



# Functional composition of gravel bar plant communities along the Rhône River: implications for management and restoration operations

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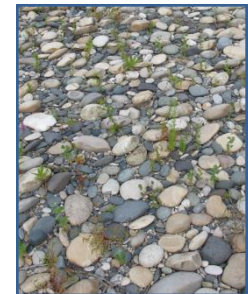
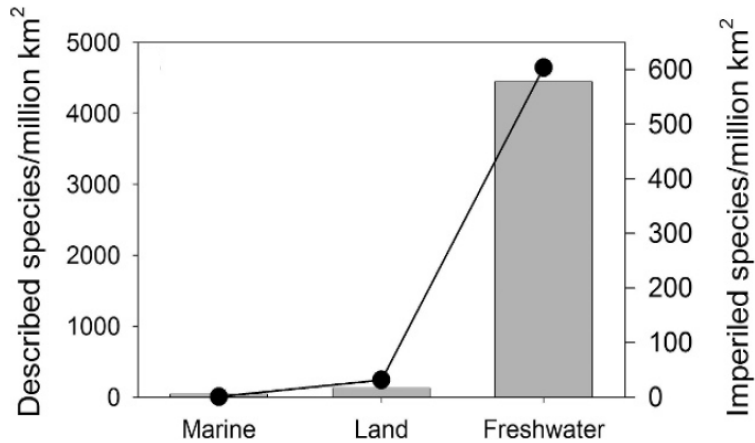
***Functional composition of  
gravel bar plant communities  
along the Rhône River:  
implications for management  
and restoration operations***

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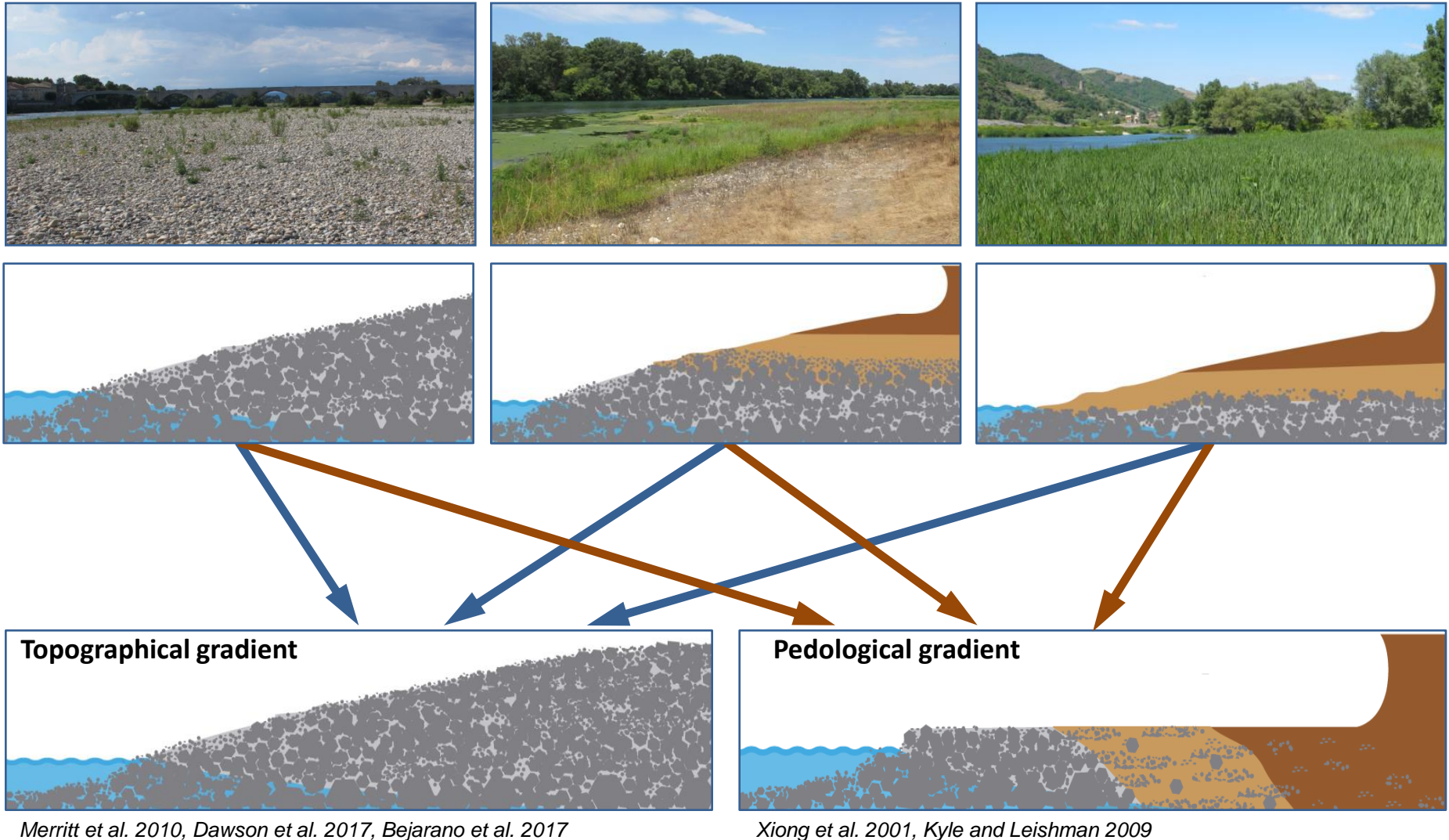
# Riparian biodiversity



