INRAE

Quantification of land-sea nutrient fluxes supplied by allis shad across the species'range

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REVE Shad'EAUNA Interreg Atlantic Area European Regional Development Fund EUROPEAN UNION DiadES

LOCAL AND GLOBAL INITIATIVES:

HOW SCIENCE SUPPORTS MANAGEMENT ACTIONS ON DIADROMOUS FISH

INTRODUCTION

Changes in land and sea use (habitat loss and degradation)

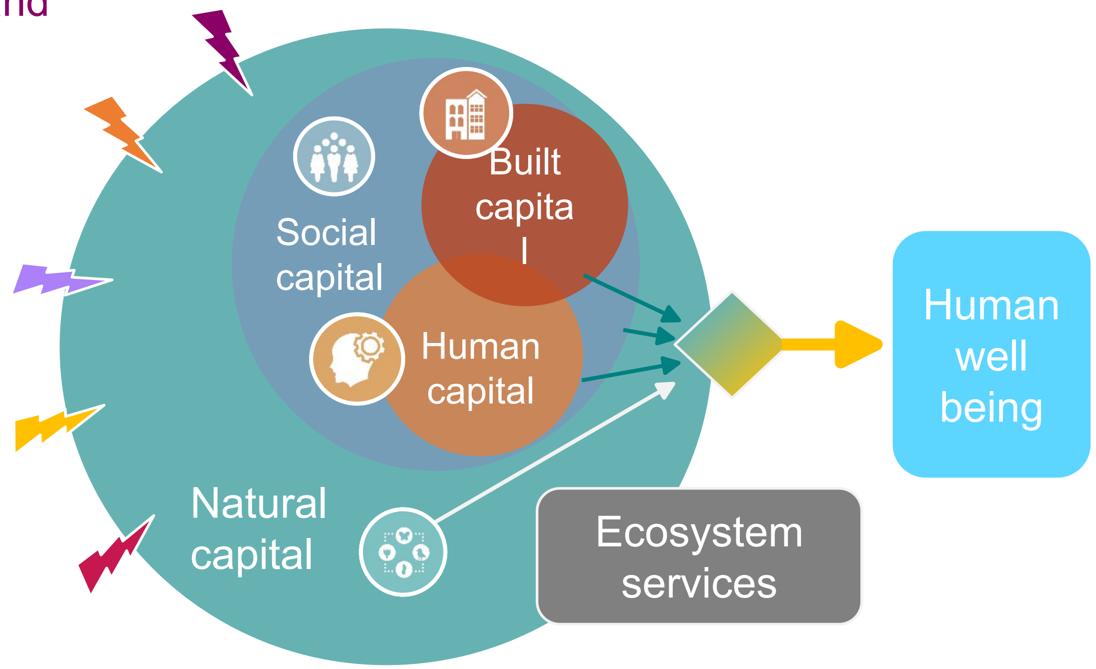
Species overexploitation

Pollution

Invasive species

Climate change

(WWF 2020 Report)

