

Projet MetaPop:

➤ Adaptation, persistence and management of Atlantic salmon metapopulation



Mathieu BUORO & Amaïa LAMARINS

UMR 1224 ECOBIOP, St Pée s/ Nivelle, Pôle MIAME

➤ Dispersal in Atlantic salmon?

Journal of Fish Biology (2003) **62**, 641–657
doi:10.1046/j.0022-1112.2003.00053.x, available online at <http://www.blackwell-synergy.com>

Atlantic salmon straying from the River Imsa

B. JONSSON*,
Norwegian Institute for Nature Research

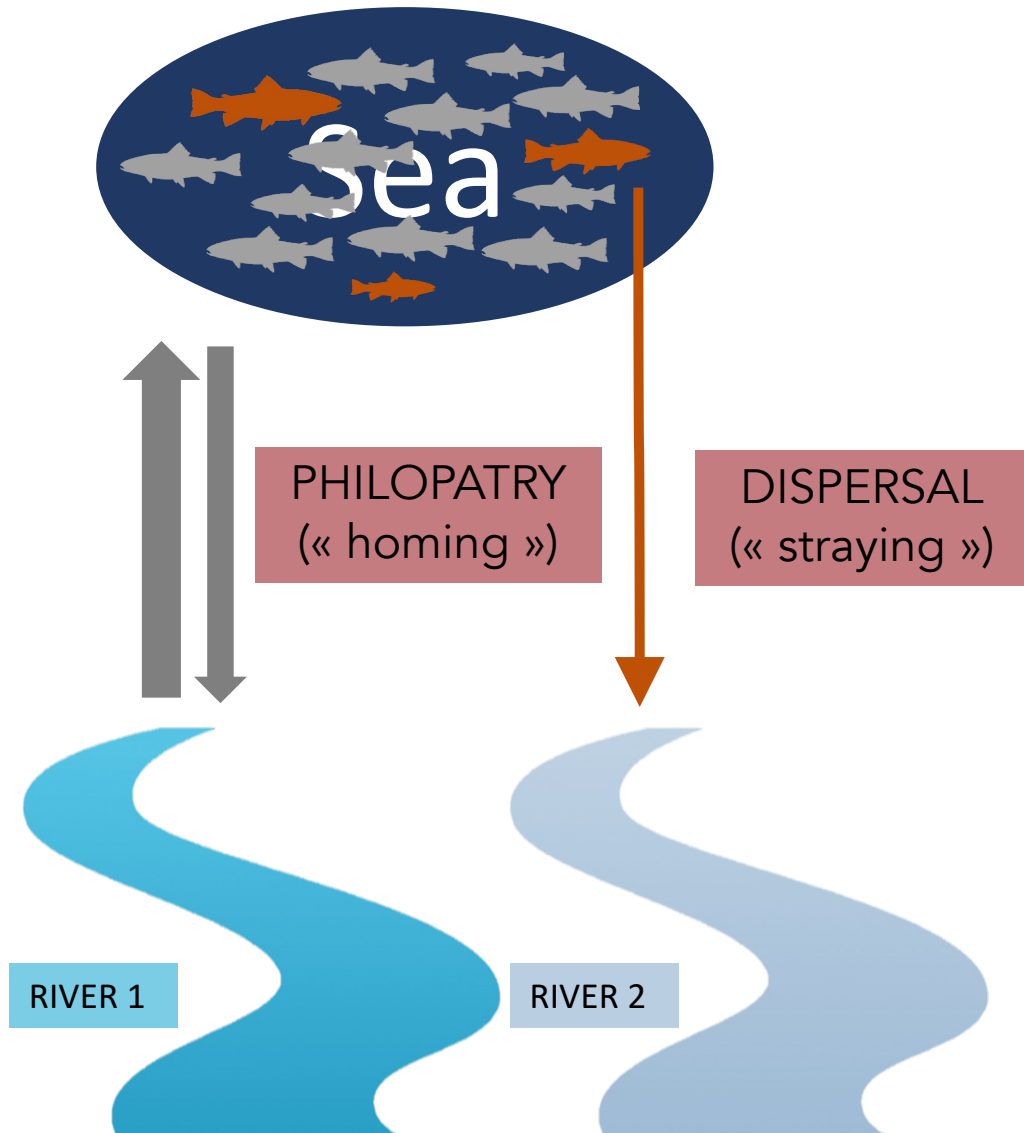
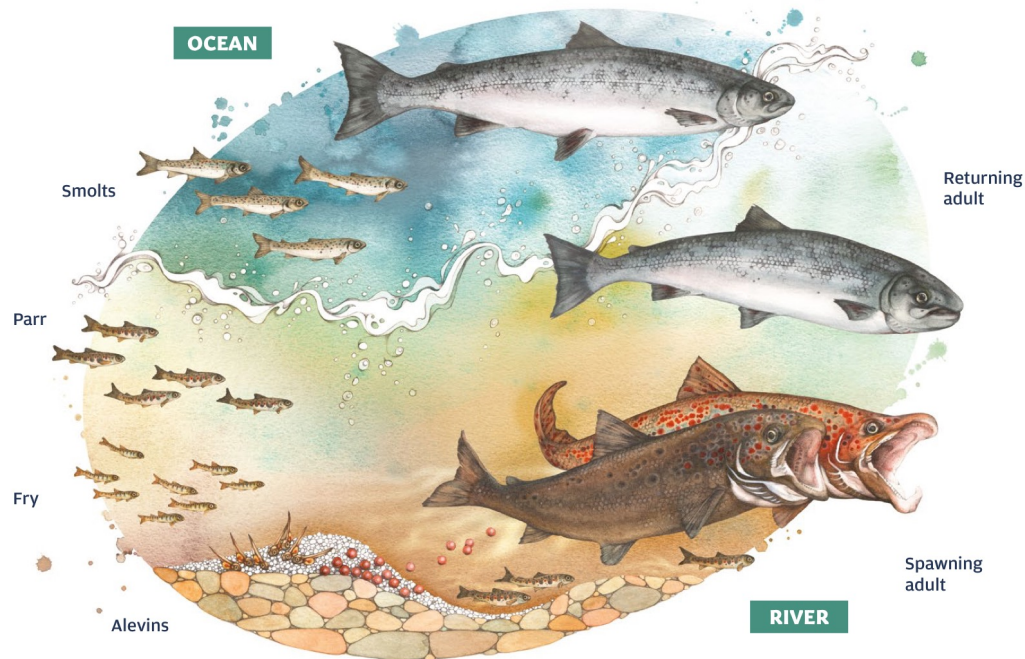
A metapopulation perspective for salmon and other anadromous fish

Nicolas Schtickzelle^{1,2} & Thomas P. Quinn²

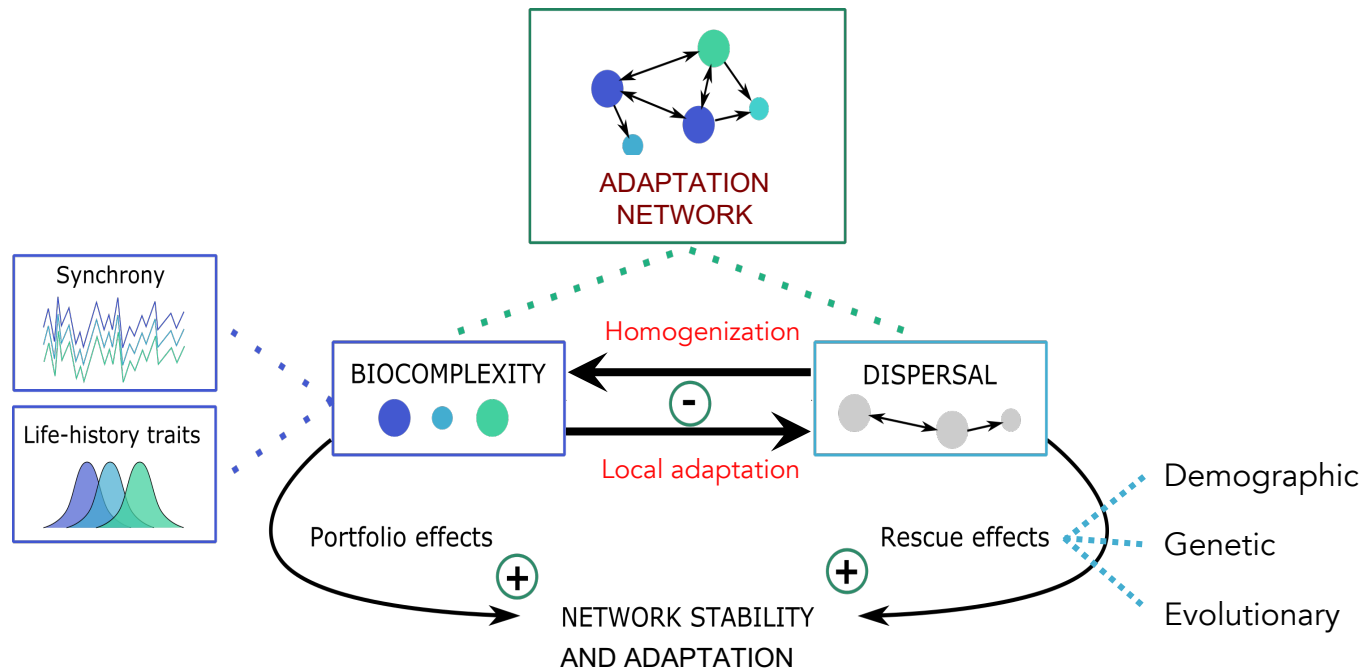
¹Biodiversity Research Centre, Université Catholique de Louvain, 4 Place Croix du Sud, B-1348 Louvain-la-Neuve, Belgium; ²School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, WA 98195-5020, USA

Atlantic salmon life cycle

Salmon at sea

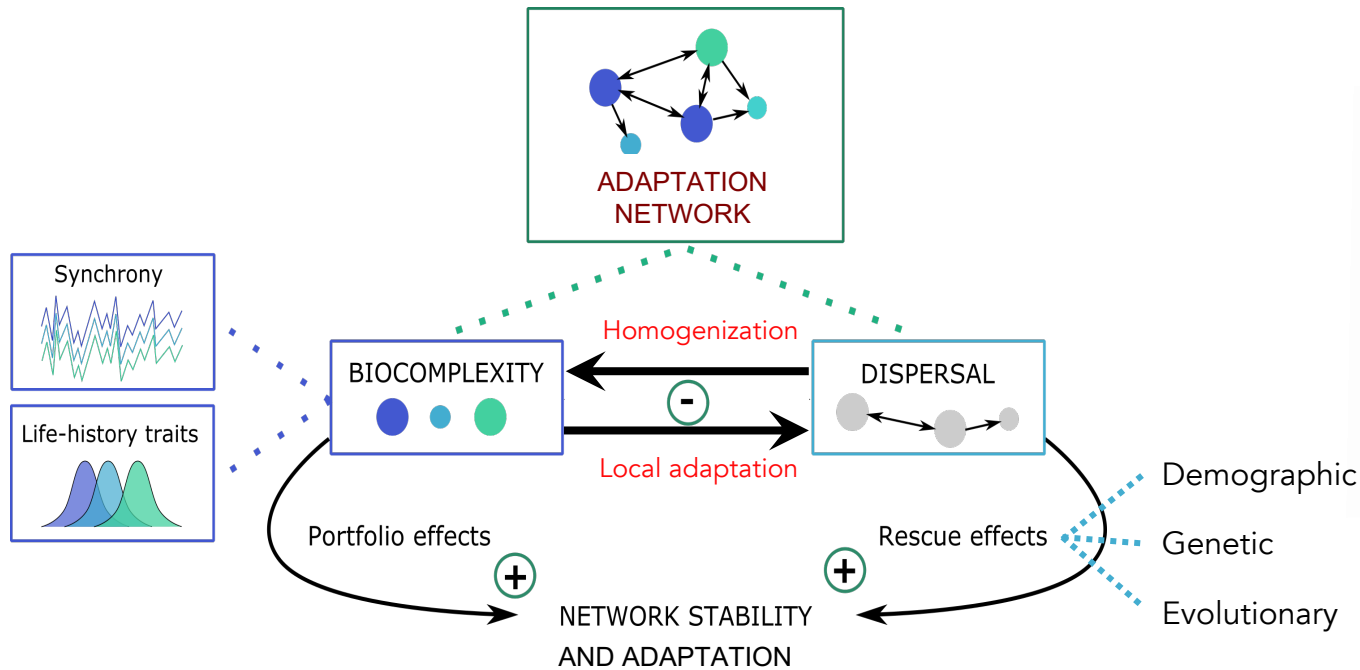


Are there implications of dispersal for the persistence, adaptation and management of Atlantic salmon populations?



