



**HAL**  
open science

# Evaluating the adaptive network theory - A demo-genetic individual based model of Atlantic salmon metapopulation

Amaia Lamarins, Stephanie M. Carlson, Mathieu Buoro

► **To cite this version:**

Amaia Lamarins, Stephanie M. Carlson, Mathieu Buoro. Evaluating the adaptive network theory - A demo-genetic individual based model of Atlantic salmon metapopulation. *Ecological and Evolutionary Ethology of Fishes*, Jul 2021, Virtual, United States. hal-03448471

**HAL Id: hal-03448471**

**<https://hal.science/hal-03448471>**

Submitted on 25 Nov 2021

**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.

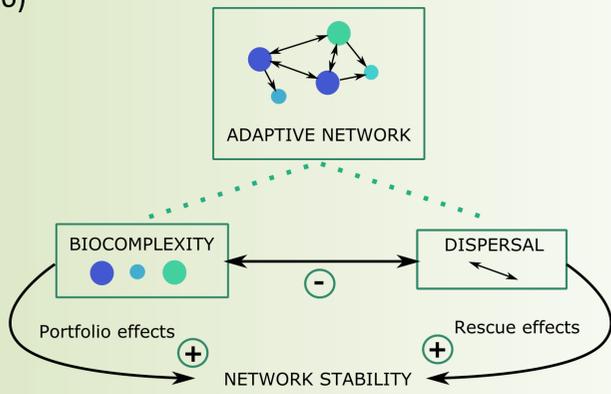
# Evaluating the adaptive network theory

## A demo-genetic individual based model of Atlantic salmon metapopulation

Lamarins A., Prévost E., Carlson S., Buoro M.  
 UMR ECOBIOP E2S-UPPA/INRAE, St-Pée-sur-Nivelle, France  
 Carlson Lab, ESPM dpt, UC Berkeley, CA USA

### CONTEXT

- Drivers of species persistence and adaptation to environmental changes
- Metapopulation scale : **Adaptive network theory** (Webster *et al.* 2016)

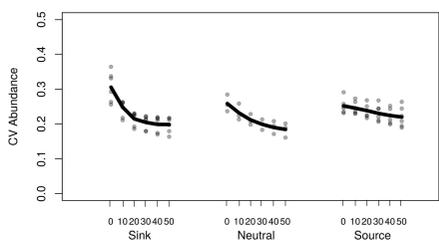


- Hypotheses rarely studied in a **unified framework**
- Salmonids**: no strict philopatry (Schtickzelle & Quinn 2007), but dispersal is still considered as negligible

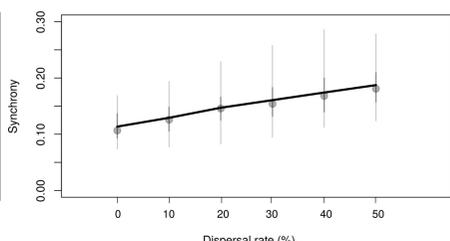


### DISPERSAL EFFECTS

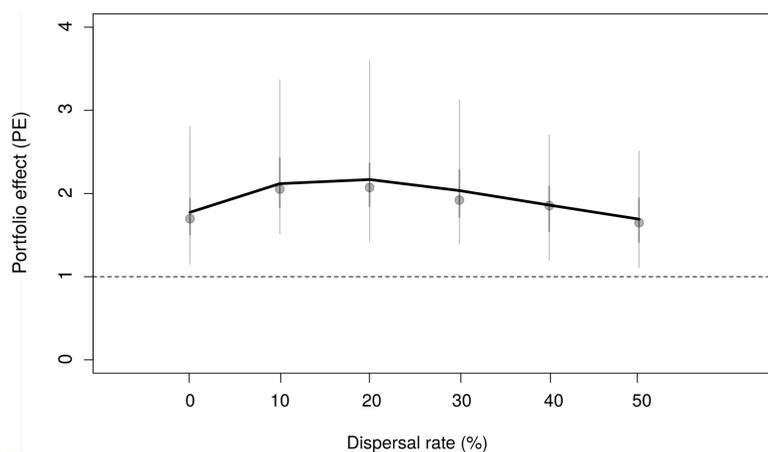
#### Demographic rescue of populations



#### Synchronization of populations dynamics



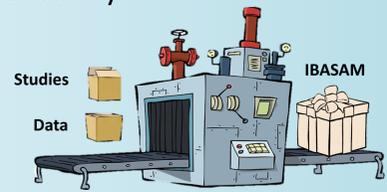
#### Non-linear relationship with network stability