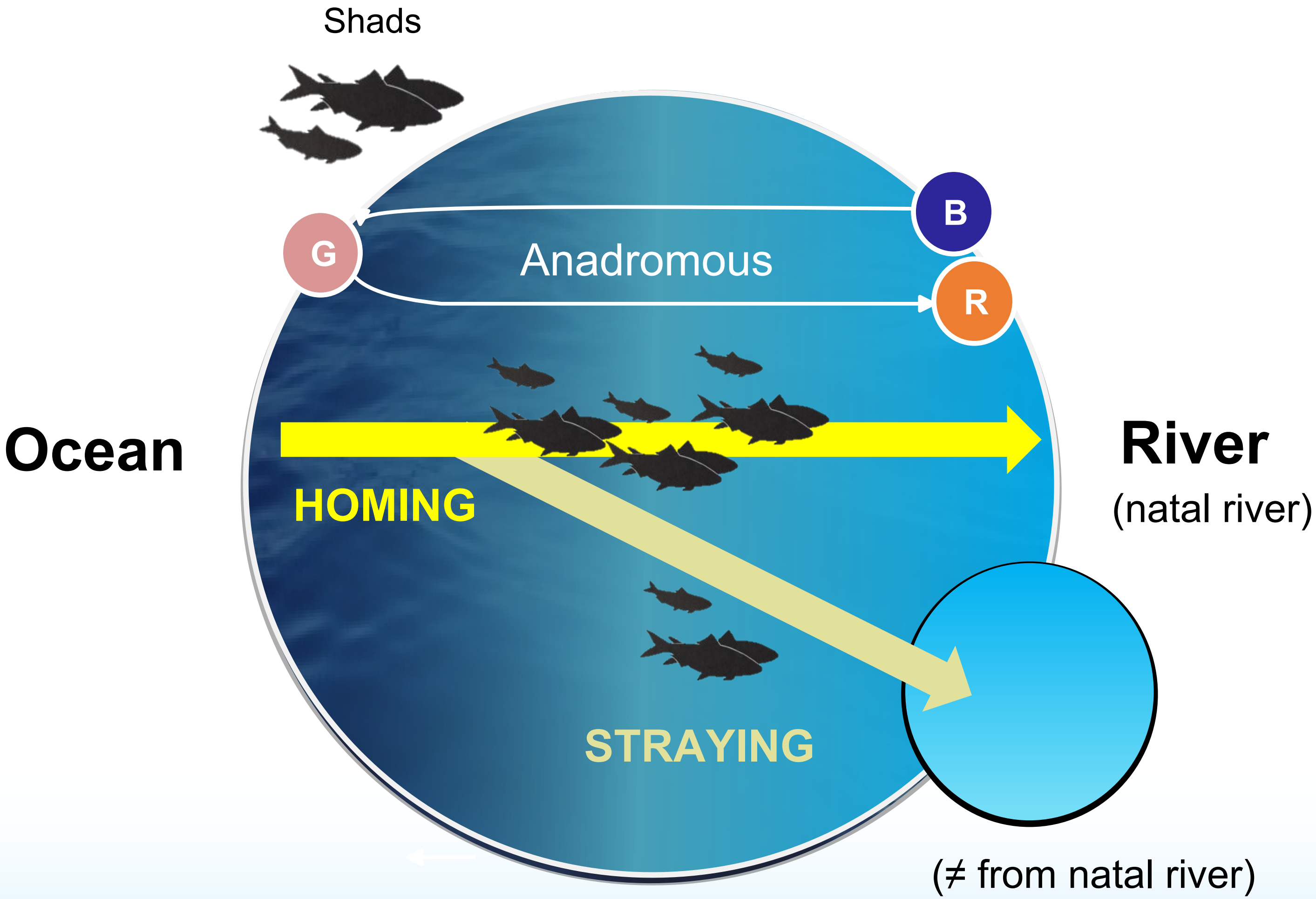


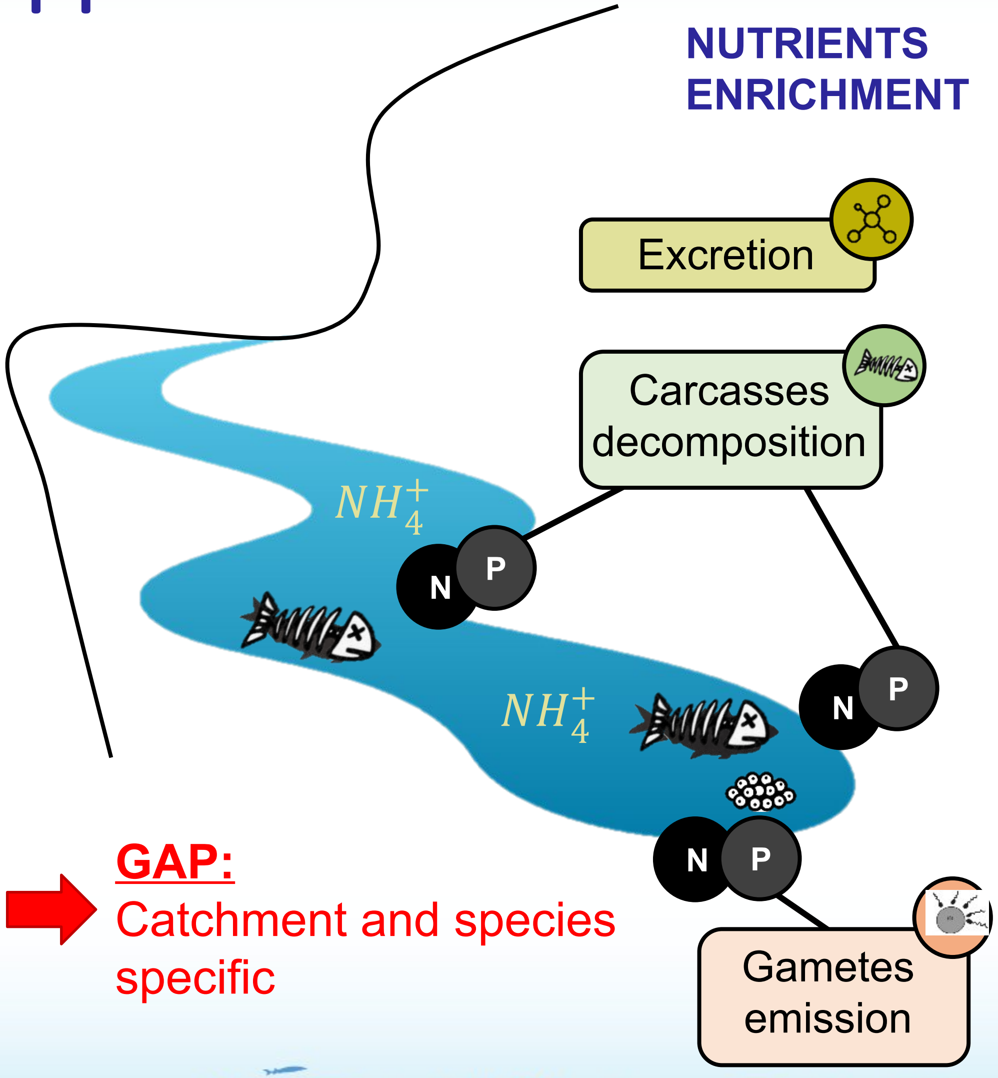
Costanza et al. (2014)

Adapted from Limburg et al. (2009)

INTRODUCTION

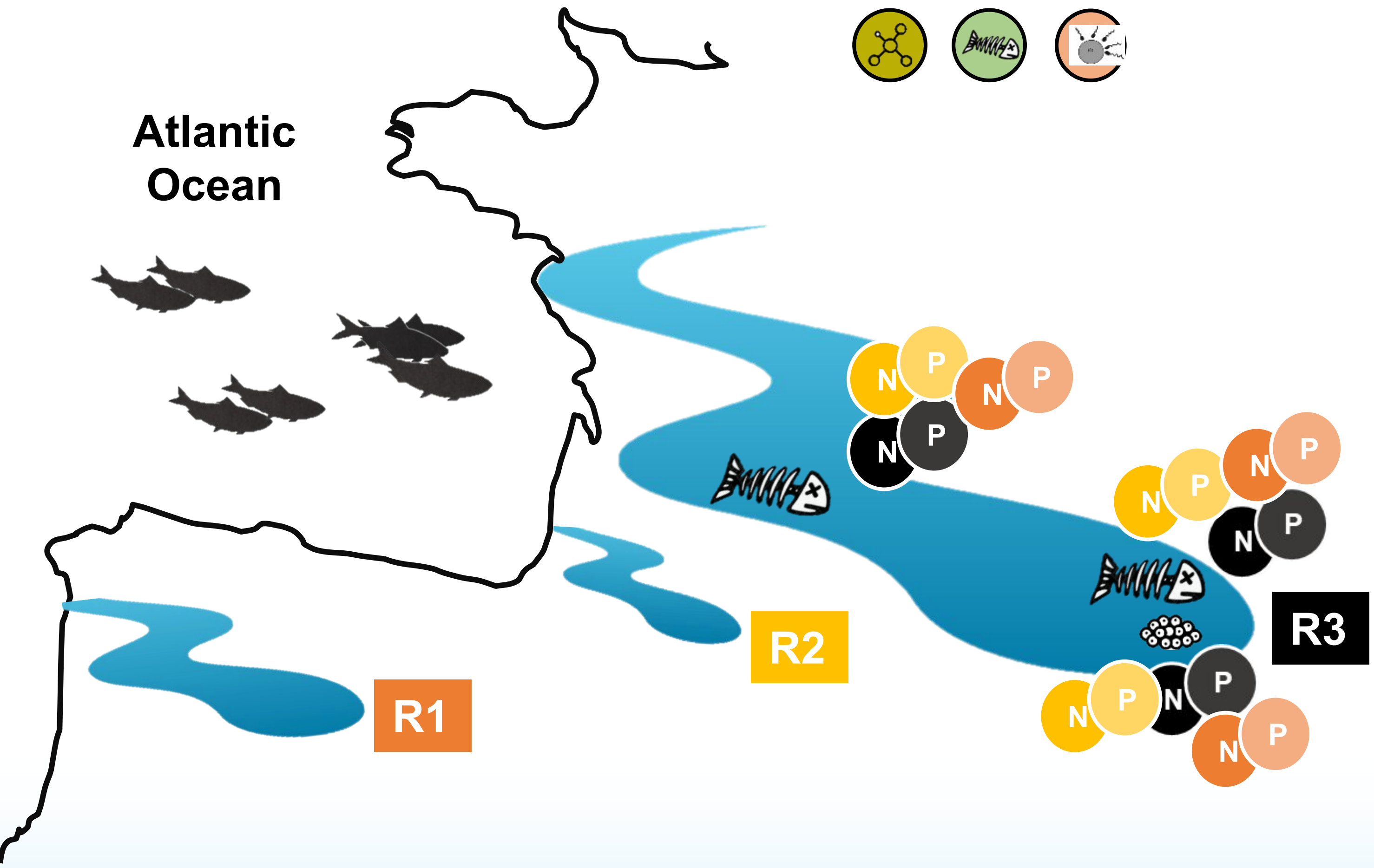
Shad as cross-borders nutrients suppliers