How connectivity and diversity influence metapopulation eco-evolutionary dynamics, stability and adaptation?

Are there implications of dispersal for the persistence, adaptation and management of Atlantic salmon populations?



The dangers of ignoring metapopulation structure for the conservation of salmonids

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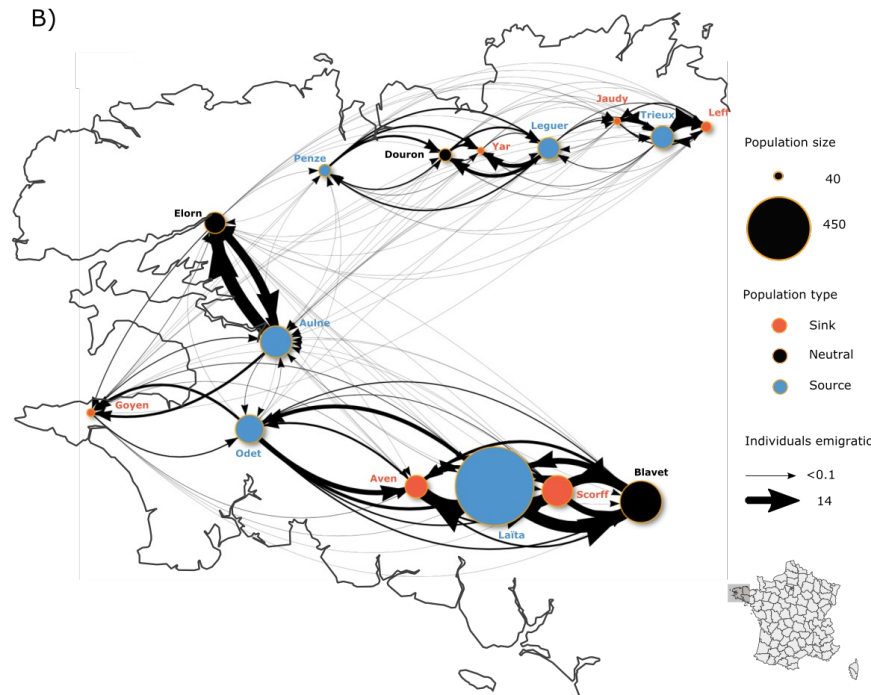
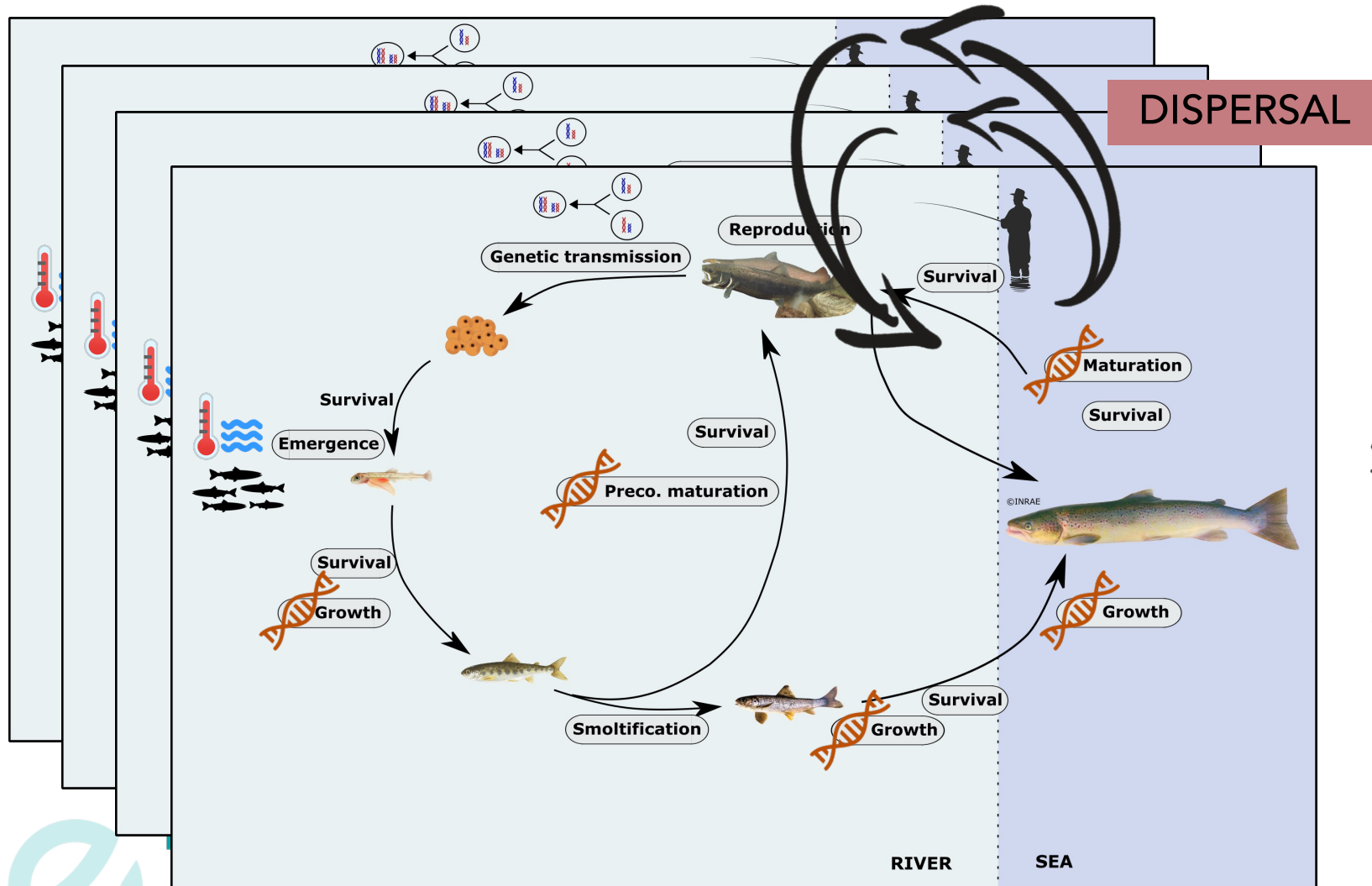
How connectivity and diversity influence metapopulation eco-evolutionary dynamics, stability and adaptation?

INRAE

Are there management practices that meet both conservation and exploitation objectives by considering metapopulation structure?

➤ Demo-Genetic approach

IBASAM (Individual Based Atlantic SALmon Model)... Towards MetaIBASAM

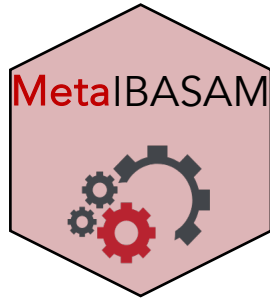
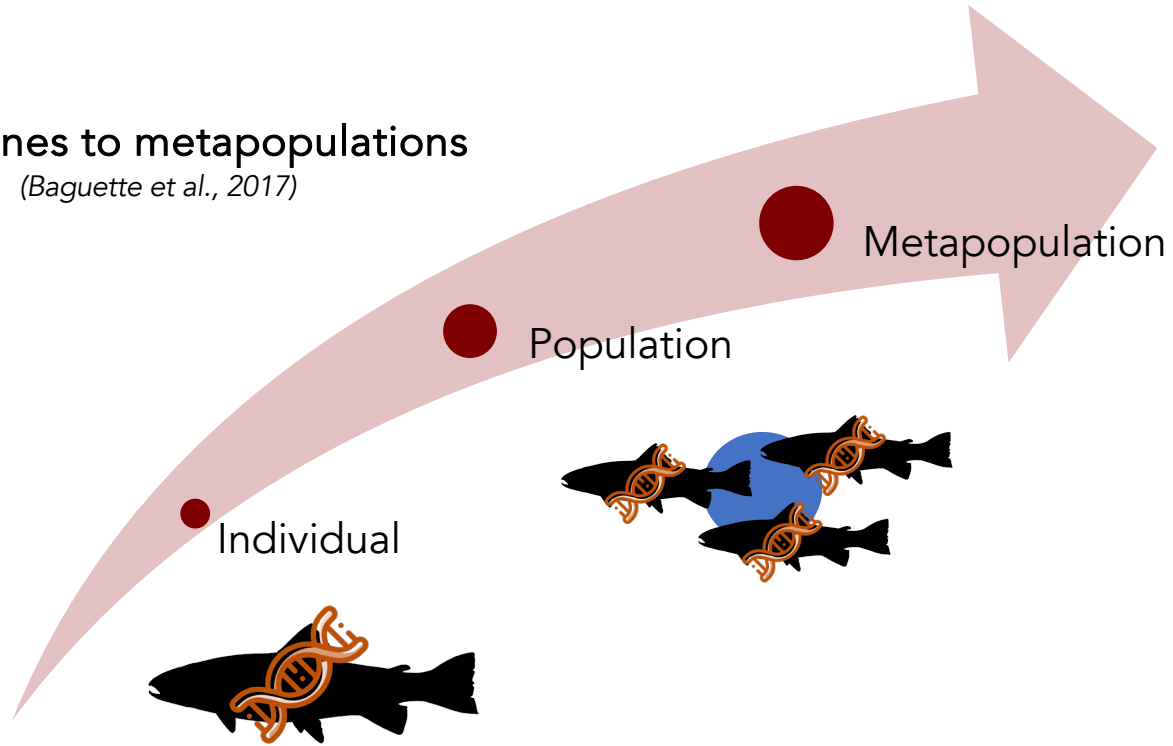


> Demo-Genetic approach

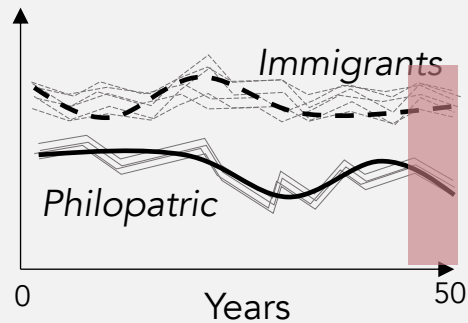
IBASAM (Individual Based Atlantic SALmon Model)... Towards MetaIBASAM

From genes to metapopulations

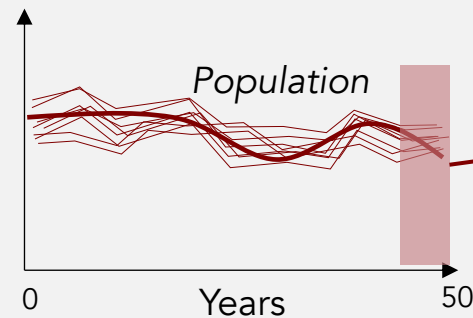
(Baguette et al., 2017)



