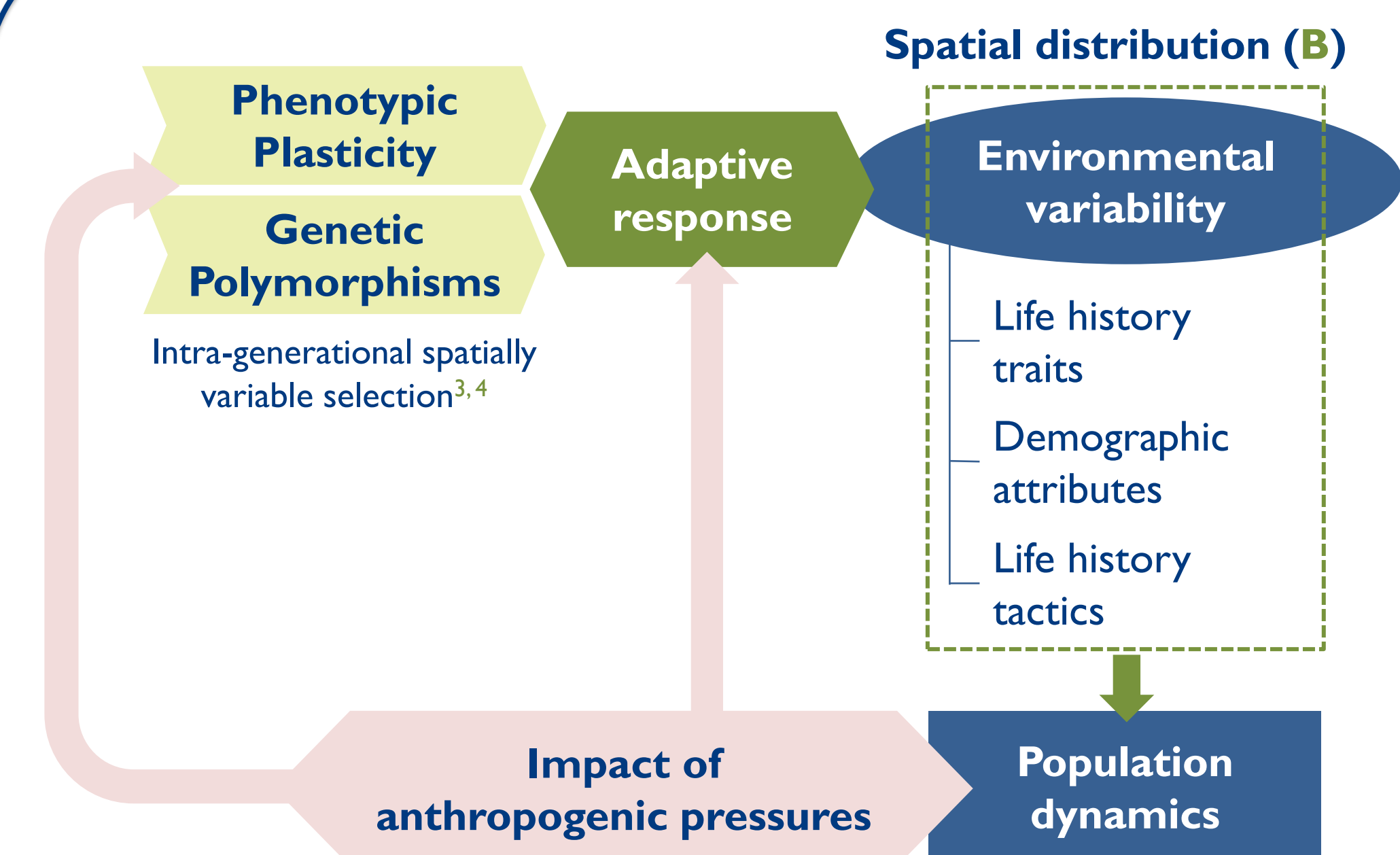
#### A. The life cycle of the European eel