GAP:
Catchment and species specific

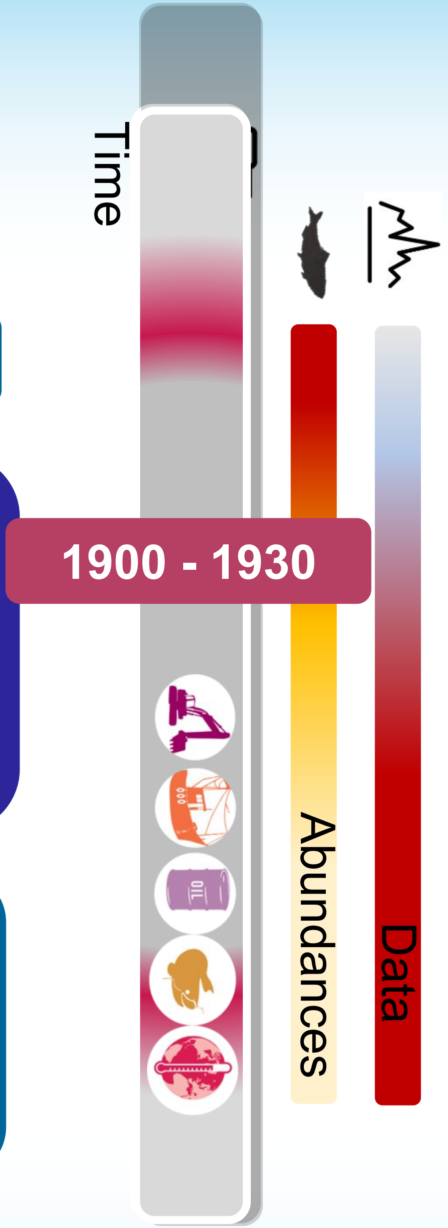
INTRODUCTION
Objectives



Source-sink dynamics

Provide a first estimates of the potentiel for allis shad to transport N and P into European rivers

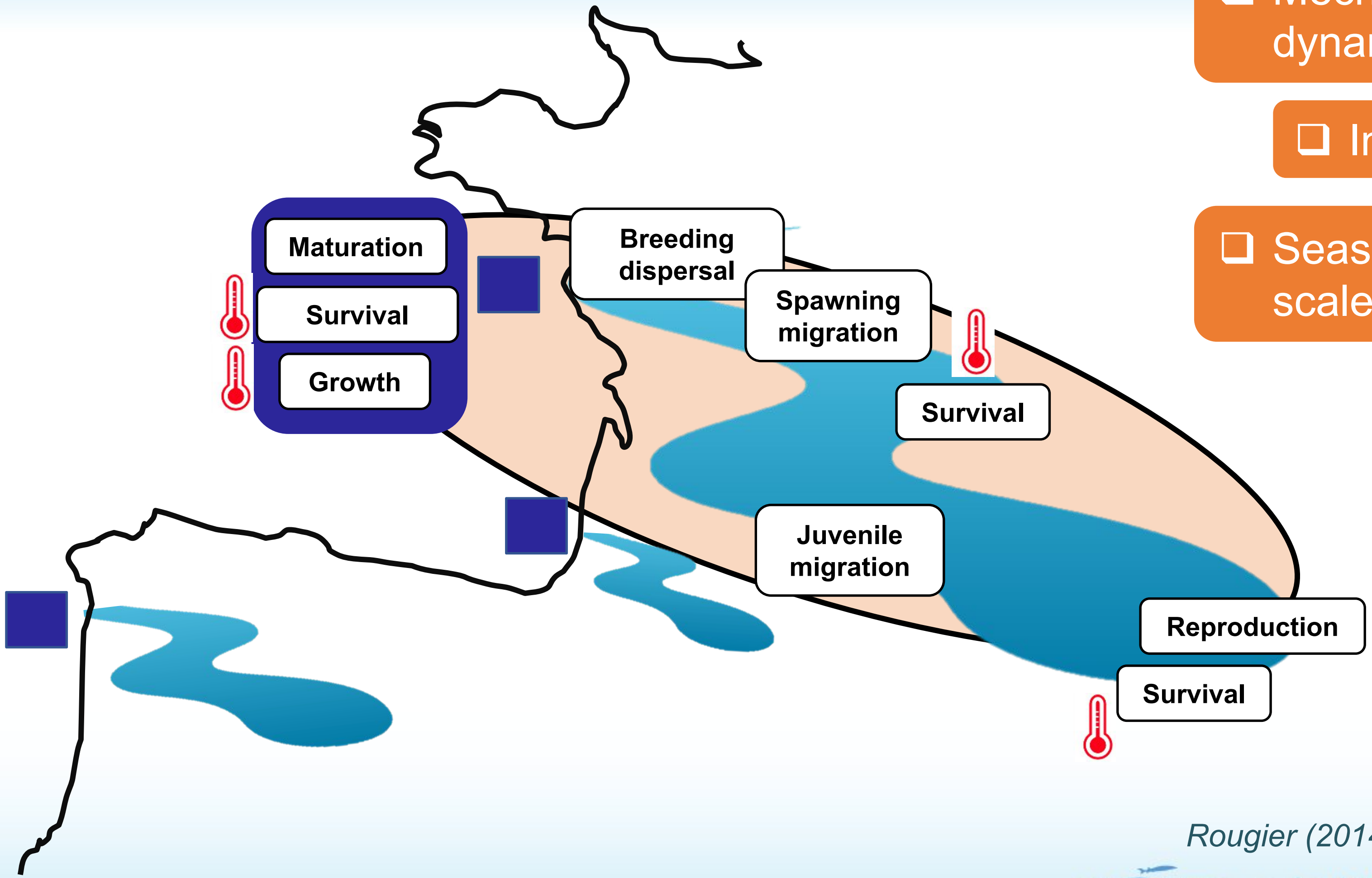
Nutrient balance (Adults import and out-migrating juvenile exports)