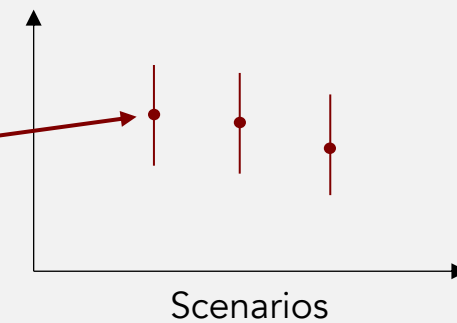
Pheno/genotypic trait



Population demography



Metapopulation demography / trait

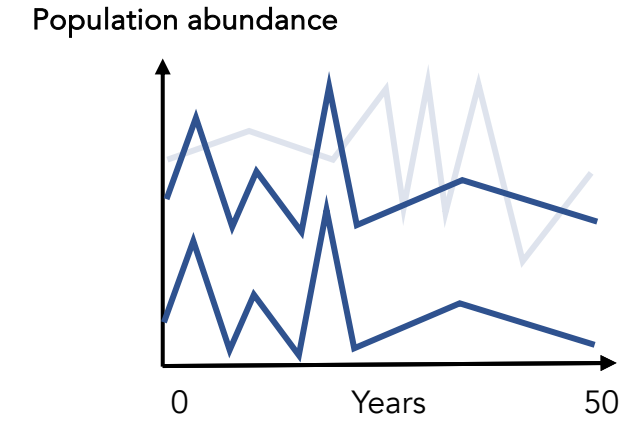
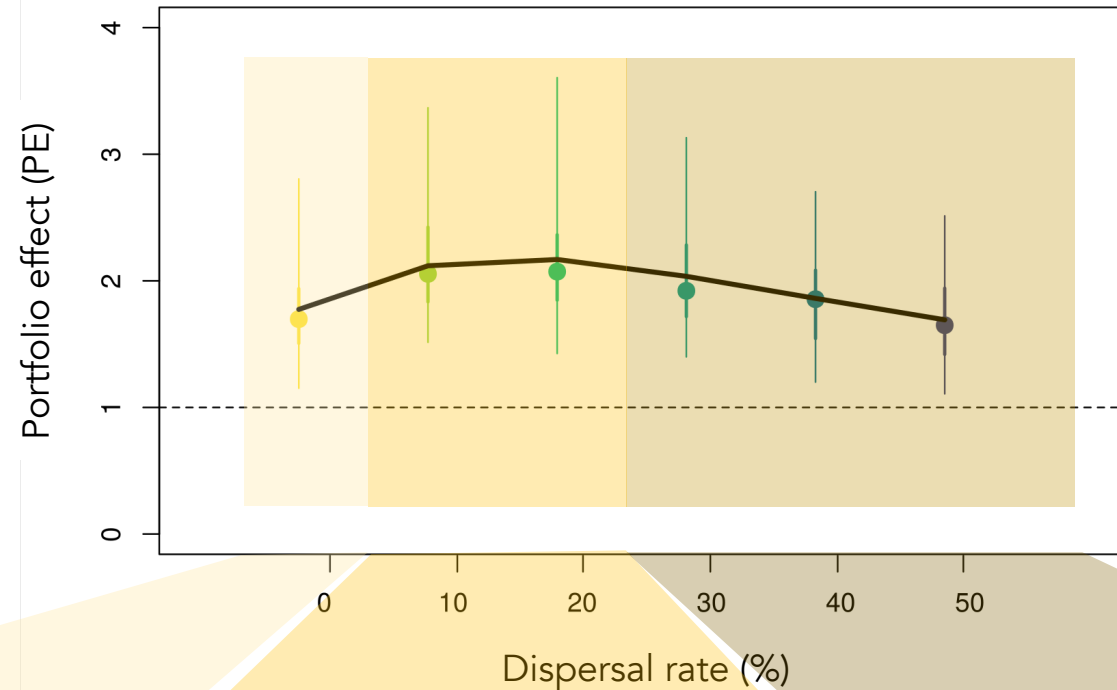
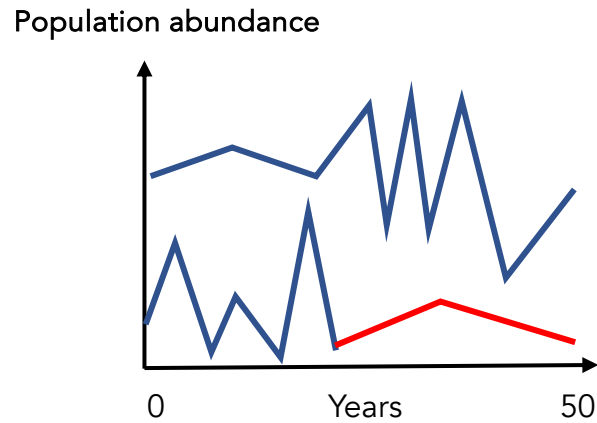


➤ Implications of dispersal

Implications of dispersal in Atlantic salmon: lessons from a demo-genetic agent-based model

Amala Lamarins[✉], Florèn Hugon[✉], Cyril Piou[✉], Julien Papaix[✉], Etienne Prévost[✉], Stephanie M. Carlson[✉], and Mathieu Buoro[✉]

Demographic consequences



0%

10-20%

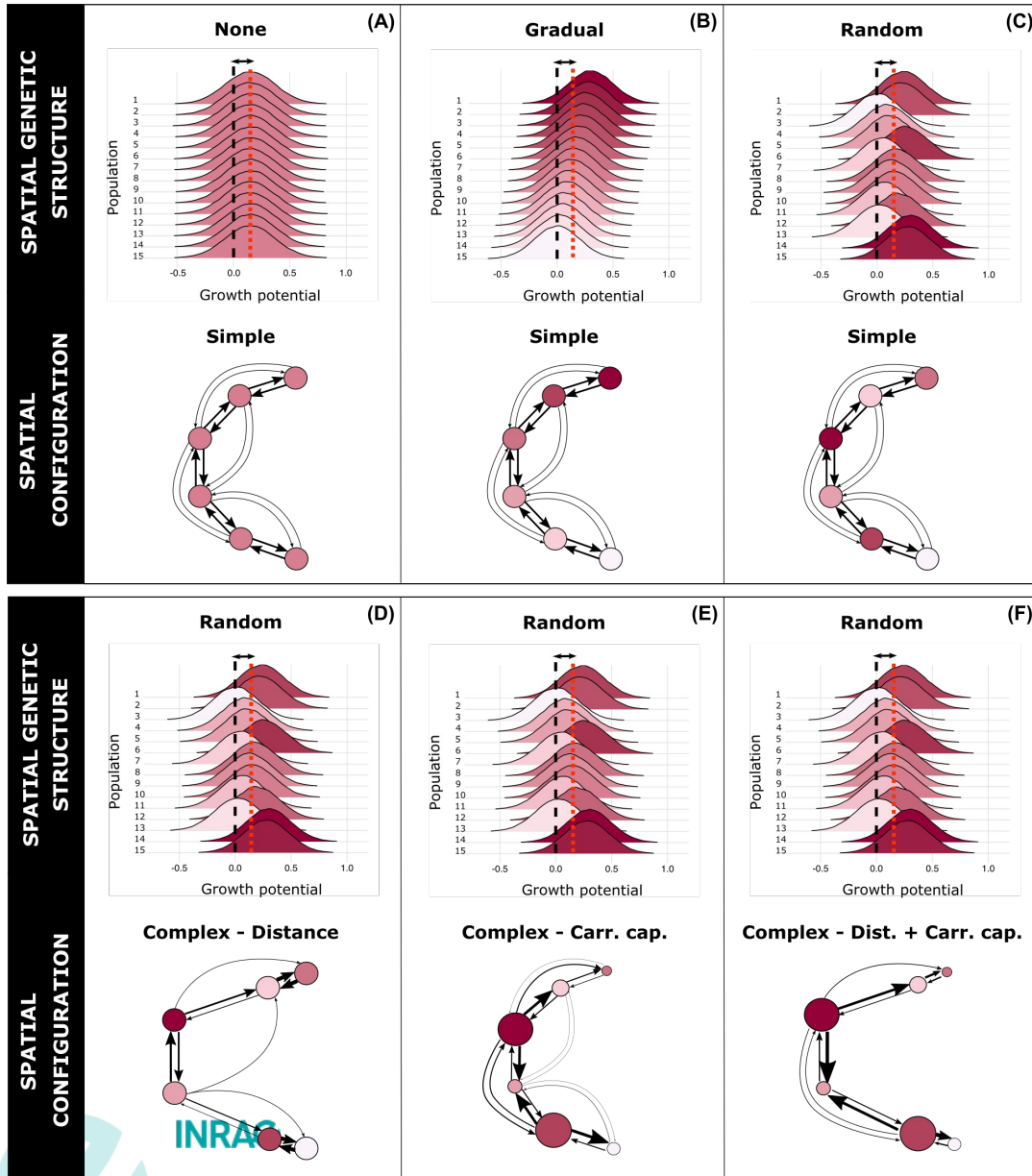
> 20%

- Asynchrony
- High risk of extinction of small populations

- Demographic rescue of small populations
- Optimum ?
≈ wild average rate: 15%

- ➡ ➡ synchrony
- « Anti-rescue » effect

➤ Implications of dispersal



Research article

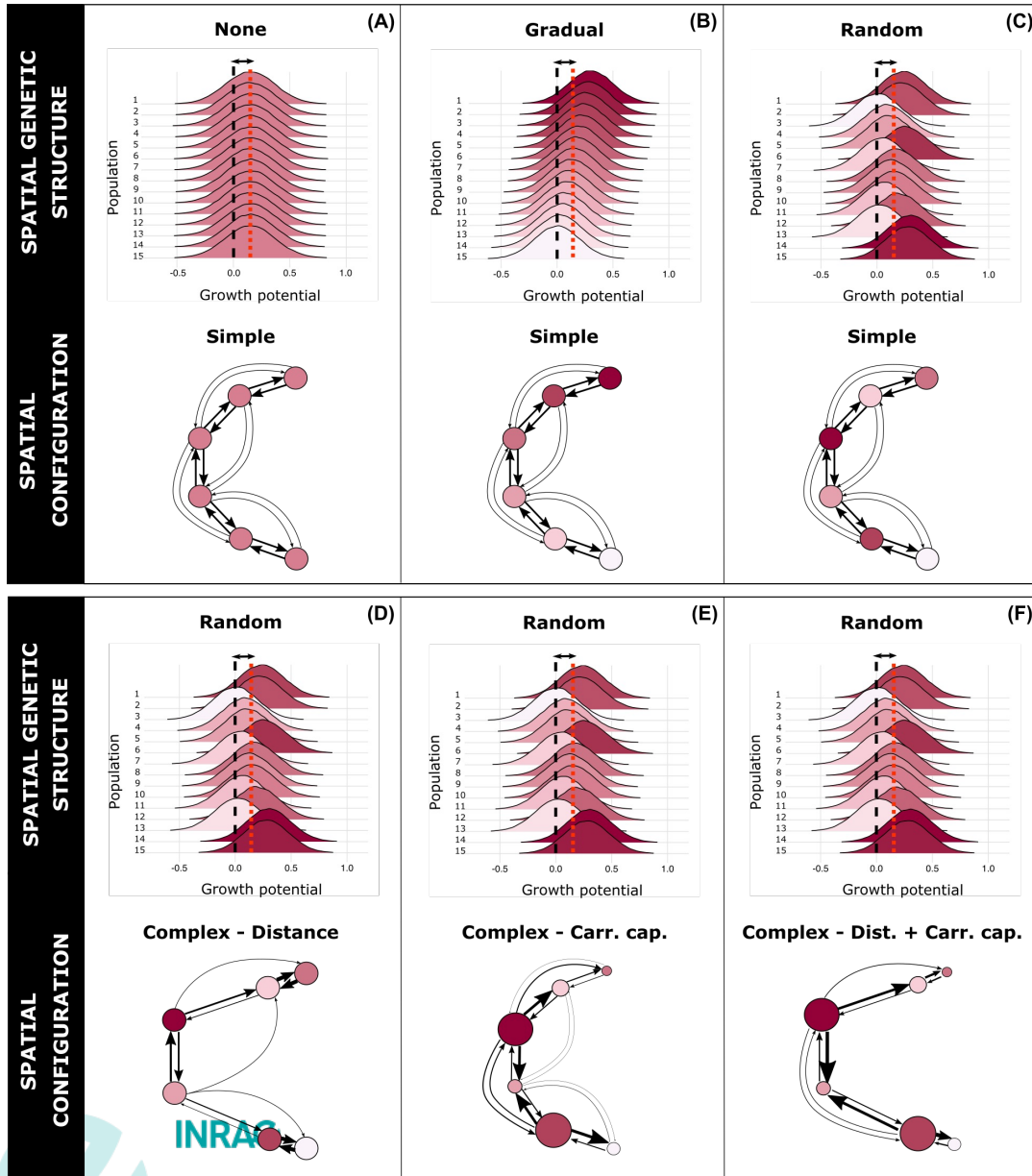
The importance of network spatial structure as a driver of eco-evolutionary dynamics