Riparian communities from the upper to the lower part of the banks

*Poff et al. 1997, Strayer & Dudgeon 2010, González et al. 2016, Naiman and & Decamps 1997, Sabo et al. 2005*

# Environmental gradients

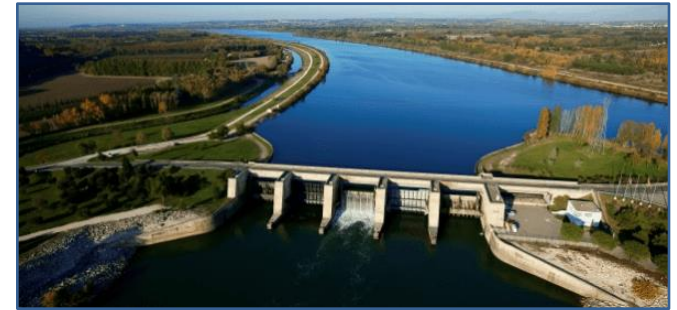


*Merritt et al. 2010, Dawson et al. 2017, Bejarano et al. 2017*

*Xiong et al. 2001, Kyle and Leishman 2009*

# Environmental changes and human activity

- Civil engineering widely used
  - Control flood risk
  - Prevent channel migration



➡ Added-value of restoration operations ?

- Maintenance/clearing operations
  - Prevent vegetation encroachment
  - Maintain wide channels



➡ Related effect on pioneer communities ?



*Nilsson et al. 2005, Feld et al. 2011, Poff et al. 2007, Poff and Zimmerman 2010, Liébault and Piégay 2002, Comiti et al. 2011*



# Research questions

Study the effect of topographical and pedological gradients on the functional composition of gravel bar plant communities

- How environmental gradients shape riparian plant functional composition along a highly degraded large River?
- How human activity, through maintenance and restoration operations, mediate the response of plant functional composition to environmental gradients?