#### B. Spatial patterns of life history traits and tactics at different spatial scales



### 2. Purpose



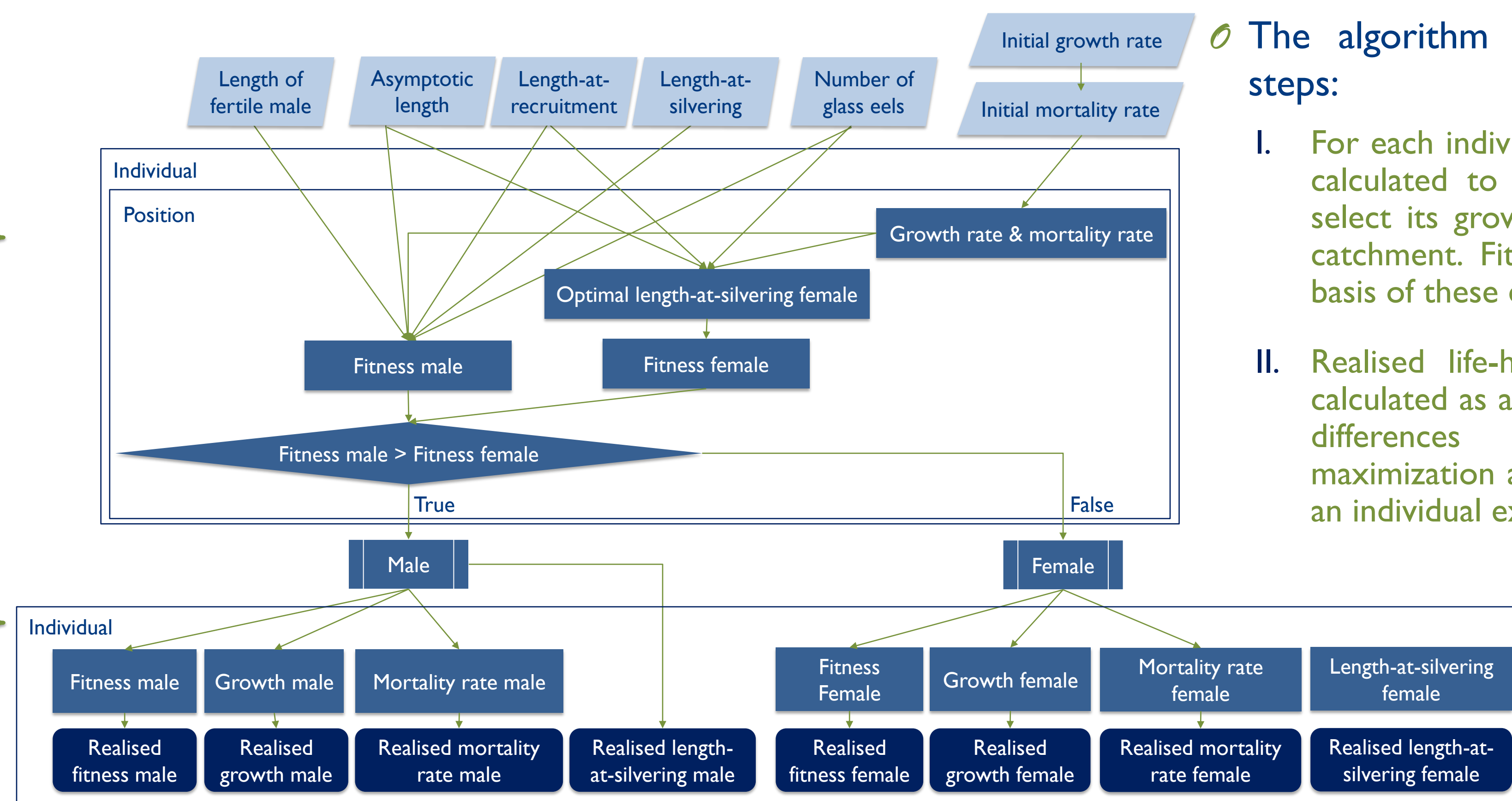
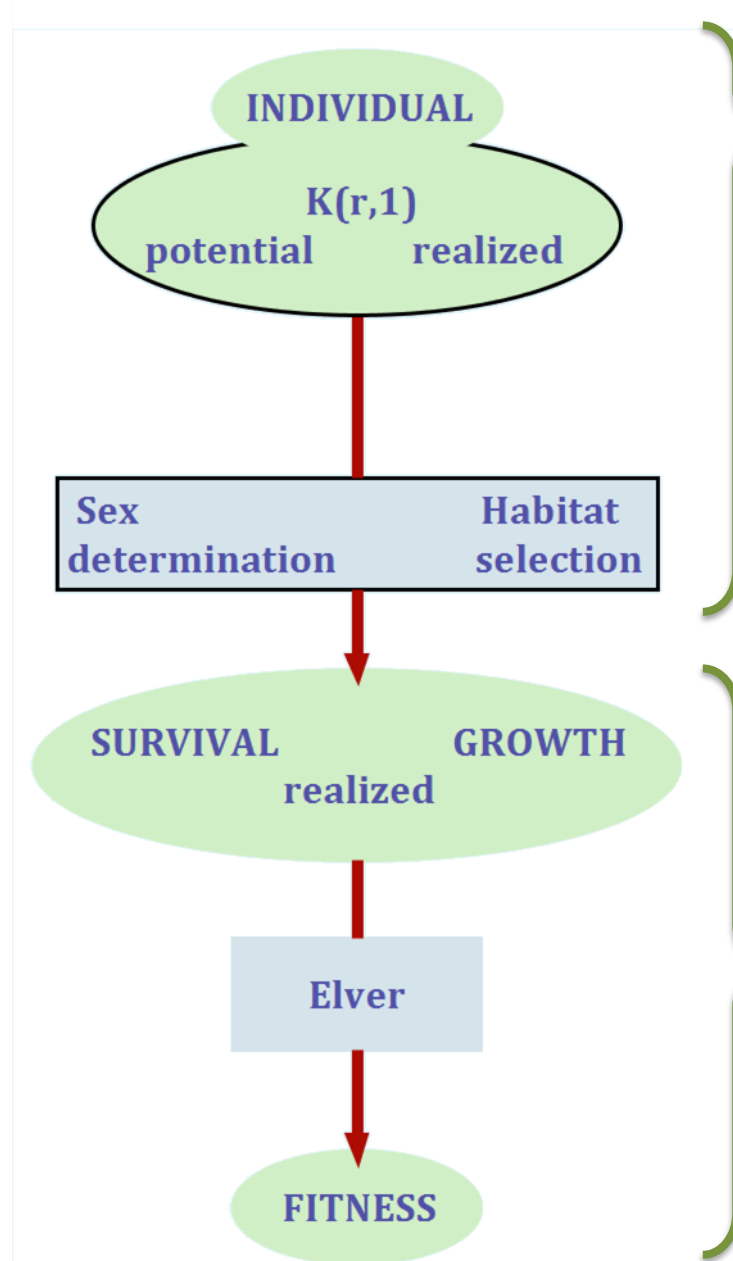
- Are phenotypic plasticity and genetic polymorphisms adaptive responses to variable environment?
- How these adaptive responses affect the impact of anthropogenic pressures on population dynamics?