Amaia Lamarins¹, Etienne Prévost¹, Stephanie M. Carlson² and Mathieu Buoro¹

1) Influence de la diversité/biocomplexité

2) Influence de la configuration spatiale (intensité de la dispersion)

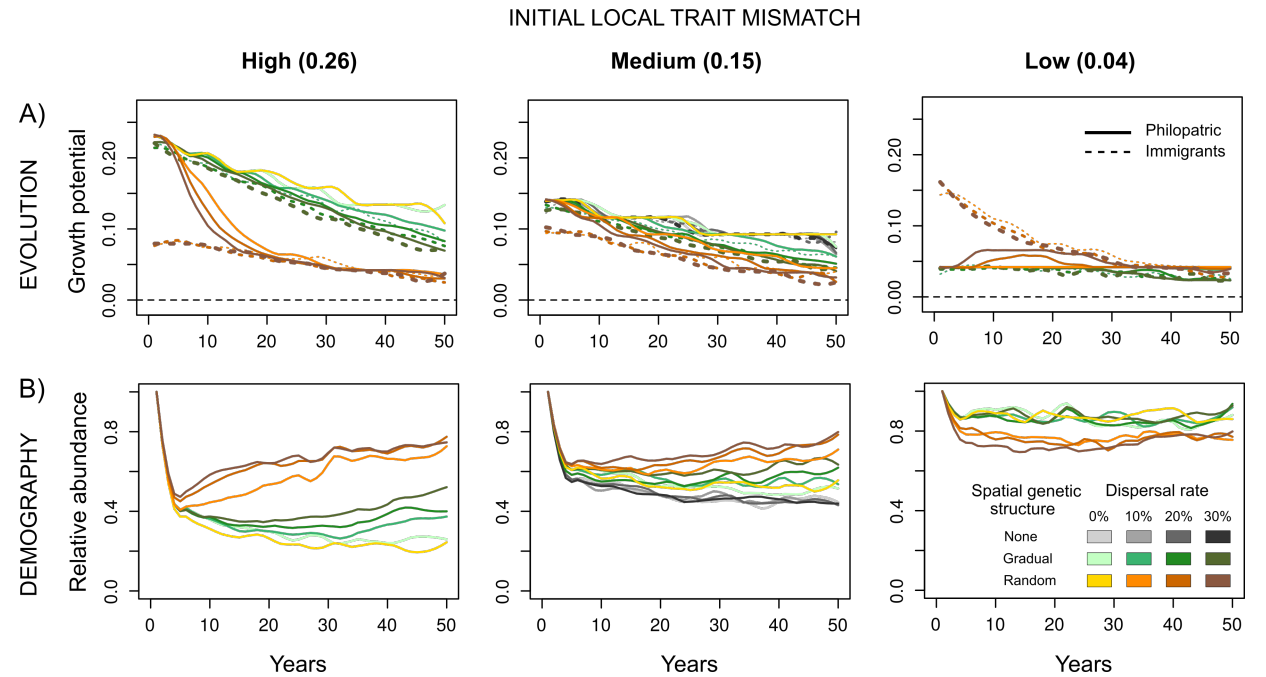
Implications of dispersal



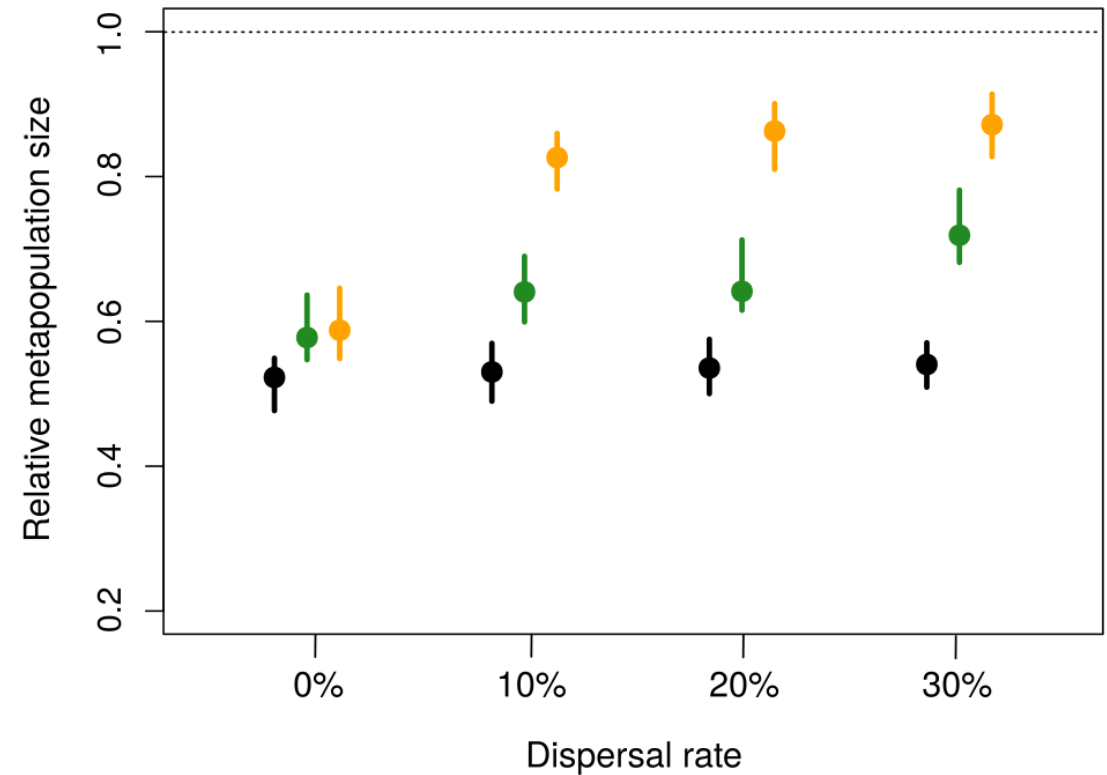
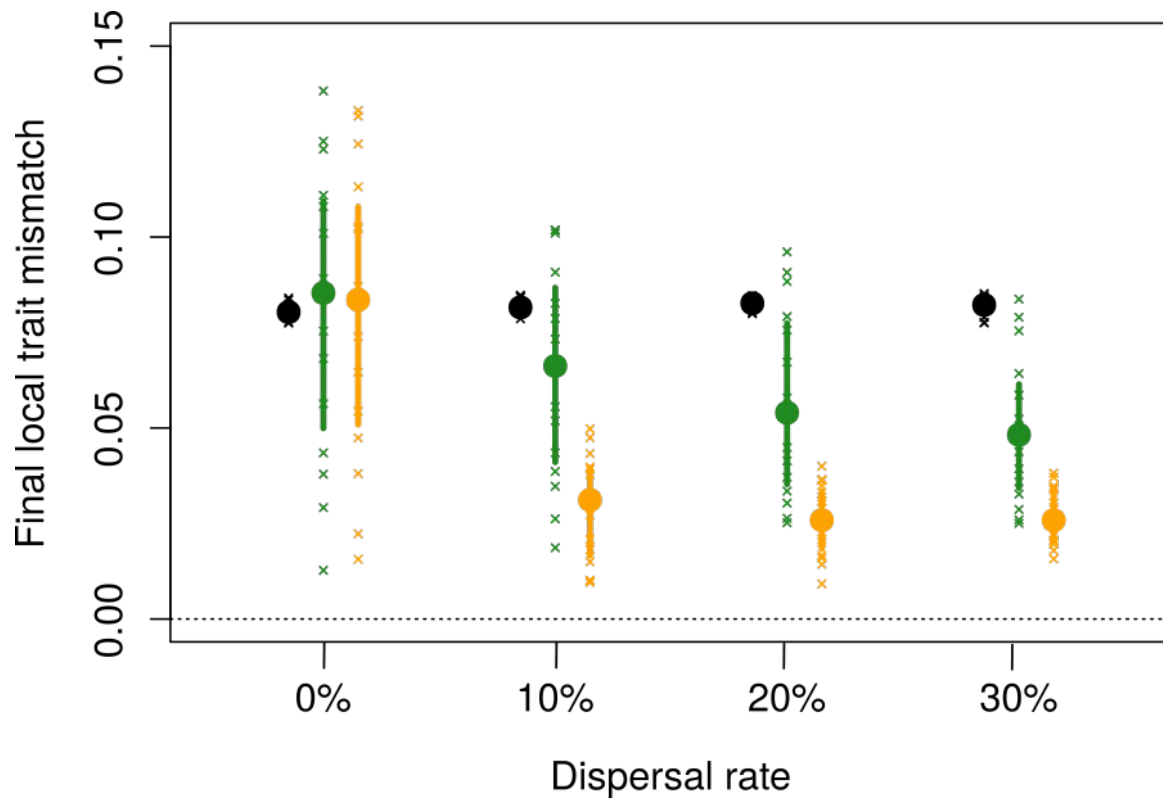
Research article

The importance of network spatial structure as a driver of eco-evolutionary dynamics

Amaia Lamarins¹, Etienne Prévost¹, Stephanie M. Carlson² and Mathieu Buoro¹



➤ Implications of dispersal



- ➔ Dispersal x genetic diversity among populations fostered adaptation via evolutionary rescue effect ➔ adaptation network theory
- ➔ Influence of spatial genetic structure

> Take home messages

- Les populations de saumons **ne sont pas isolées**
- Les trajectoires évolutives et démographiques des populations locales peuvent être fortement influencées par la configuration spatiale (e.g. distance) et la composition (e.g. génétique) des populations liées par la dispersion.



- Étudier les dynamiques démographiques et évolutives d'une population isolément de son contexte spatial dans lequel elle évolue peut être trompeur sur les causes de ces changements.

Implications :

- Actions (e.g. repeuplement, construction/arasement barrage) sur une population peut avoir des conséquences sur les autres populations environnantes;
- Eviter une **exploitation sélective** intra et inter populations;
- **Adaptation network:** favoriser la stabilité, persistance & adaptation -> options écologiques et évolutives

MAIS encore de nombreuses inconnues...