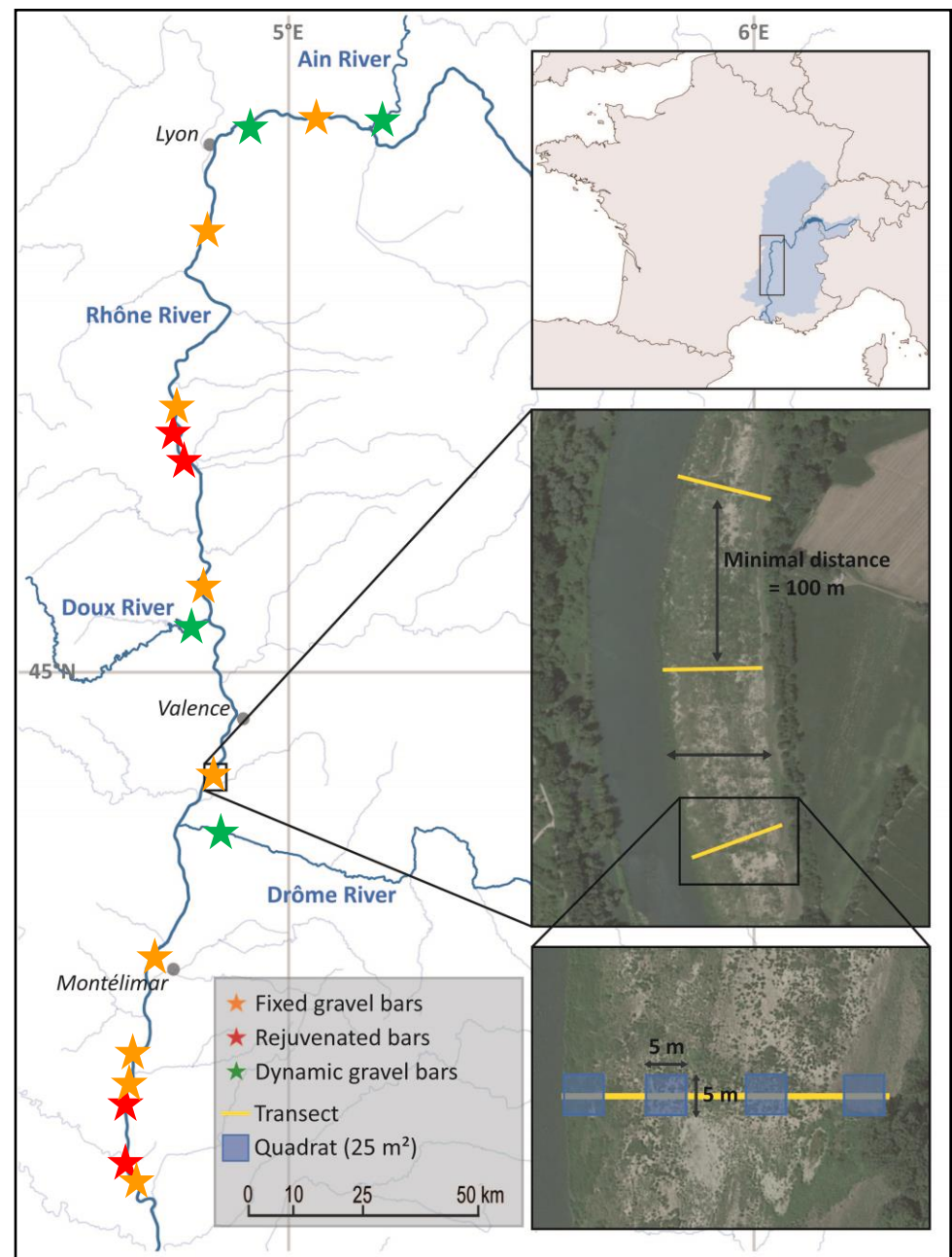


# Case study: the Rhône River

- A large River
  - total length = 810 km
  - watershed area = 96 500 km<sup>2</sup>
  - mean flow = 1 700 m<sup>3</sup>/s
- A highly degraded system
  - rectification phase in the 19<sup>th</sup> century
  - derivation phase in the 20<sup>th</sup> century
- Riparian zones intensively managed
- Ambitious ecological restoration program