### 3. Building the optimality model GenEvEel 1.0.

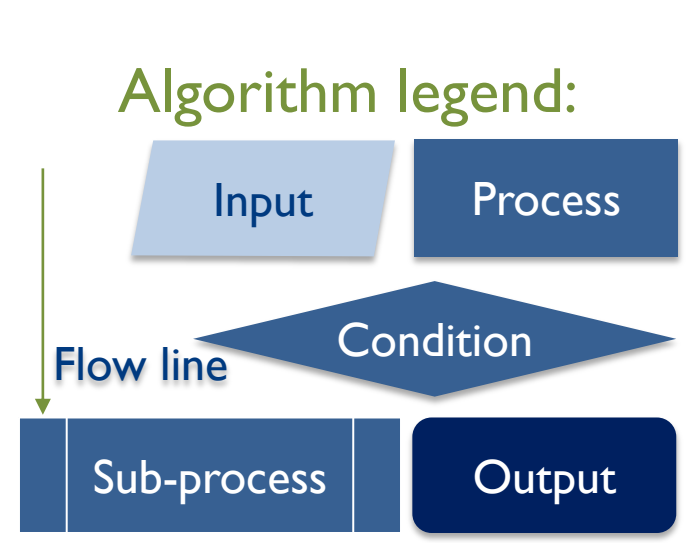
- Applying pattern-oriented modelling approach<sup>1</sup>, spatial patterns of model output are compared with those observed in real river catchment:

- Higher density downstream than upstream<sup>2</sup>.
- Male-biased sex ratio downstream and female-biased sex ratio upstream<sup>2</sup>.
- Faster growth rates in downstream than those from upstream<sup>3,4</sup>.
- Higher length-at-silvering upstream than downstream<sup>2</sup>.