Perspectives – Causes and consequences of dispersal

CAUSES

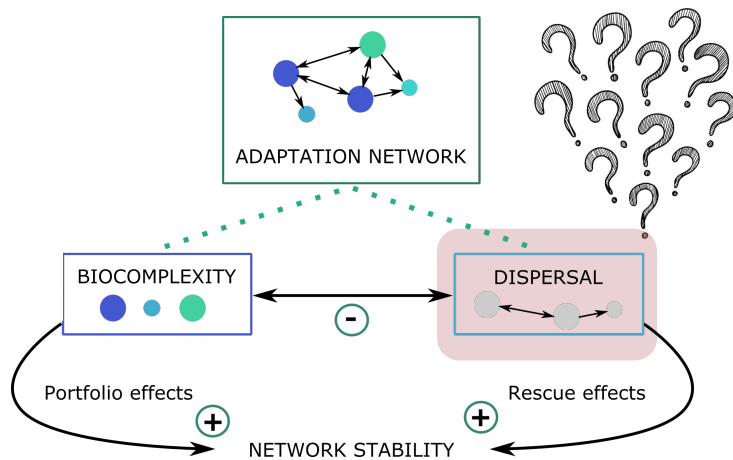
- Constant dispersal rate over space (populations) and time ?
- Non-random dispersal: Sex-biased? phenotypically or genotypically determined?
- Choice of destination population based on distance and attractivity?

CONSEQUENCES

- Density-dependence effects
- Rescue effects
- Fitness of immigrants?

CHALLENGES

- Identifying immigrants in wild populations (thèse Emillio EGAL)
- Evaluating their contributions (e.g. reproductive success)
- CC and/or Fisheries-induced dispersal evolution?

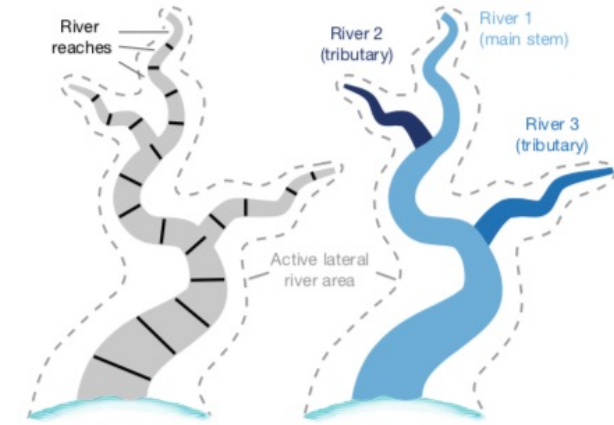


➤ IBASAM v2

Plateforme Capsis (java)



+ Spatially explicit

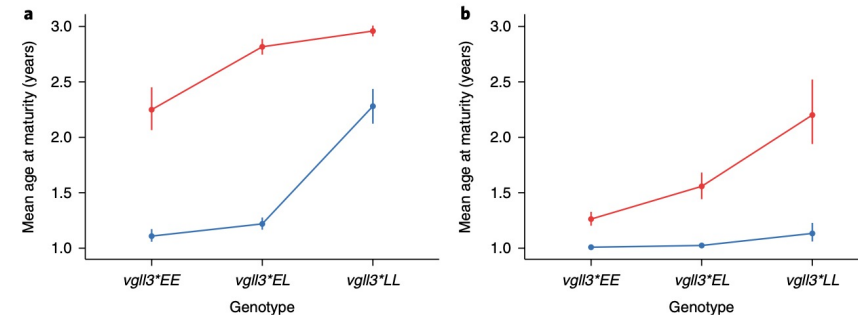


+ Phenology (e.g. timing of migration)

Thèse Edel Lheureux (2021-2024)
Investigating environmental determinants and individual variation of the migration phenology in wild Atlantic salmon (Salmo salar)



+ Genetic architecture (FishLegs project)



Amaia Iamarins



Thank you for your attention!

Acknowledgment

Amaïa Lamarins (Univ Helsinki)

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Etienne Prévost

Julien Papaïx

Stephanie Carlson (UC Berkeley)

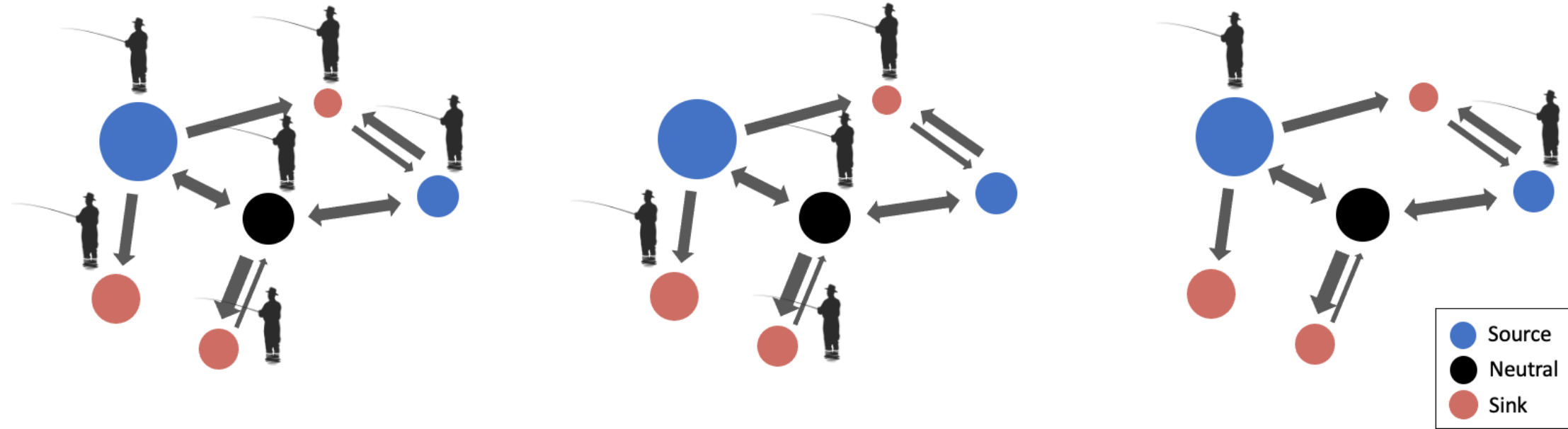
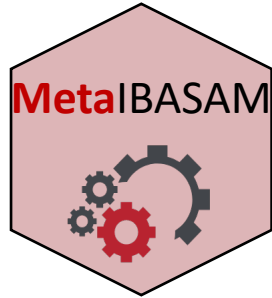


➤ IV – Metapopulation management strategies

Exploitation (all pop.)

Source conservation

Source exploitation

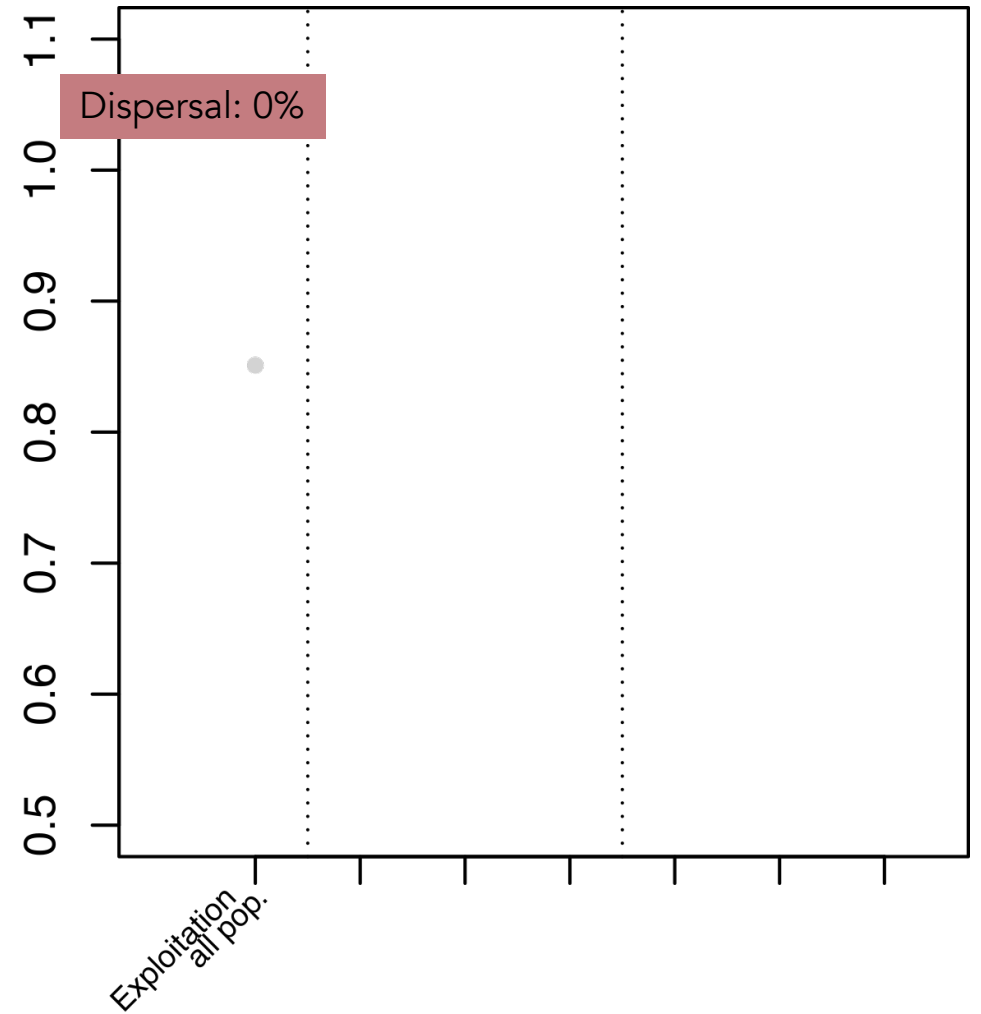
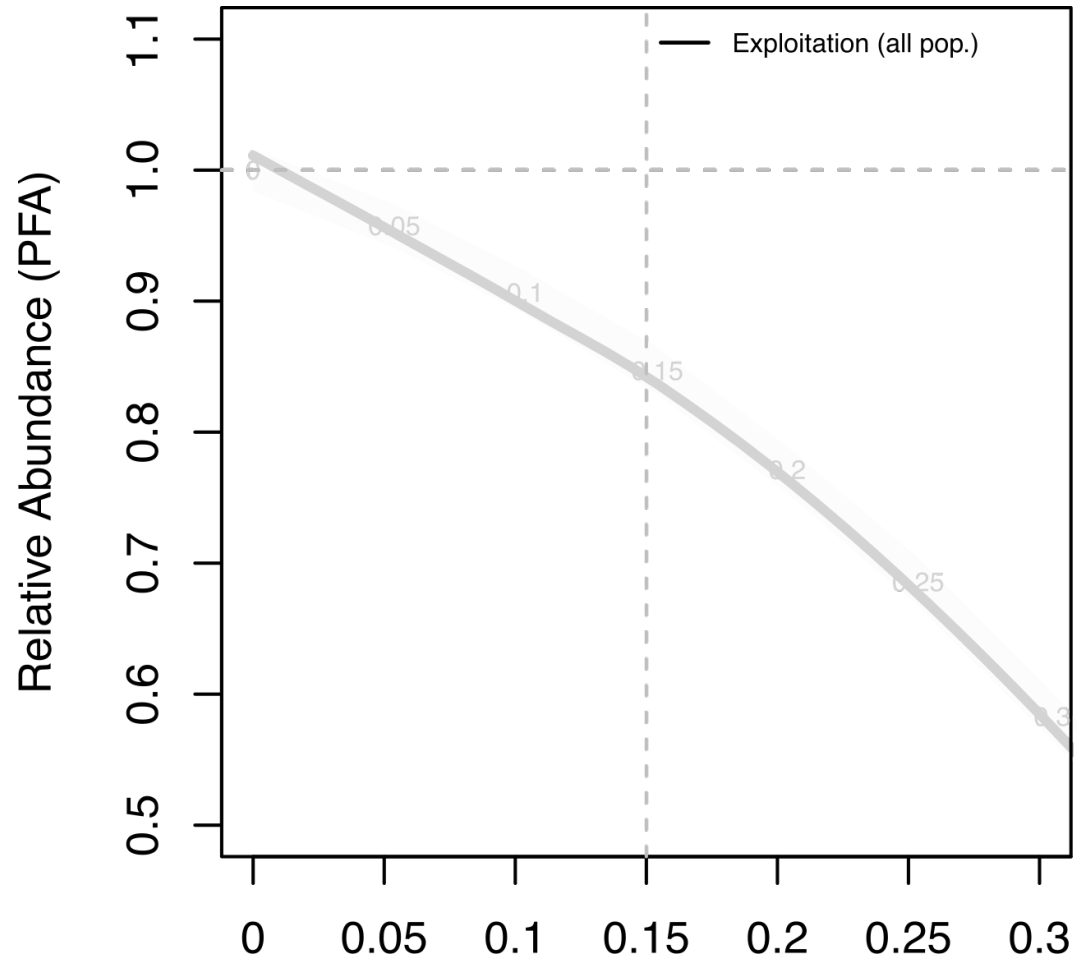