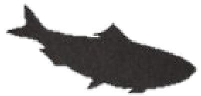
Poulet et al. (2021)

METHODS

Species distribution model (GR3D)



- ❑ Mechanistic (population dynamics)
  - ❑ Individual-based
- ❑ Seasonal and temporal scales



ID
Sex
Age
Length
Weigth

Rougier (2014); Rougier et al. (2014, 2015)

METHODS

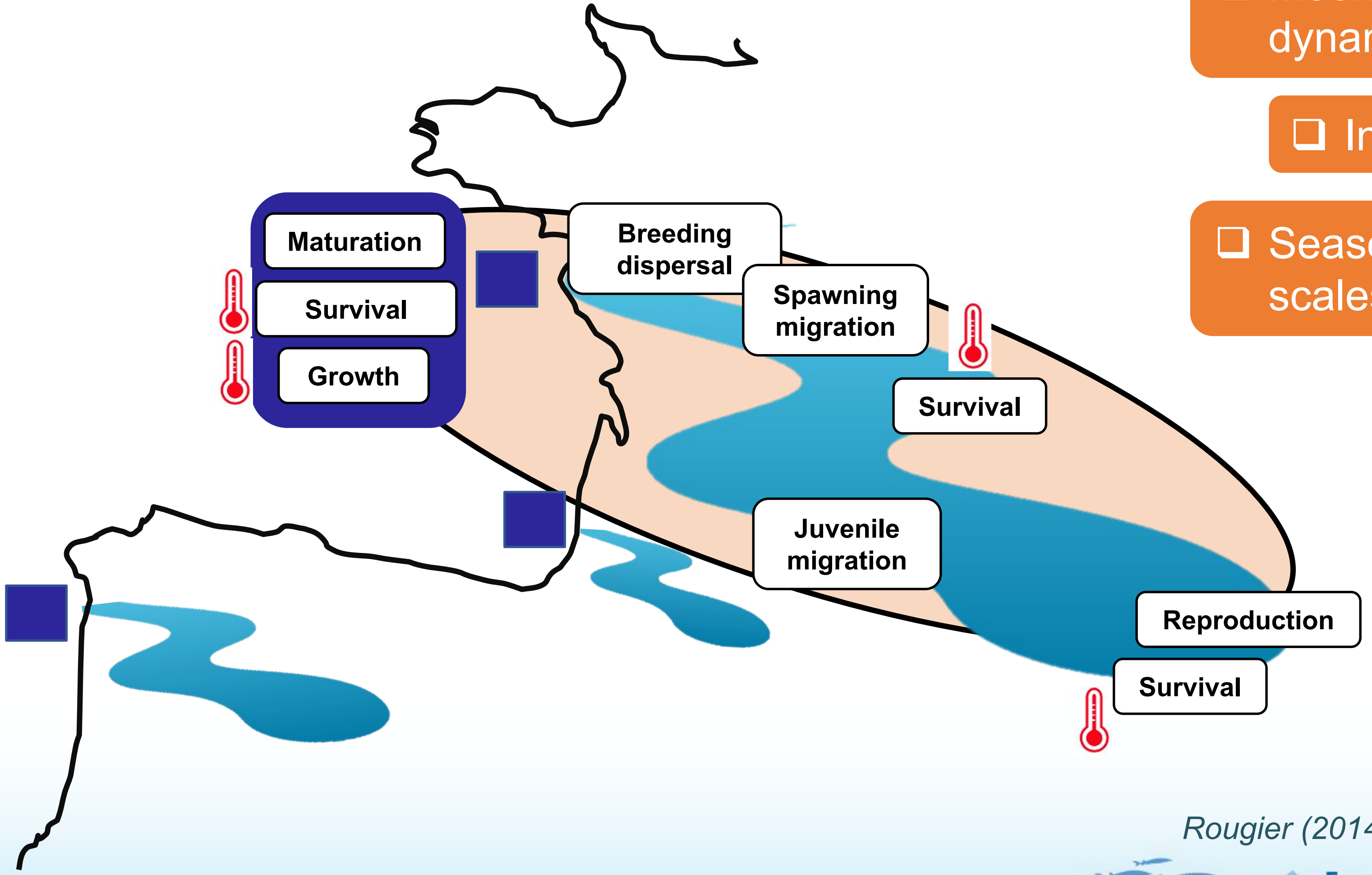
Species distribution model (GR3D)

Tem ture tim ies

esen abse

Bio cal pro es

(e.g., age at first maturity, homing rate, growth coefficient)



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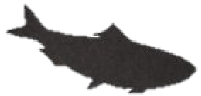