- Flowchart outlining the work-flow for using GenEvEel 1.0.:



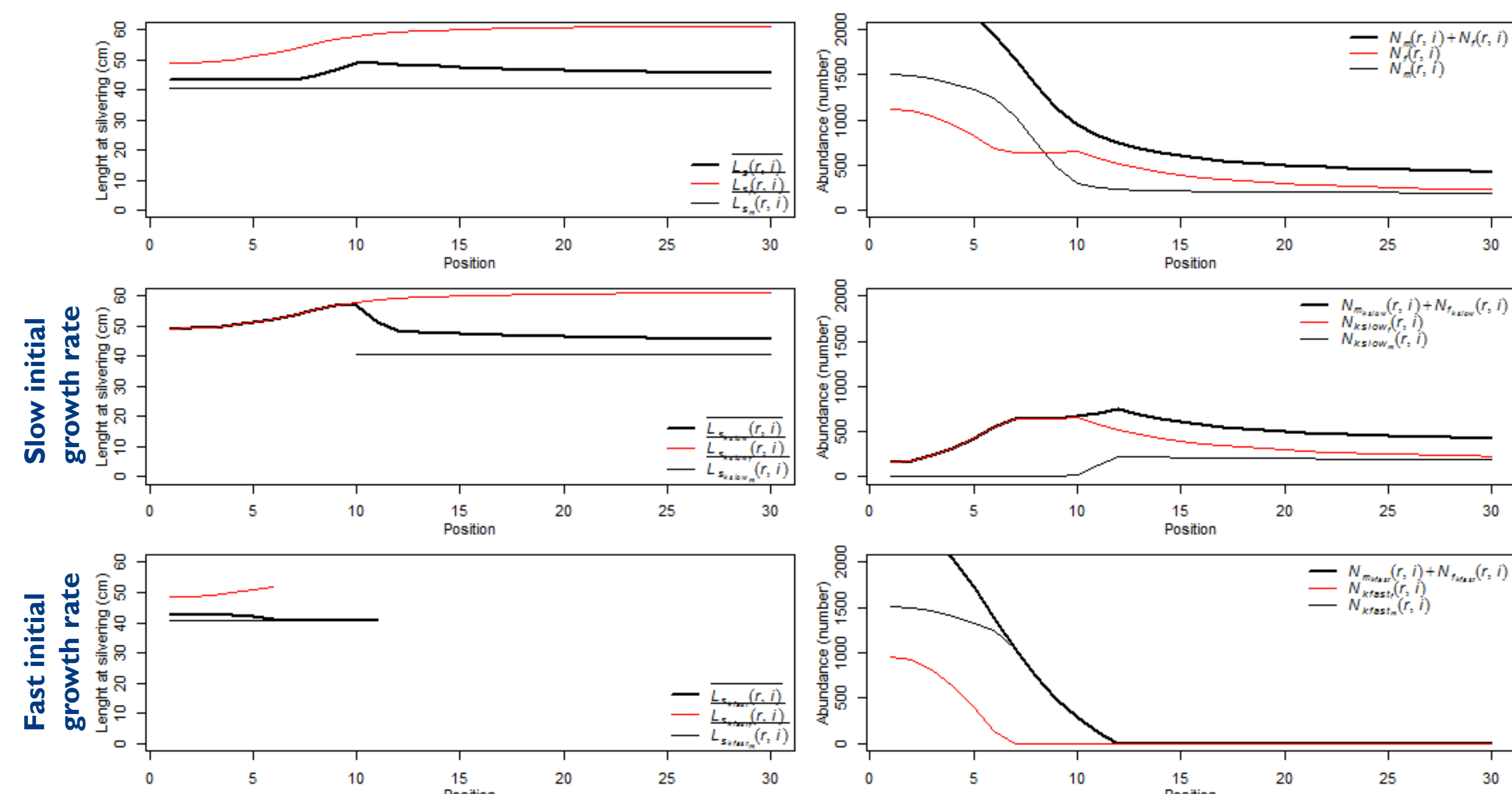
- The algorithm proceeds in two steps:
  - For each individual, potential fitness is calculated to determine its sex and select its growth habitat in the river catchment. Fitness-maximization is the basis of these decisions.
  - Realised life-history traits are then calculated as a combination of genetic differences in growth, fitness maximization and density-dependence an individual experiences.