→ Gradient Local exploitation rate (0-50%)

→ Gradient dispersal rate (0-30%)

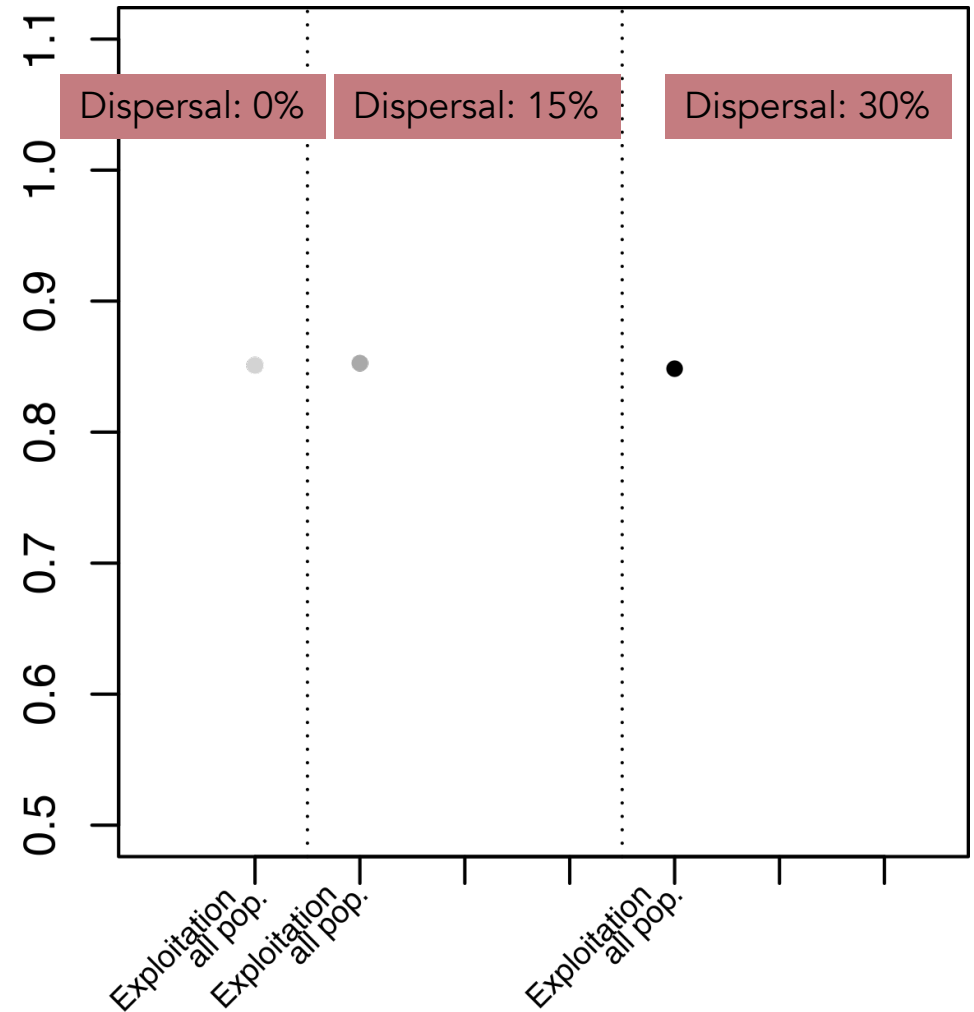
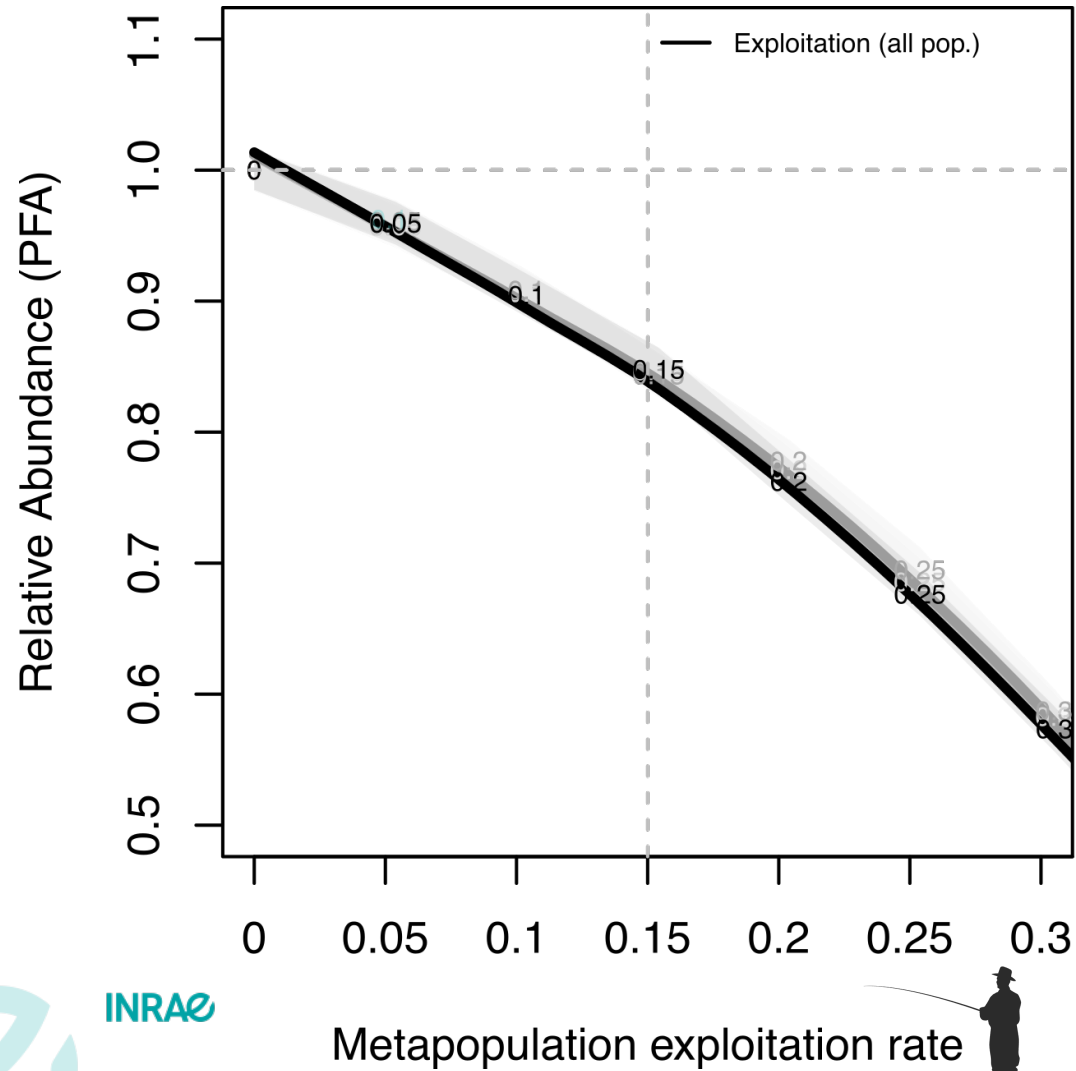


Demographic consequences



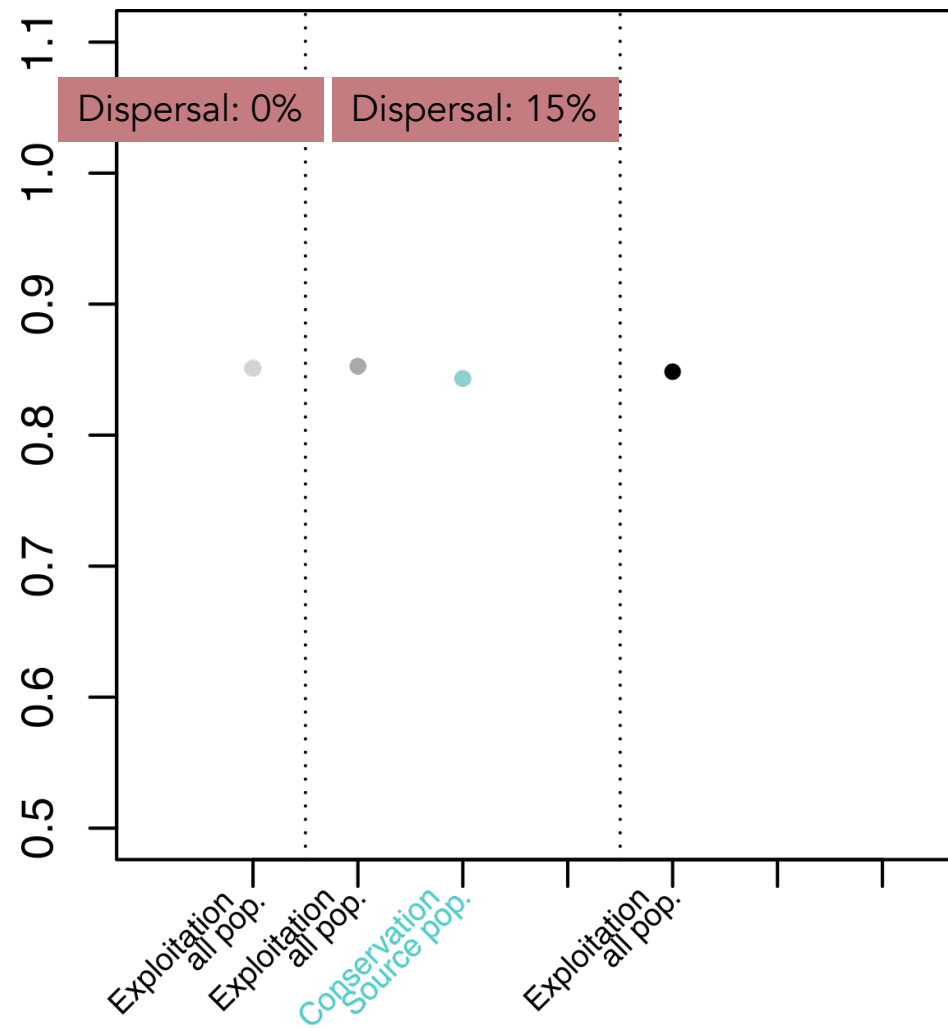
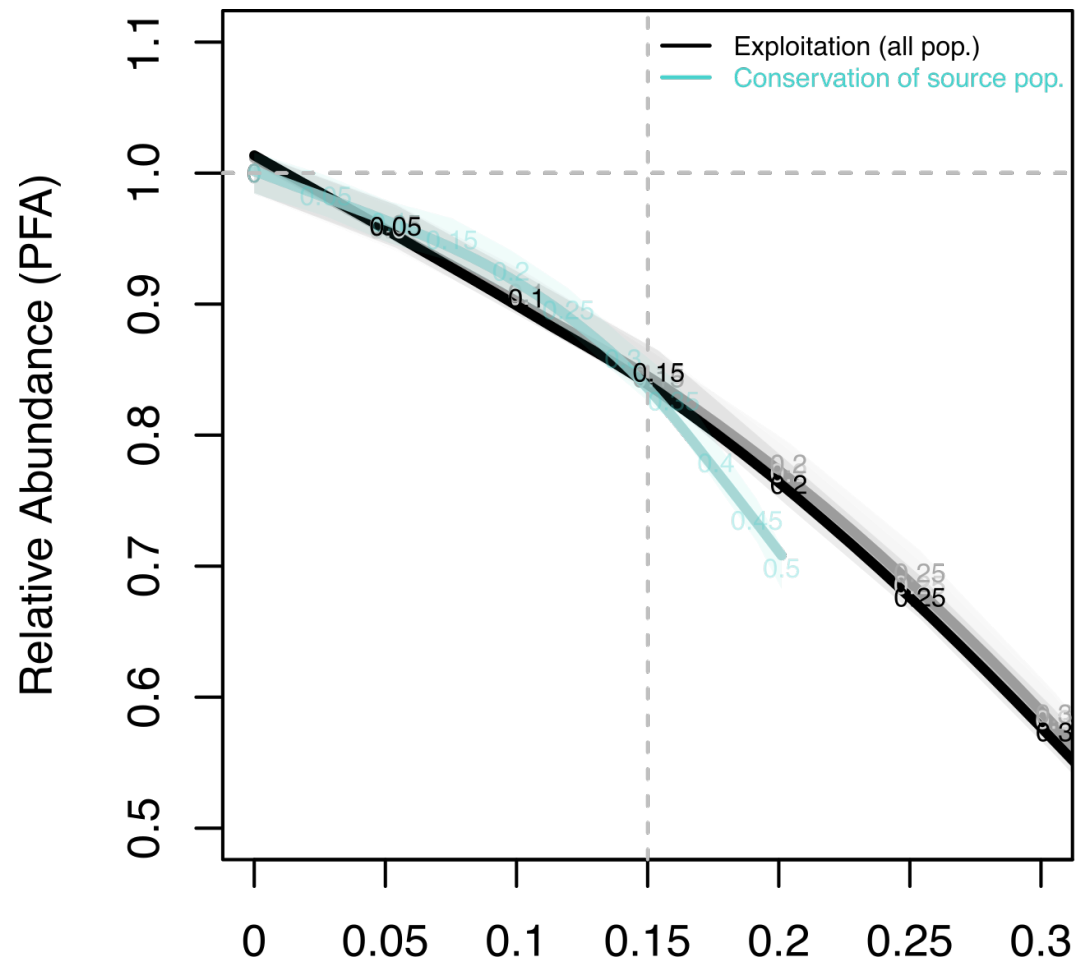