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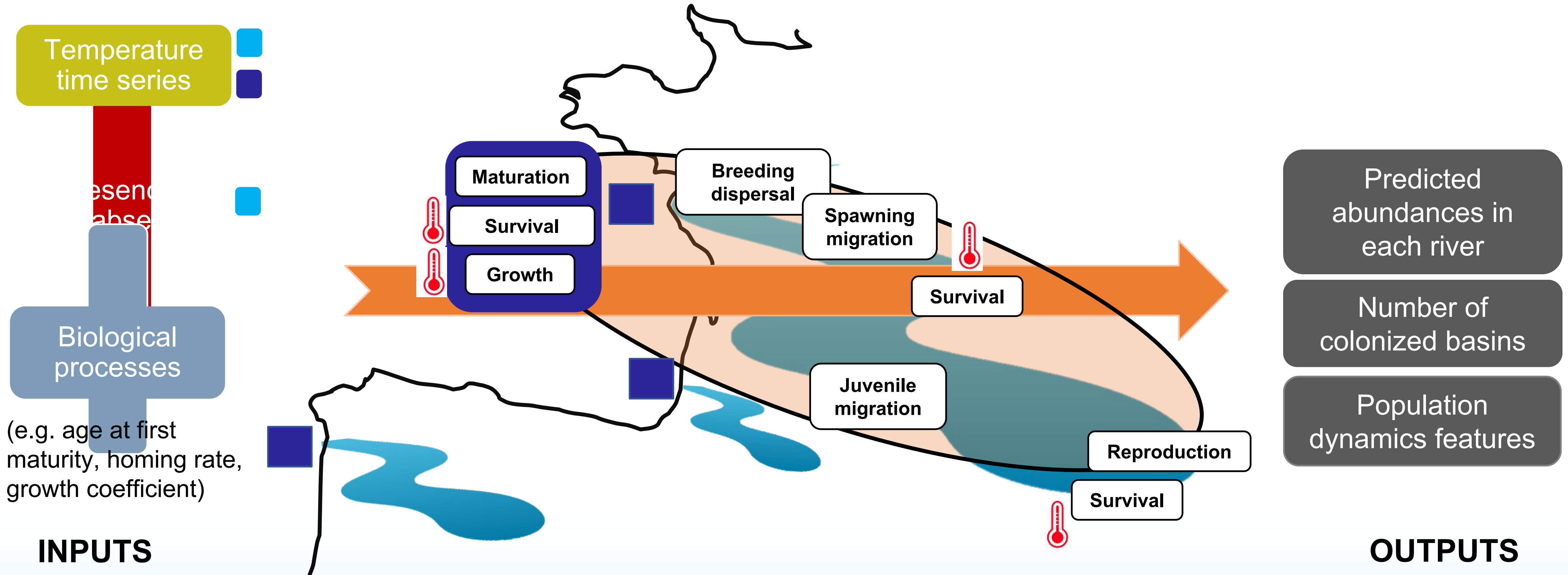
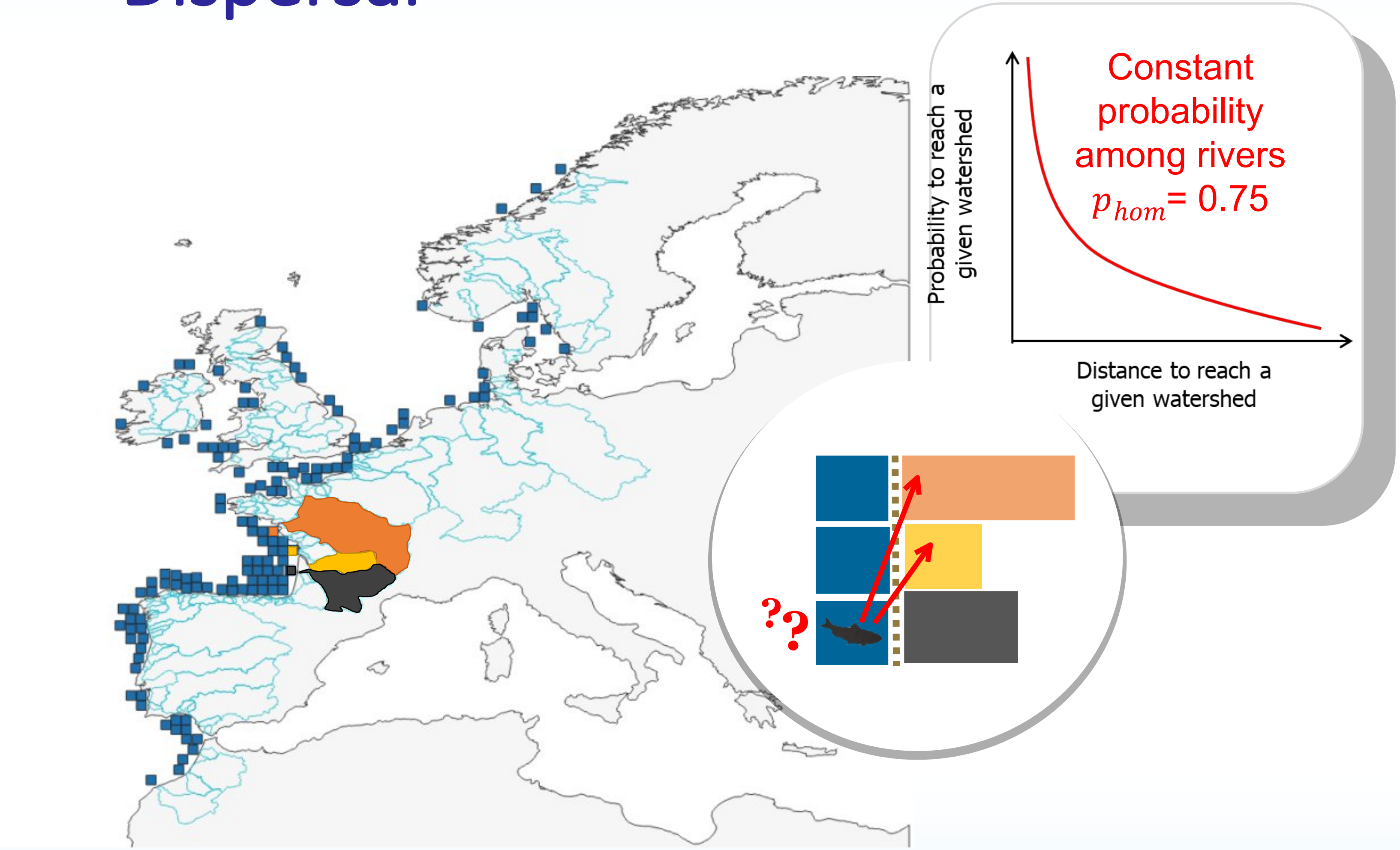
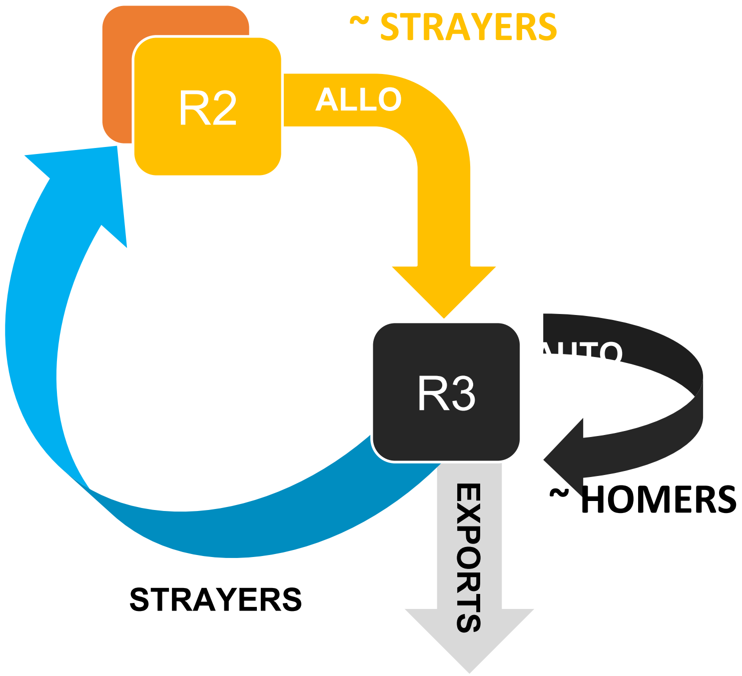