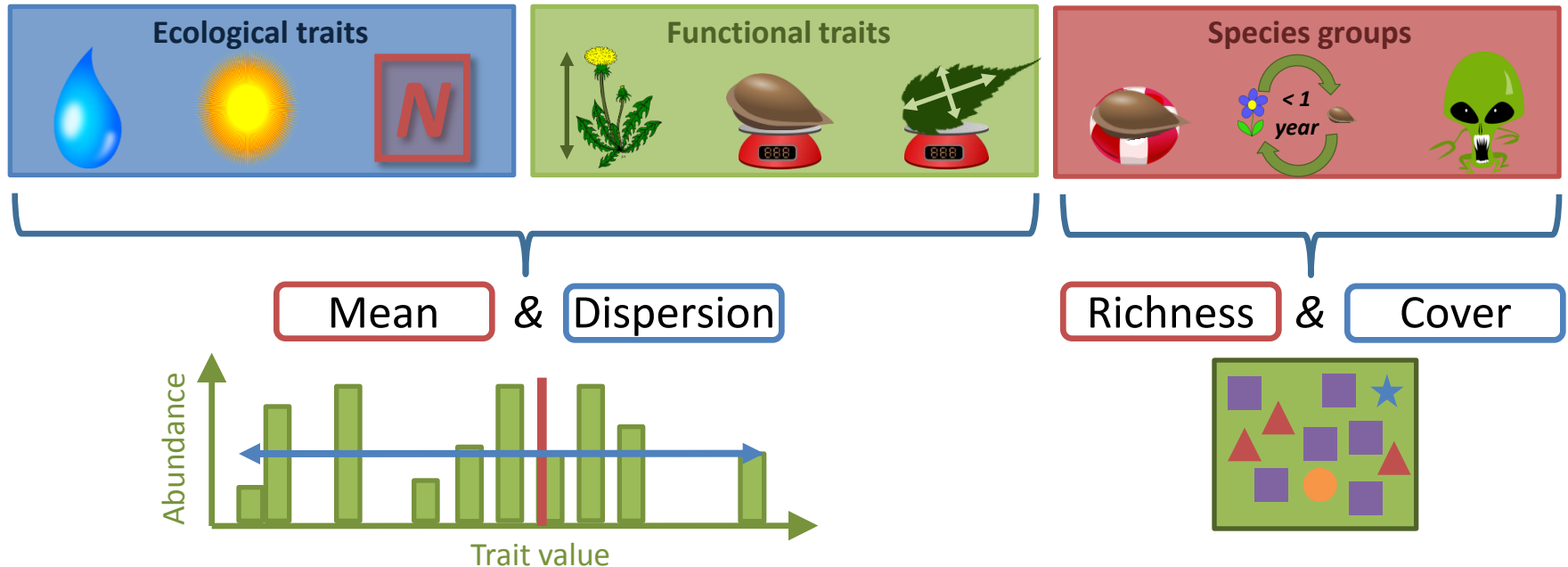


# Study area and sampling design



# Trait-based approach

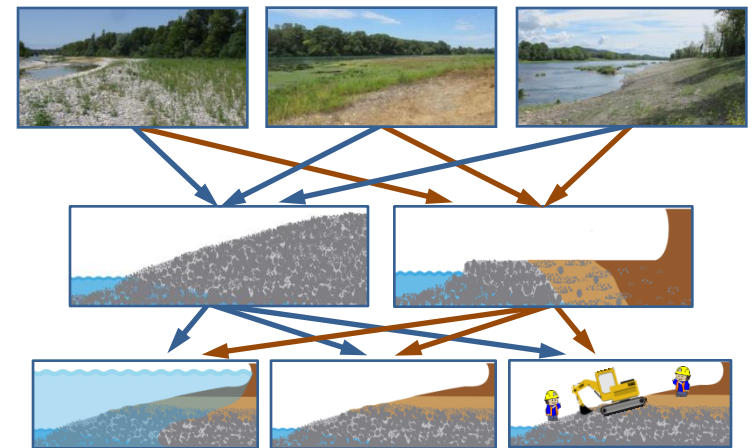
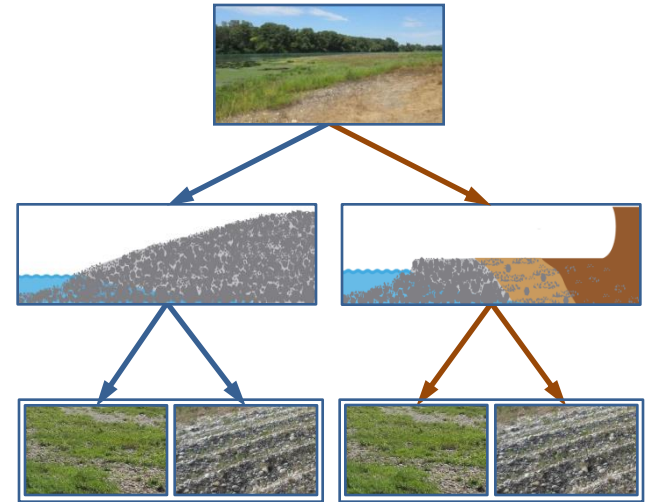
- Three groups of plant traits:



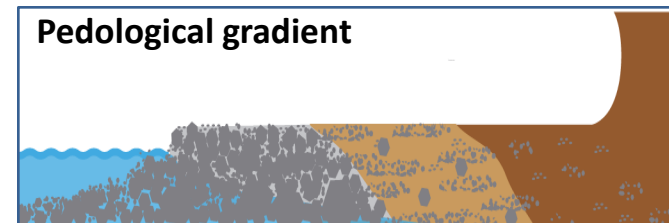
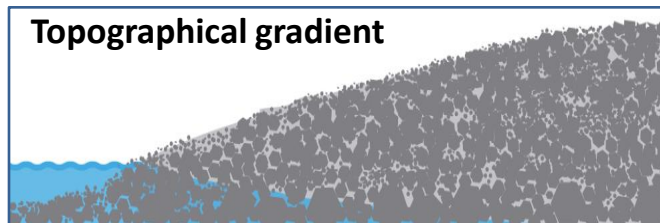
- Modeling framework: LMMs / GLMMs + multimodel inference