Demographic consequences



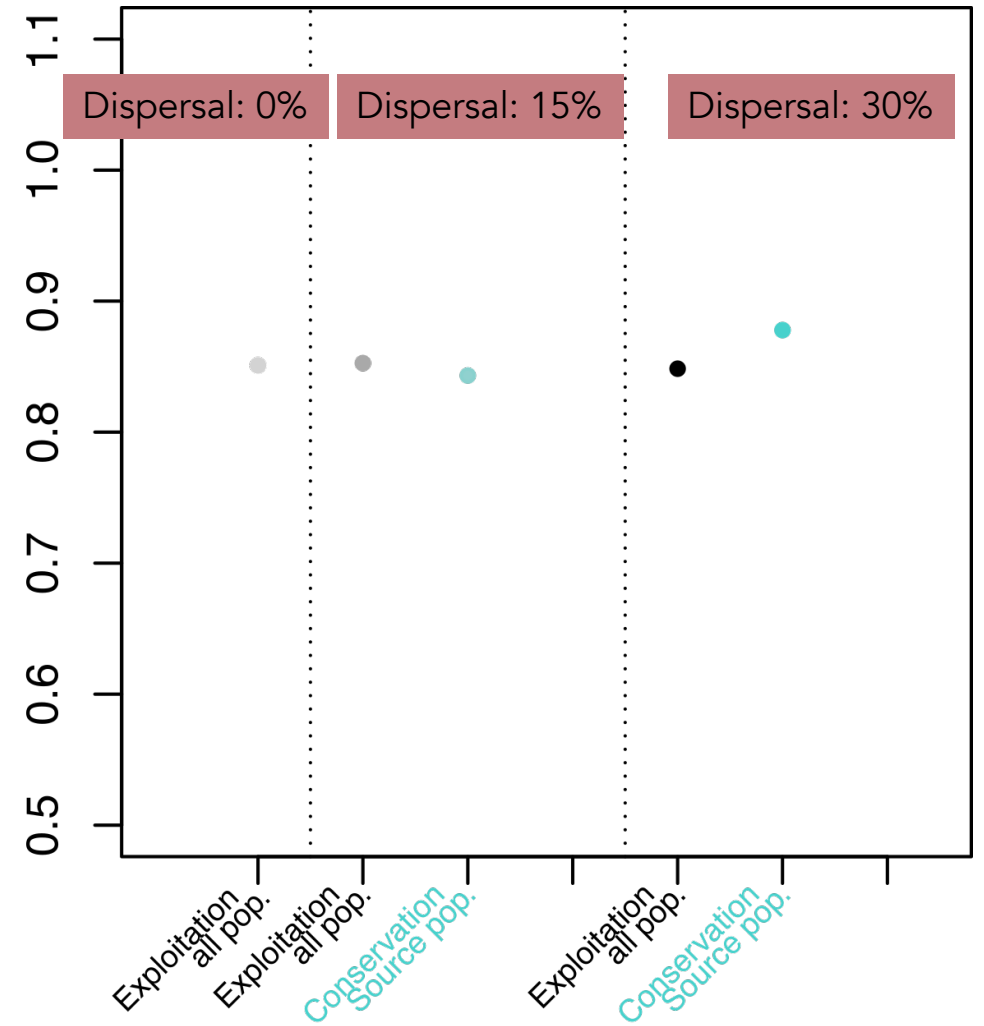
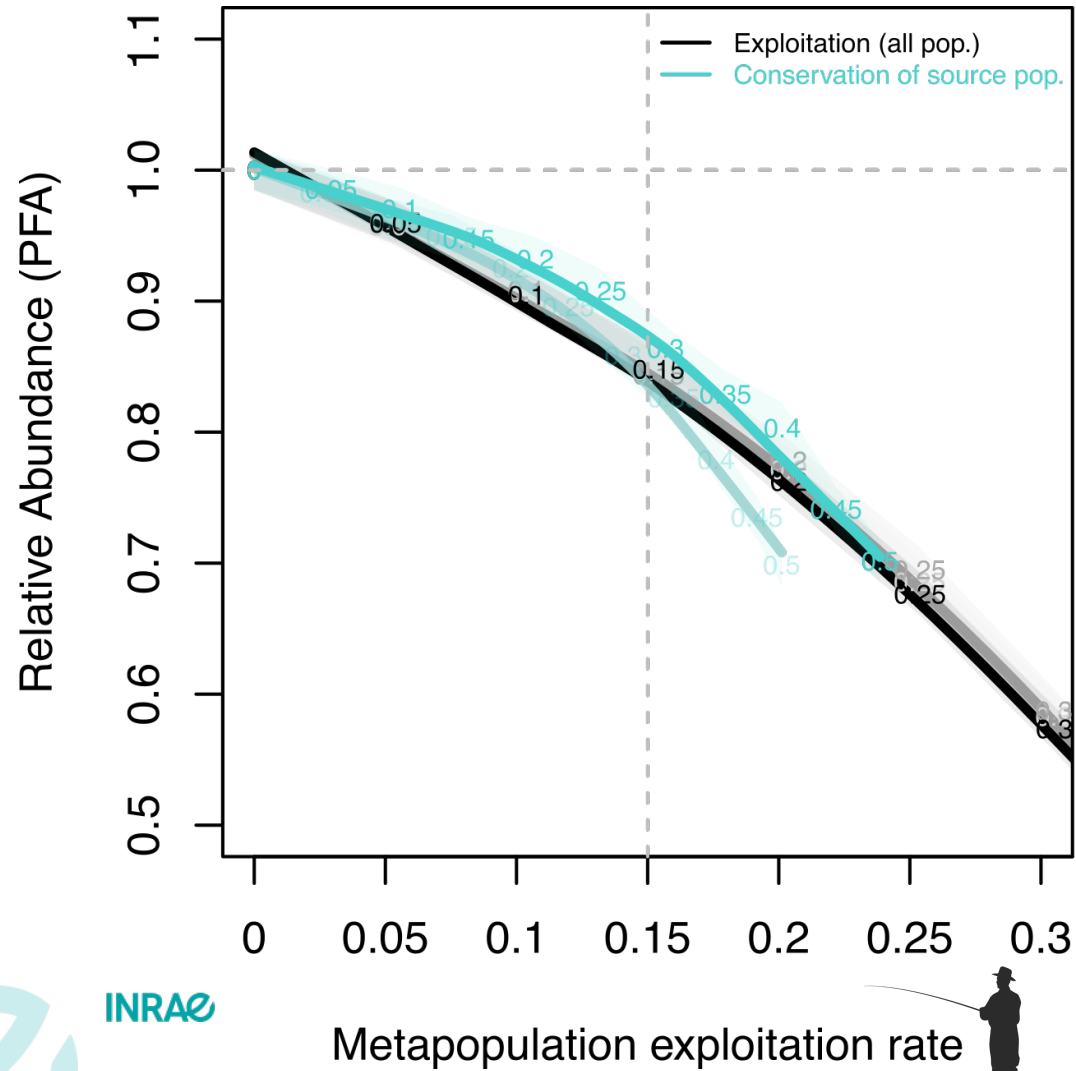