Rougier (2014); Rougier et al. (2014, 2015)

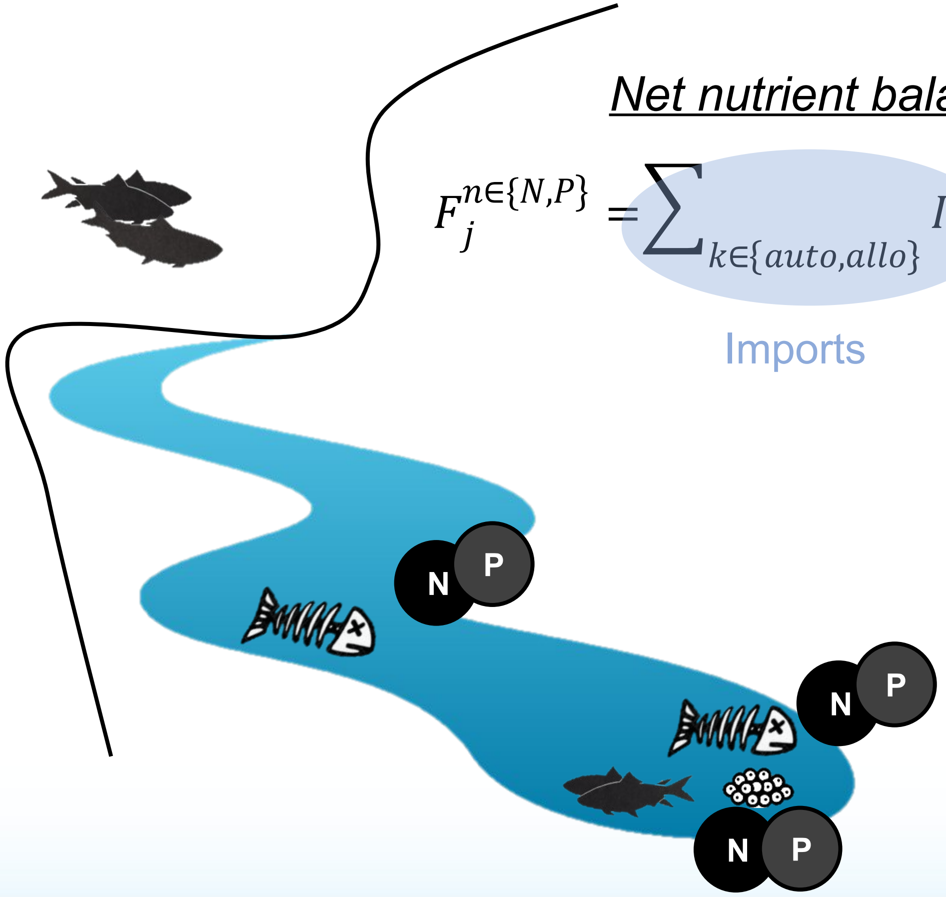
METHODS
Dispersal





Poulet et al. (2021)

METHODS
Nutrients routine



Net nutrient balance

$$F_j^{n\in\{N,P\}} = \sum_{k\in\{auto,allo\}} I^n_{k,j} - E^n_j$$

Imports Exports

Adult imports

$$I^n_{k,j} = Id^n_{k,j} + Is^n_{k,j}$$

$$Id^n_{k,j} = \sum_{s\,\in\{male,\,female\}} Nd_{k,s,j} \times W_s \times (\eta^n_s + RT \times \tau^n)$$

$$Is^n_{k,j} = \sum_{s\,\in\{male,\,female\}} Ns_{k,s,j} \times W_{g,s} \times \left(\eta^n_{g,s} + RT \times \tau^n\right)$$