# Analytical strategy

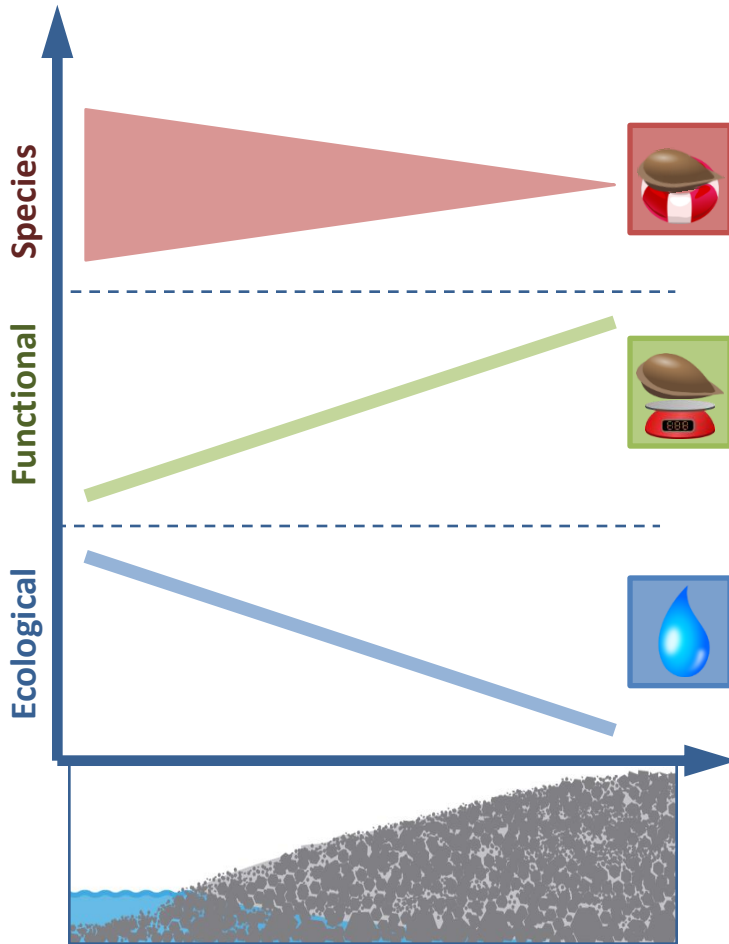
- How do environmental gradients shape plant communities along the Rhône River?
- How do maintenance operations mediate their response to environmental gradients?
- How is the response consistent among fixed, rejuvenated and dynamic bars?