### 4. First results

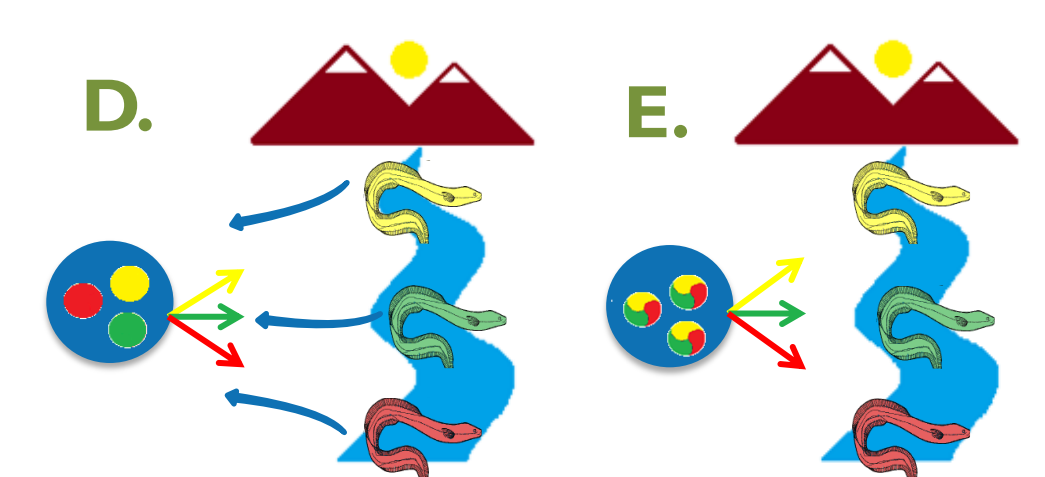
- The model mimics the four spatial patterns (C):
  - There are more individuals in downstream than upstream section of river.
  - Males are more concentrated in downstream section of river while females are concentrated in upstream section of river.
  - Individuals in downstream tend to grow fast and mature early (lower length-at-silvering). Individuals in upstream grow slowly and mature older (higher length-at-silvering).
  - Silver eels are smaller downstream than upstream.