Abundances | Weigth | Nutrient content | Residence time | Excretion rate

Juvenile exports

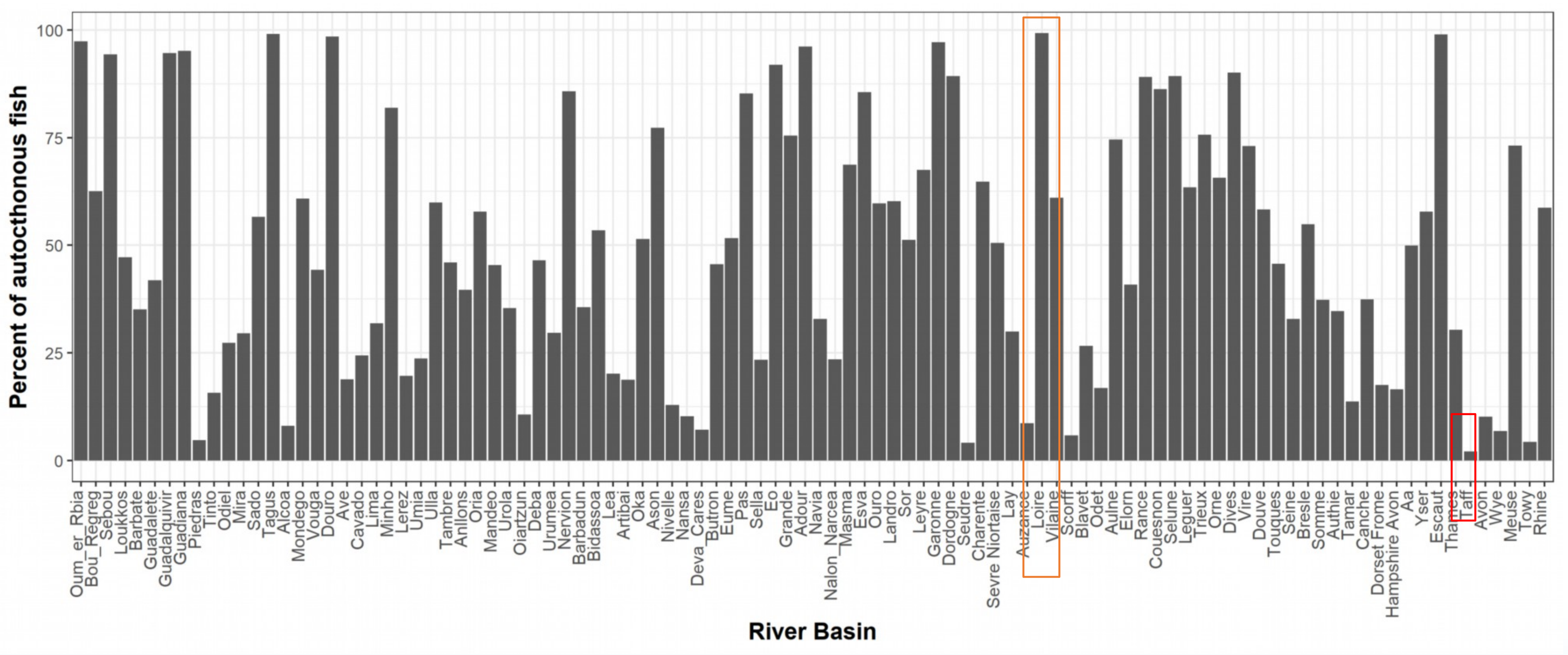
$$E^n_j = No_j \times W_O \times \eta^n_O$$

Poulet et al. (2021)

RESULTS

Autochtonous imports

Latitude



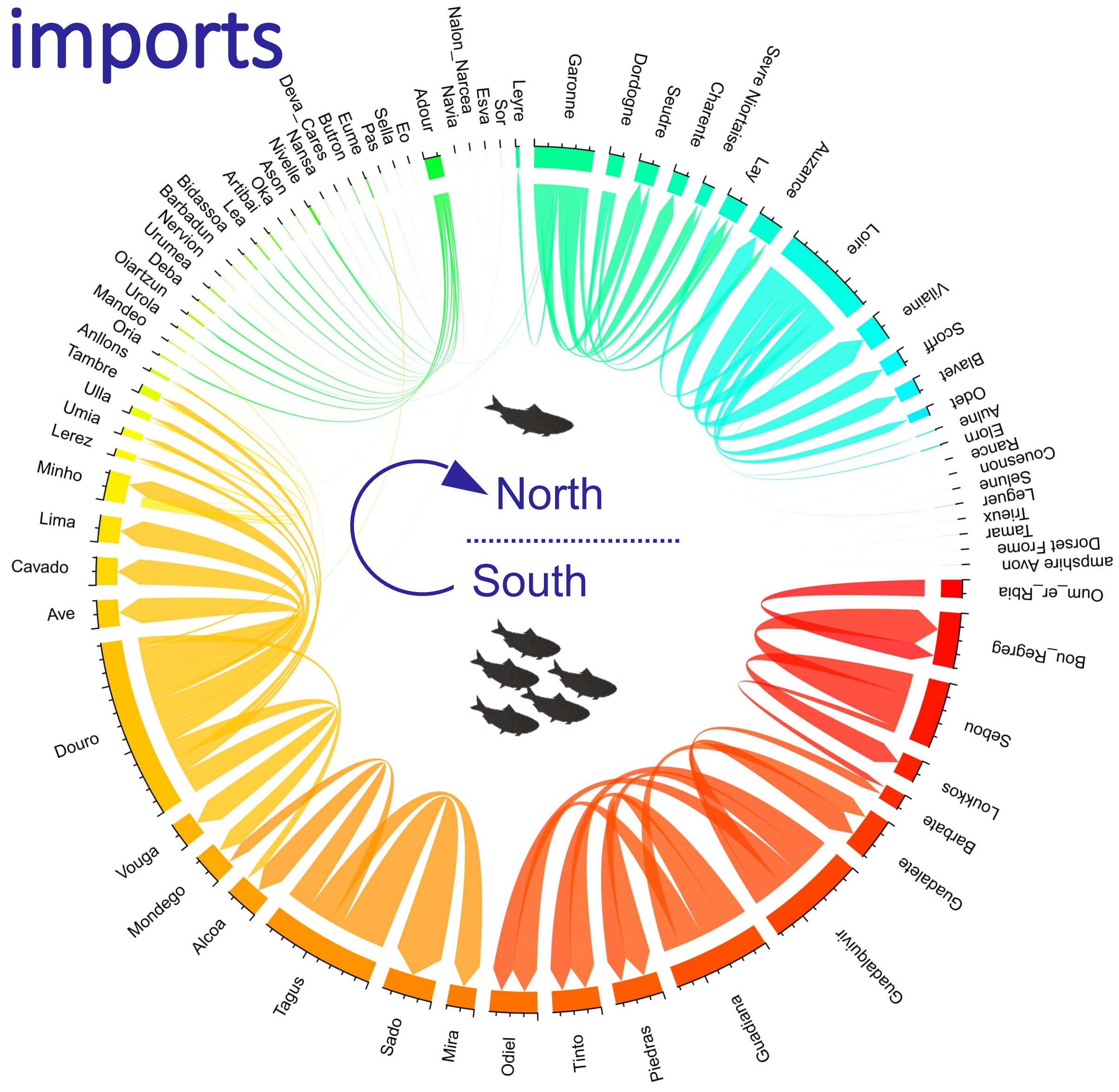
High variability across rivers

Poulet et al. (2021)

RESULTS

Allocthonous imports

- ❑ Each river basin supports the provision of ecosystems services in other locations
- ❑ Driving by size, location and the number of neighboring basins