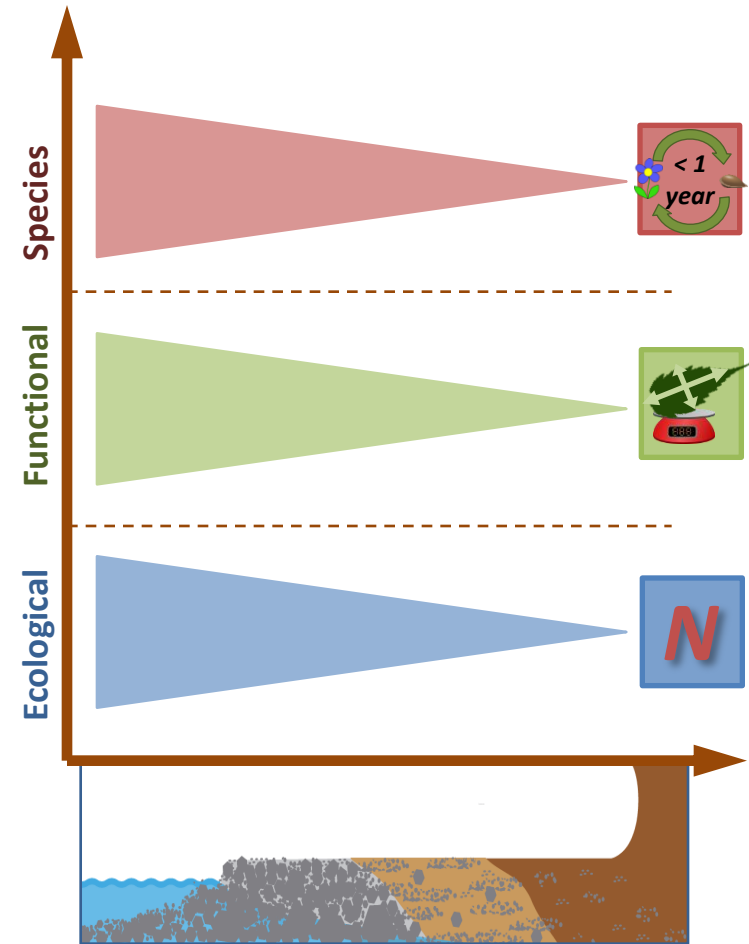
# Effect of environmental gradients



# Effect of environmental gradients

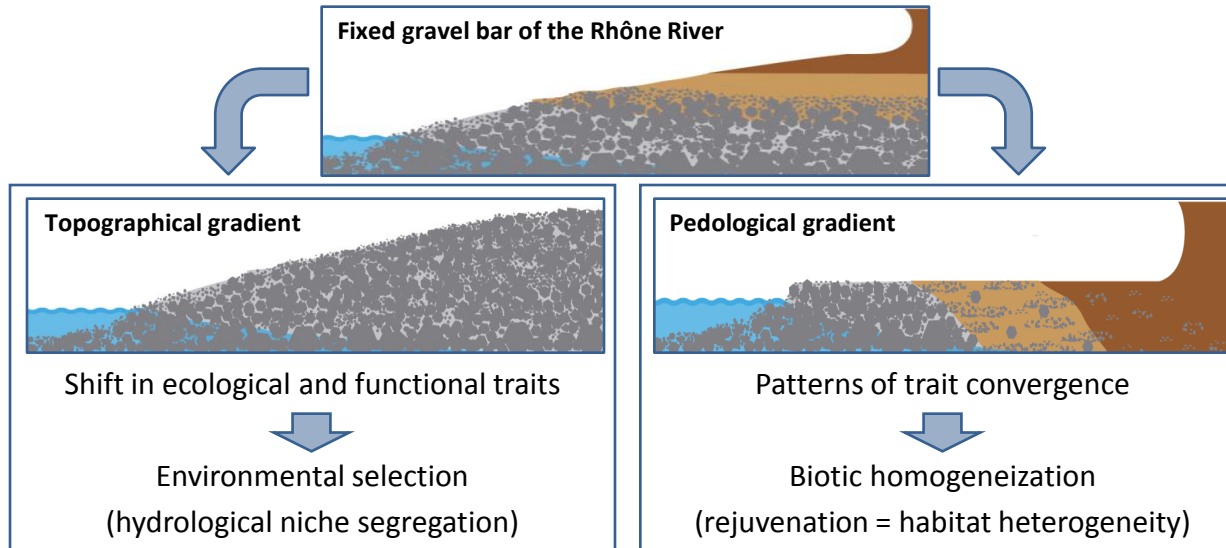


Topographical gradient