### METHODS

#### A demo-genetic individual based model of Atlantic salmon populations...

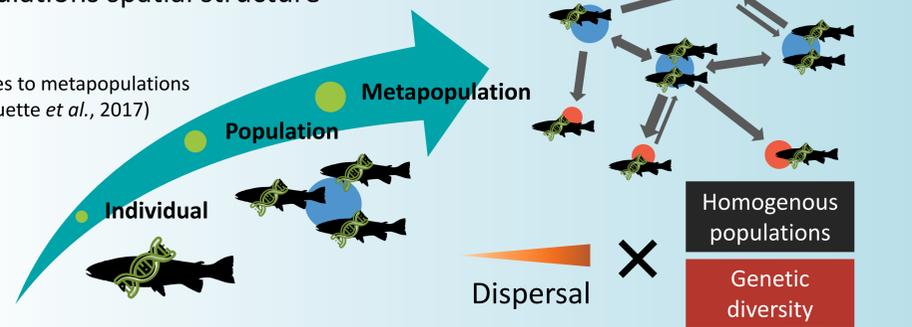
- IBM: a life cycle model including individual variability
- Explicit genetic transmission of traits
- Eco-evolutionary feedbacks



#### ... Connected through dispersal

- Dispersal kernel (distance and attractivity)
- Populations spatial structure

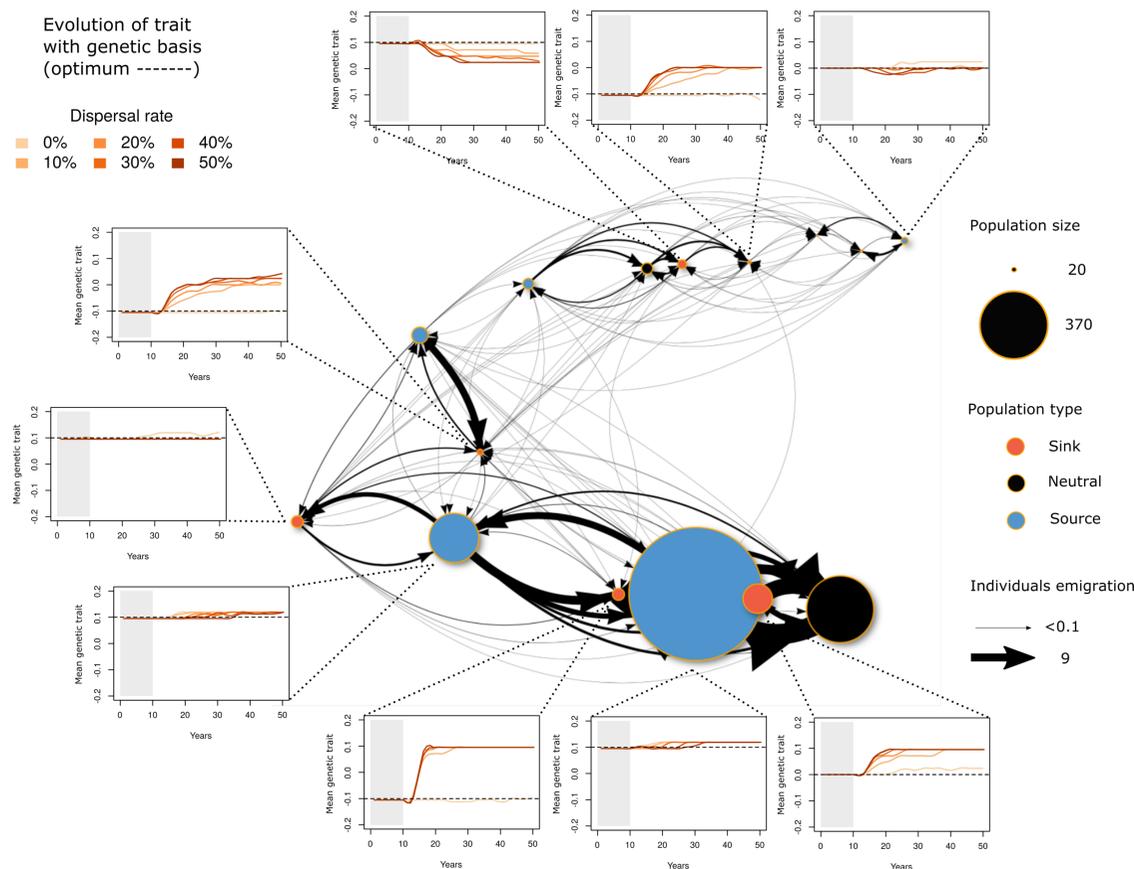
From genes to metapopulations (Baguette *et al.*, 2017)



### RESULTS

### INTERPLAY DISPERSAL - BIocomplexity

Homogenizing effect may lead to populations **maladaptation**...



... Depending on populations **spatial structure** (immigration rate and nearby populations genetic features)

### DISCUSSION

Using a theoretical approach to evaluate the adaptive network theory in a single framework, we first showed **rescue effects** on populations with low rates of dispersal (Hill *et al.* 2002). However, our results also suggest that higher rates of dispersal might **synchronize** populations dynamics and reduce network stability (Yeakel *et al.* 2018). Taking advantage of the demo-genetic feature of our modeling approach, we highlighted the potential interplay between dispersal and between-populations genetic diversity, and especially **local adaptation impairment** through gene flow (Moore *et al.* 2013). However, these eco-evolutionary consequences might rely on our dispersal assumptions, populations trait optimum and **spatial structure**, as well as the environmental pressures they have to deal with. Altogether, we argue that focusing on a single population eco-evolutionary dynamic **without considering connectivity can be misleading**, especially for management decisions.