#### C. Length-at-silvering and abundance by sex (red line, females; black line, males) and all initial growth rates



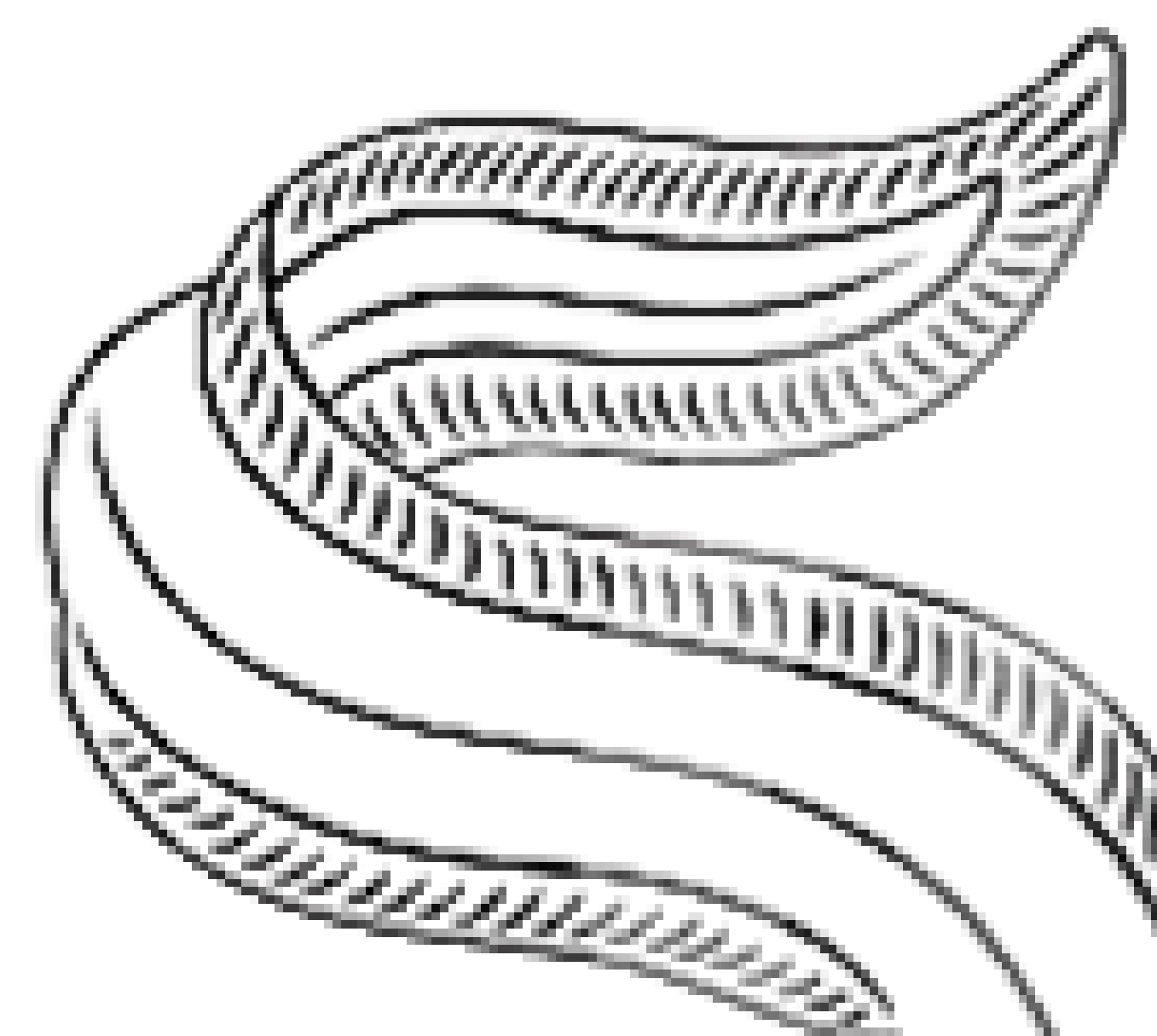
These results suggest that...

Intra-generational spatially variable selection (D) and phenotypic plasticity (E) could be two complementary adaptive mechanisms that explain different spatial patterns in terms of length-at-silvering, sex-ratio and habitat use.



### 5. Perspectives

- A second version of GenEvEel will be developed to assess the impacts of anthropogenic pressures (habitat fragmentation, pollution or fishing) in terms of spawning biomass and population's demographic attributes.
- Finally, the model will be calibrated and validated on a real study case, such as the Garonne-Dordogne catchment.
- Hopefully, this model could be used as decision-support system to help management of this resource.



This study is supported by IRSTEA-EDF HYNES

Life History Theory,  
27<sup>th</sup> September - 2<sup>nd</sup> October, 2015  
University of Groningen

1. Grimm, V., and Railsback, S. 2012. Pattern-oriented modelling: A "multi-scale" for predictive systems ecology. *Philos. Trans. R. Soc. B Biol. Sci.* 367, 298–310.

2. Drouineau, H., Rigaud, C., Daverat, F., and Lambert, P. (2014). EvEel (evolutionary ecology-based model for eel): a model to explore the role of phenotypic plasticity as an adaptive response of three temperate eels to spatially structured environments. *Can. J. Fish. Aquat. Sci.* 71, 1561–1571.

3. Côté, C.L., Pavey, S.A., Stacey, J.A., Pratt, T.C., Castonguay, M., Audet, C., and Bernatchez, L. (2015). Growth, Female Size, and Sex Ratio Variability in American Eel of Different Origins in Both Controlled Conditions and the Wild: Implications for Stocking Programs. *Trans. Am. Fish. Soc.* 144, 246–257.

4. Pavey, S.A., Gaudin, J., Normandeau, E., Dionne, M., Castonguay, M., and Audet, C. (2015). RAD Sequencing Highlights Polygenic Discrimination of Habitat Ecotypes in the Panmictic American Eel. *Current Biology* 25, 1–6.