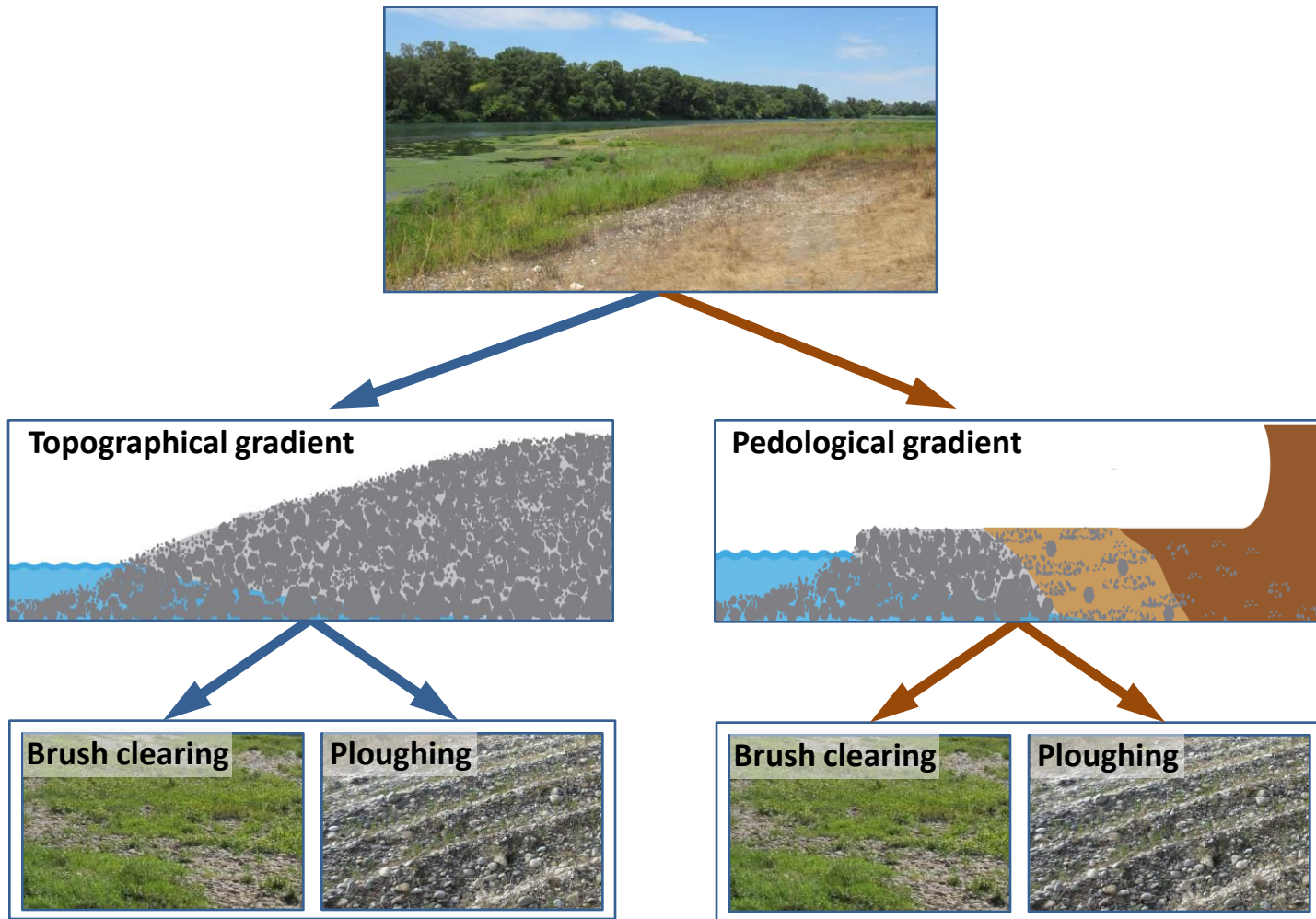


Pedological gradient

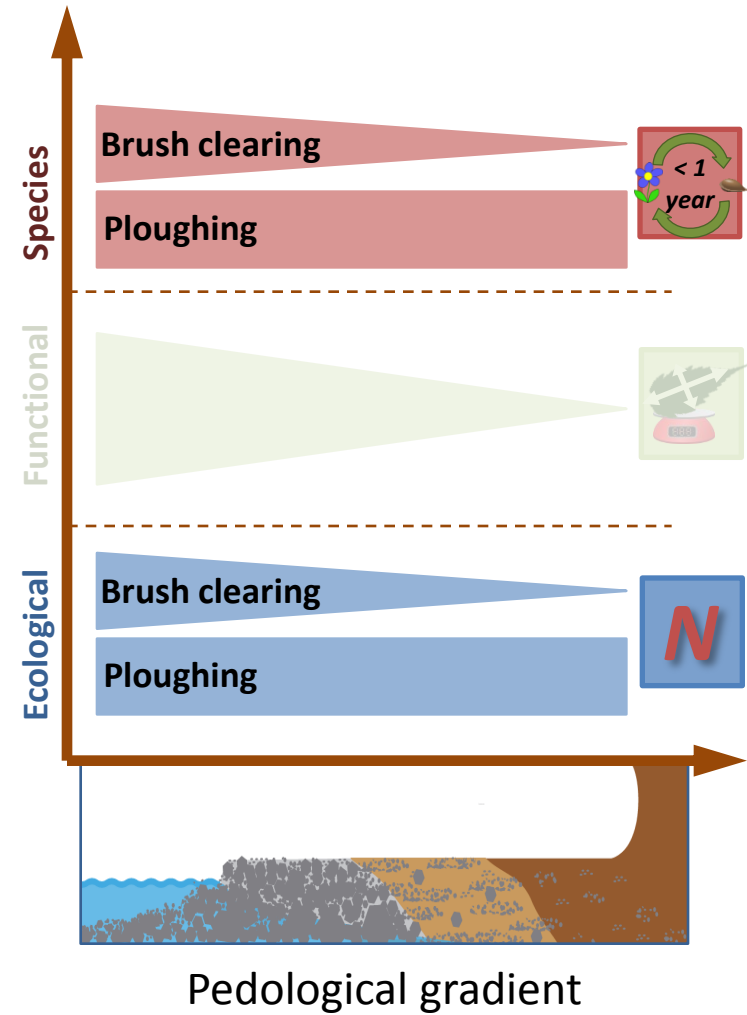
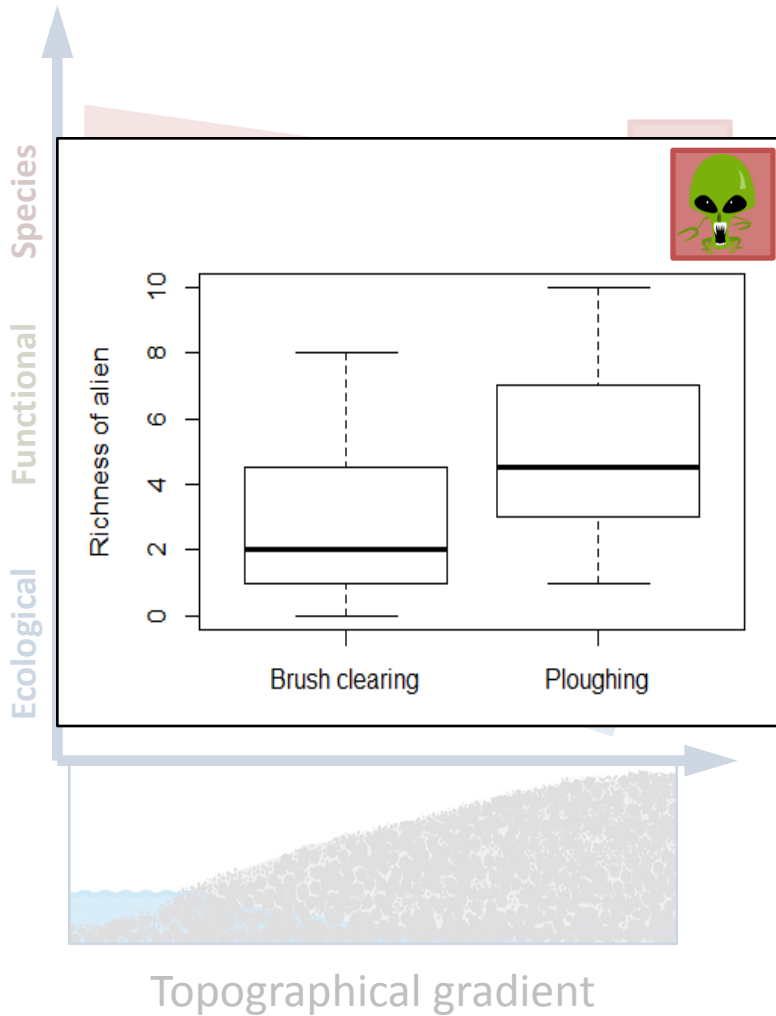
# Effect of environmental gradients