Demographic consequences



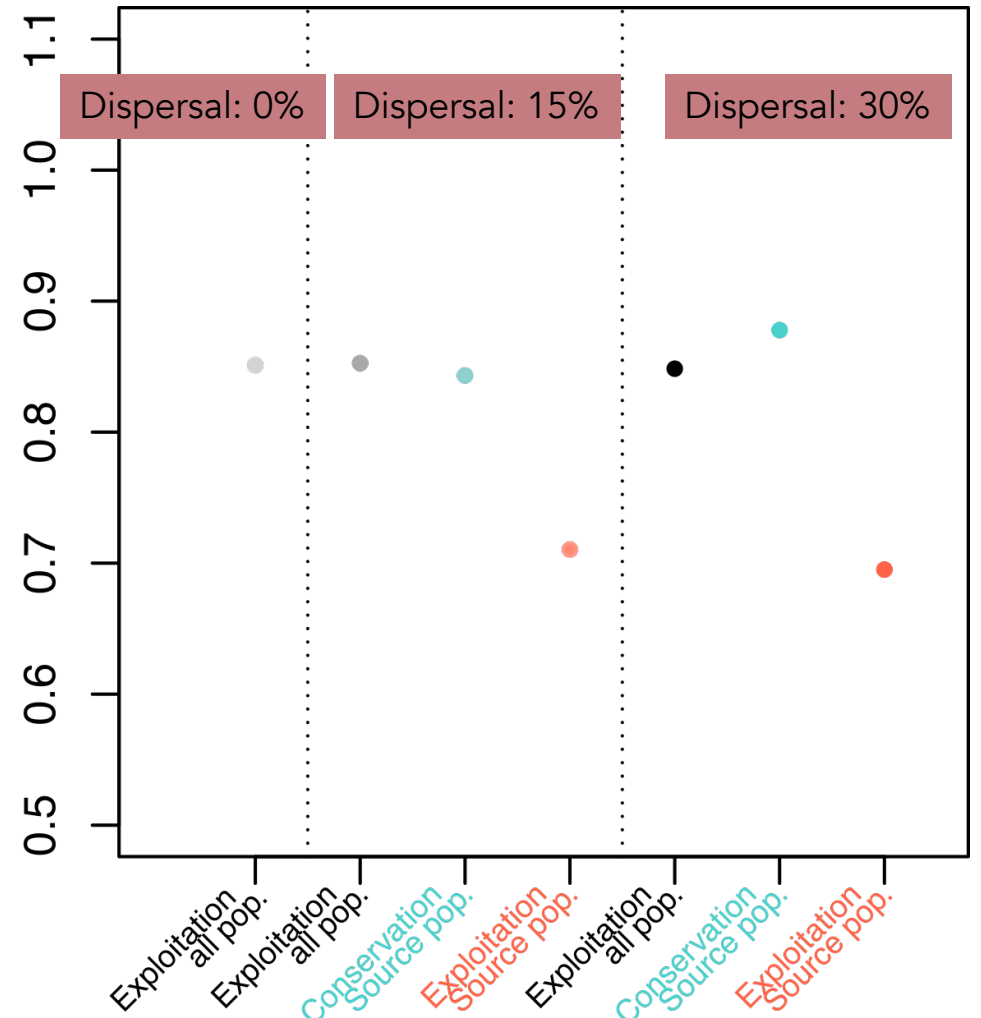
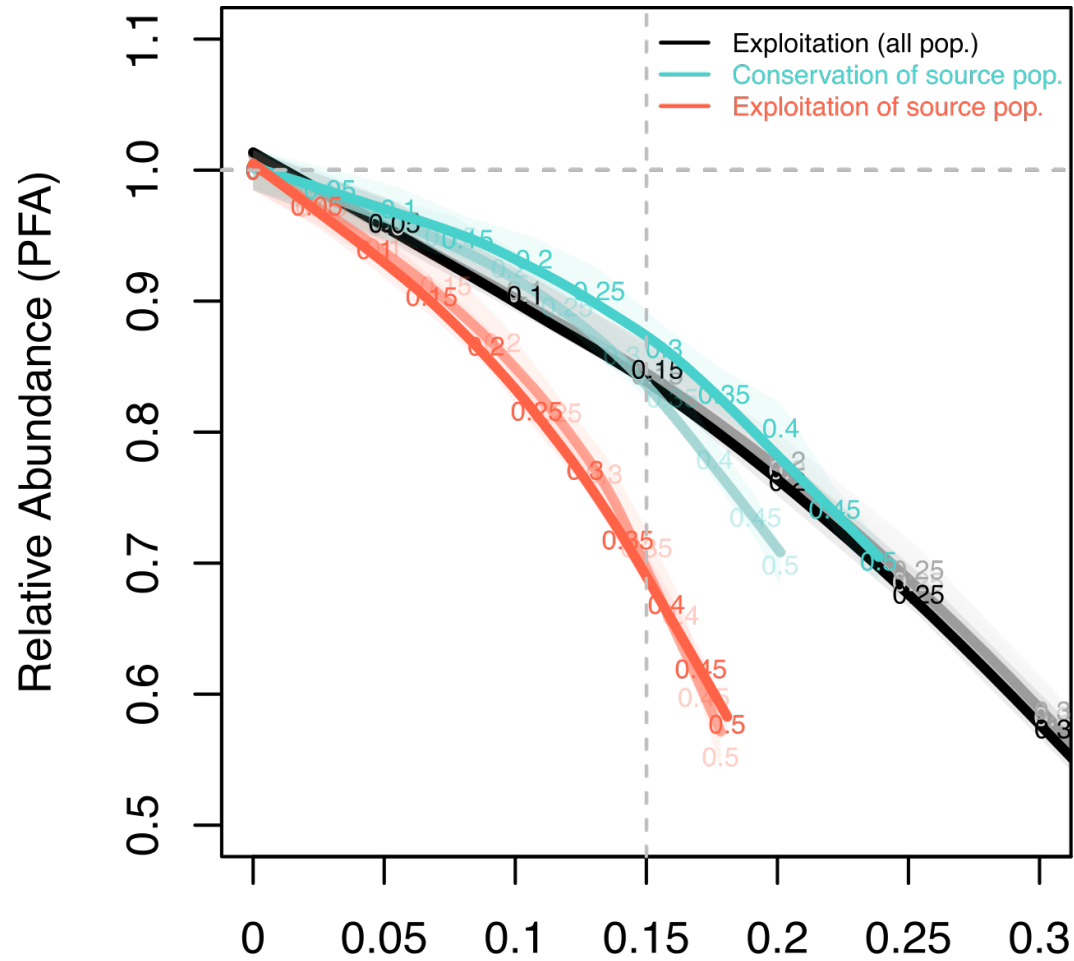


Demographic consequences



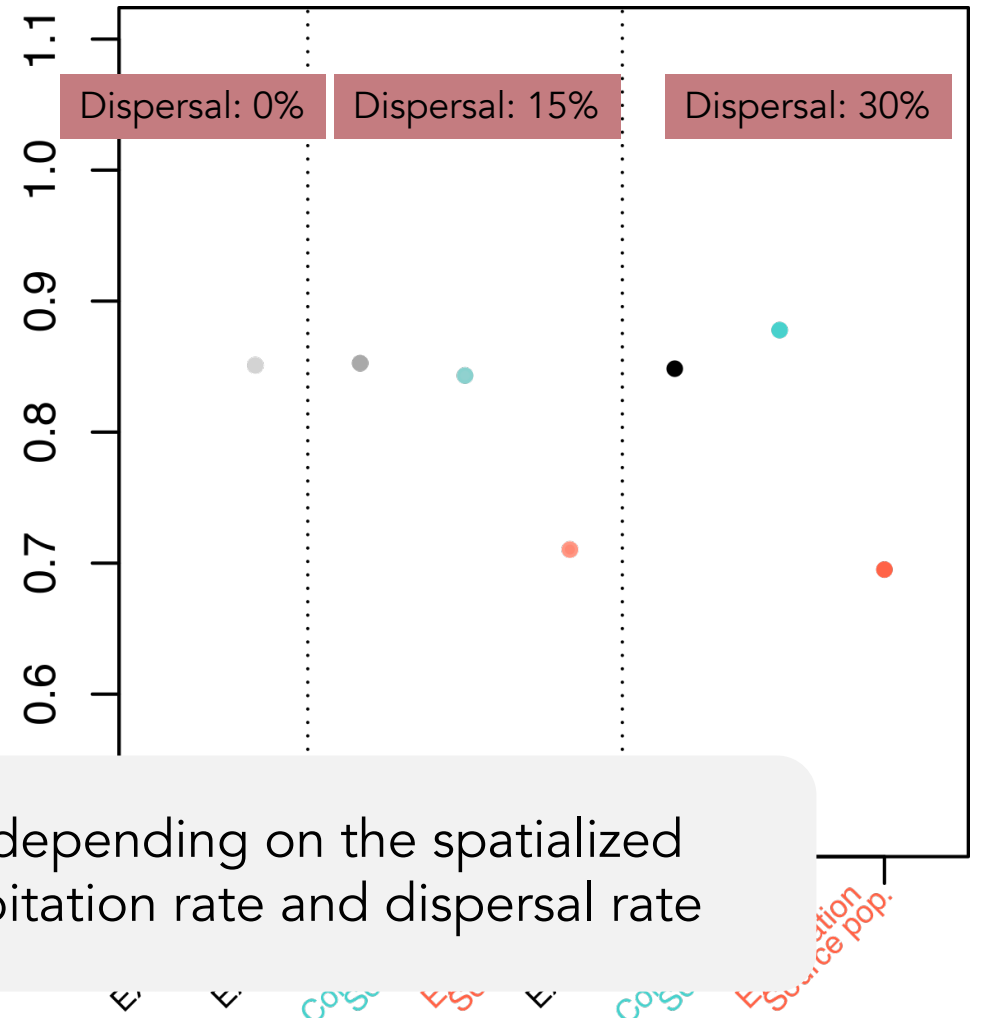
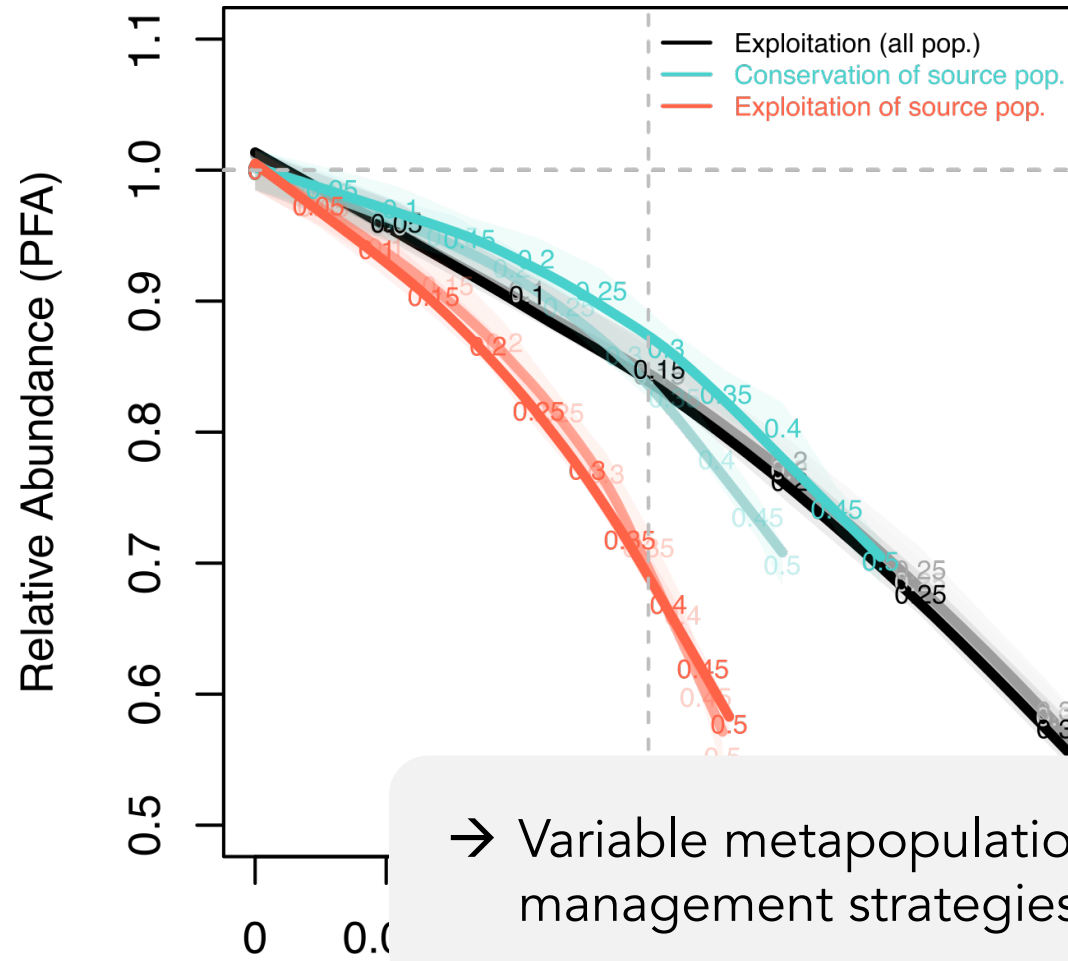


Demographic consequences





Demographic consequences



→ Variable metapopulation size depending on the spatialized management strategies, exploitation rate and dispersal rate