RESULTS

N

8×10^6 to 1.2×10^4 kg N$\cdot km^{-2} \cdot year^{-1}$

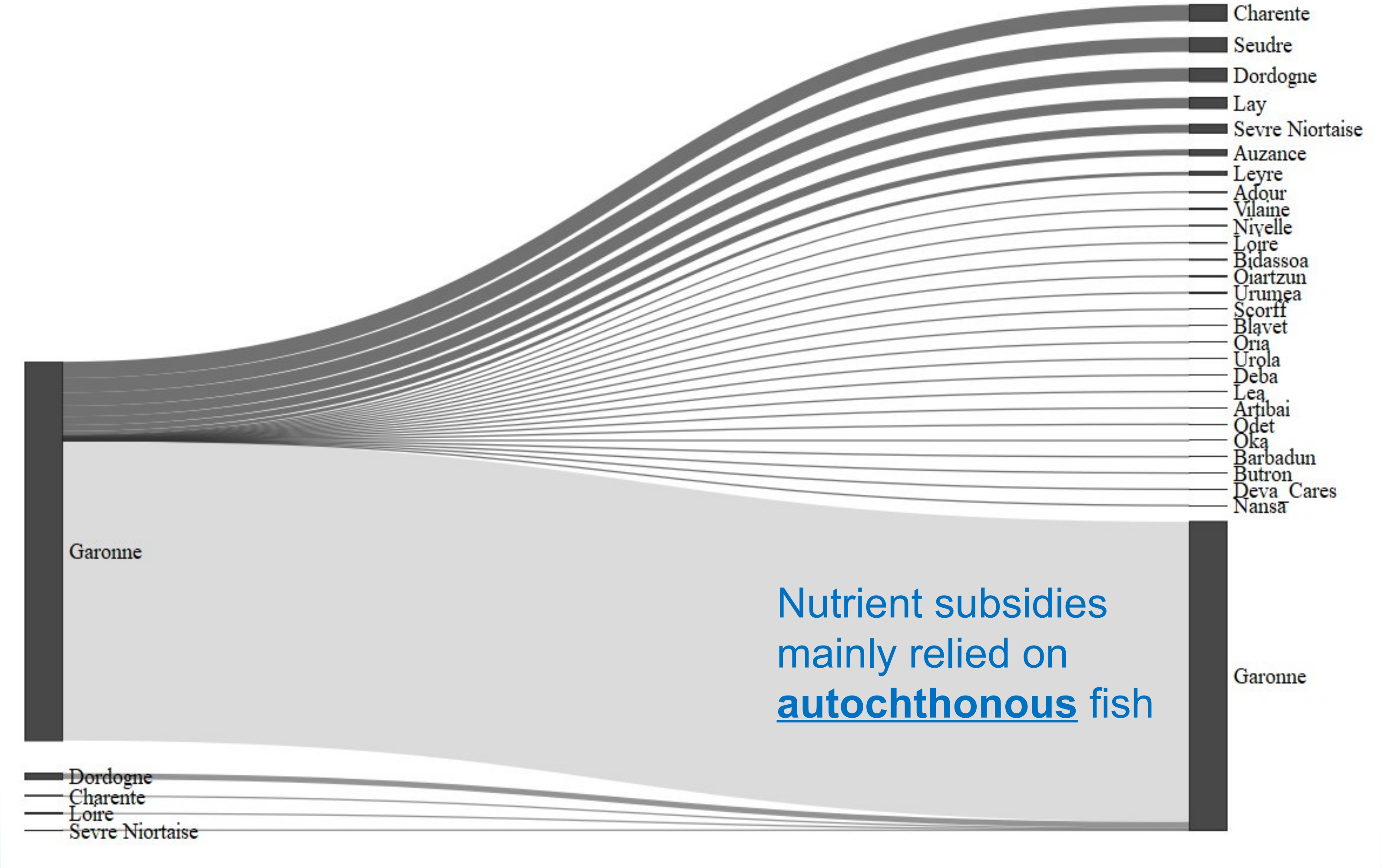
P

1.4×10^6 to 2.1×10^3 kg P$\cdot km^{-2} \cdot year^{-1}$

Poulet et al. (2021)

RESULTS

Focus on the Garonne River



RESULTS

N

0.324 kg ± 0.048 kg $N \cdot km^{-2} \cdot year^{-1}$

P

0.055 kg ± 0.008 kg $P \cdot km^{-2} \cdot year^{-1}$

Low compared to American shad and inputs from upstream *(Haskell 2018; Romero et al. 2013)*

CONCLUSION

- Low contribution compared to other related species and inputs from upstream (e.g., *Haskell 2018; Romero et al. 2013)*

➡ BUT… Concentrated in space and time

- Substantial flow of strayers delivering nutrient subsidies in several rivers

➡ Cross-border cooperative management efforts instead of catchment specific measures *(Semmens et al. 2011; 2018; www. diades.eu)*

PERSPECTIVES

Provide an economic assessment related to these estimates *Short-term*

- Replacement coast *(e.g., Morton et al. 2017)*
- Compensate the loss of shad-derived nutrients imported into inland waters by organic fertilizers

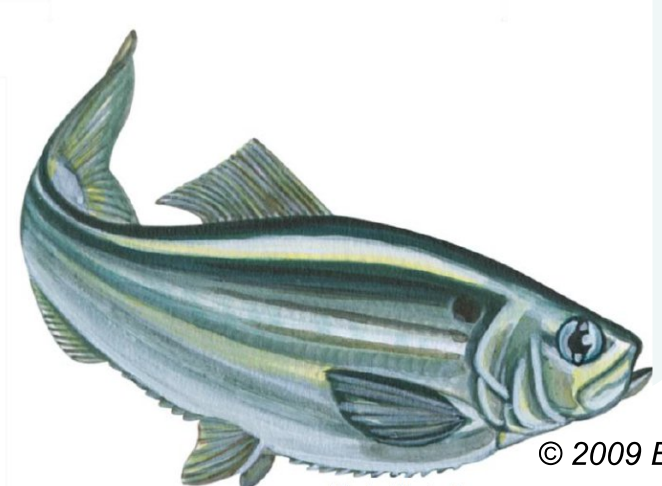
Project these estimates under climate change scenarios *Long-term*

Expected to be reduced by the end of the century considering the predicted reduction in fish body and population sizes

(Daufresne et al. 2009; Twining et al. 2017)

Should we maintain our efforts to ensure a sustainable regulating a service ?

ACKNOWLEDGMENTS



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The Atlantic Area Interreg Project DiadES

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