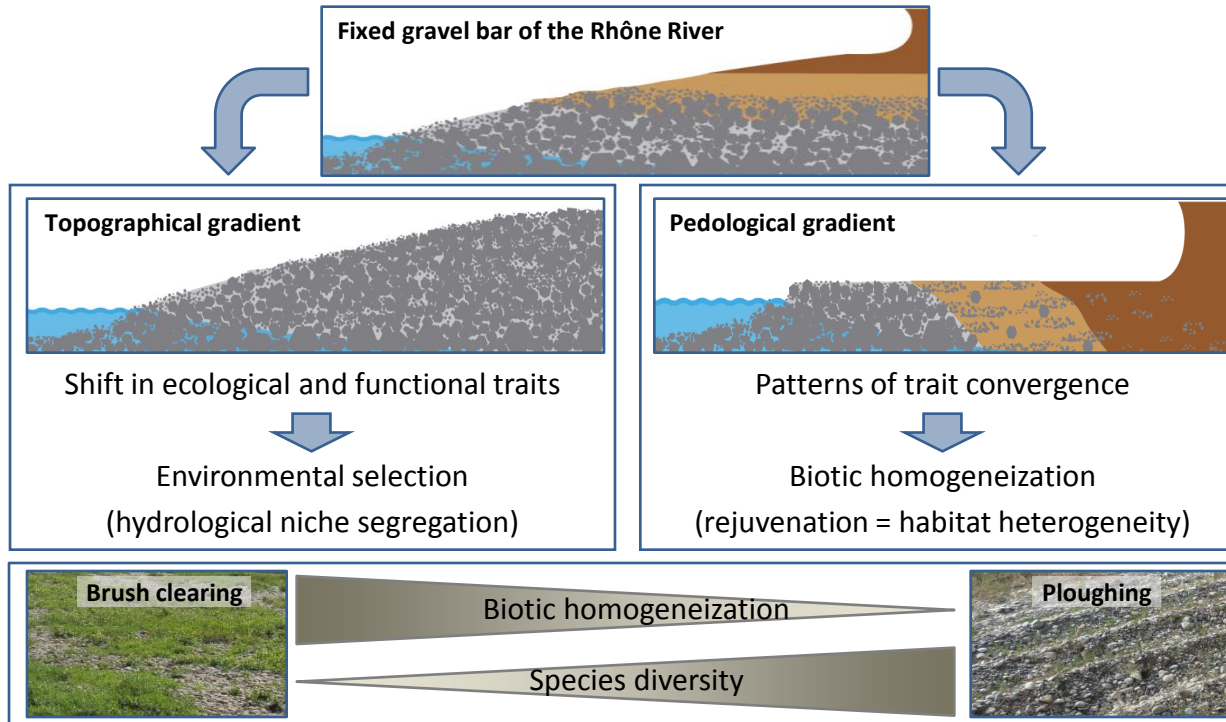
# Effect of maintenance operations



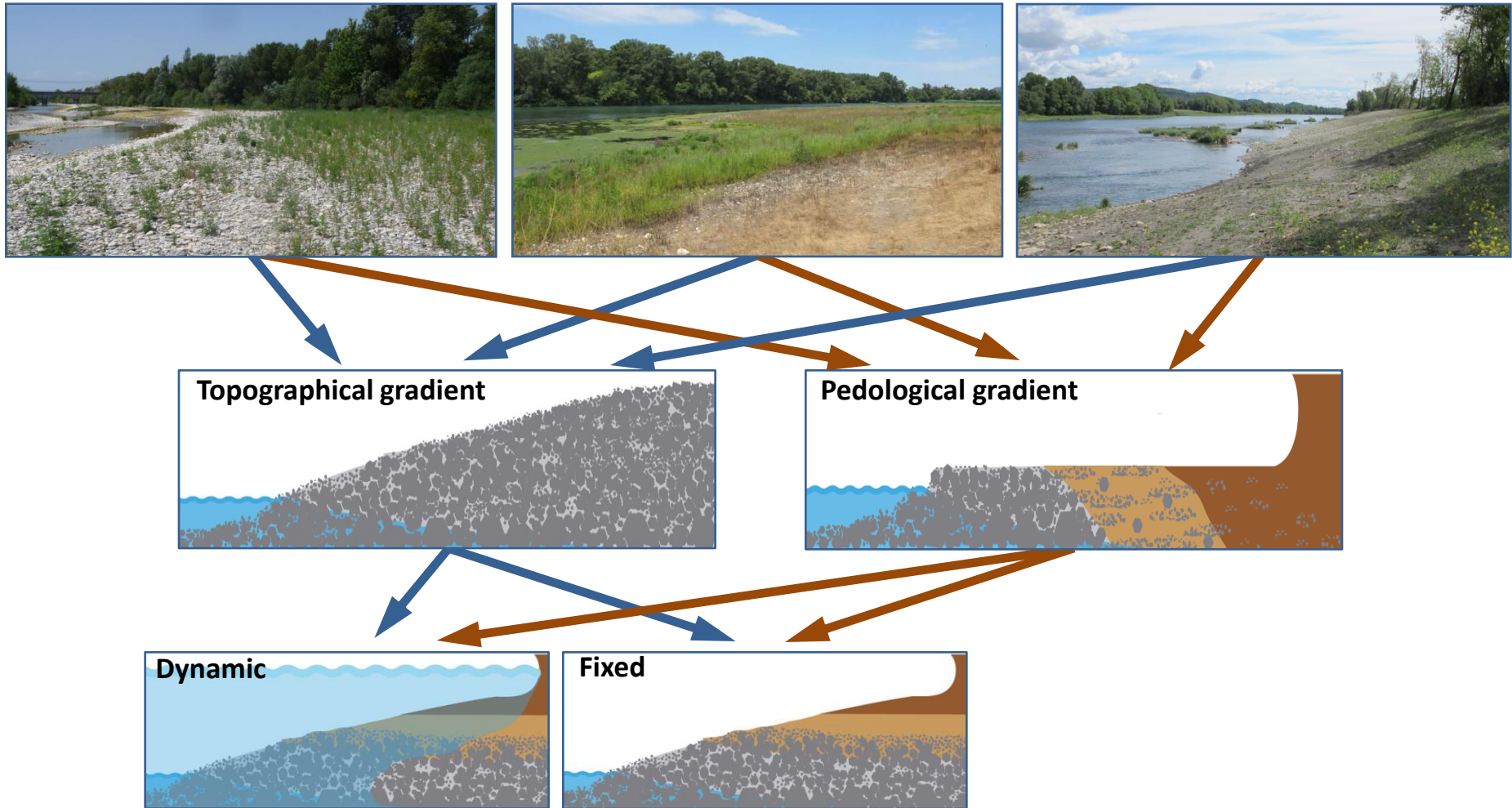
# Effect of maintenance operations



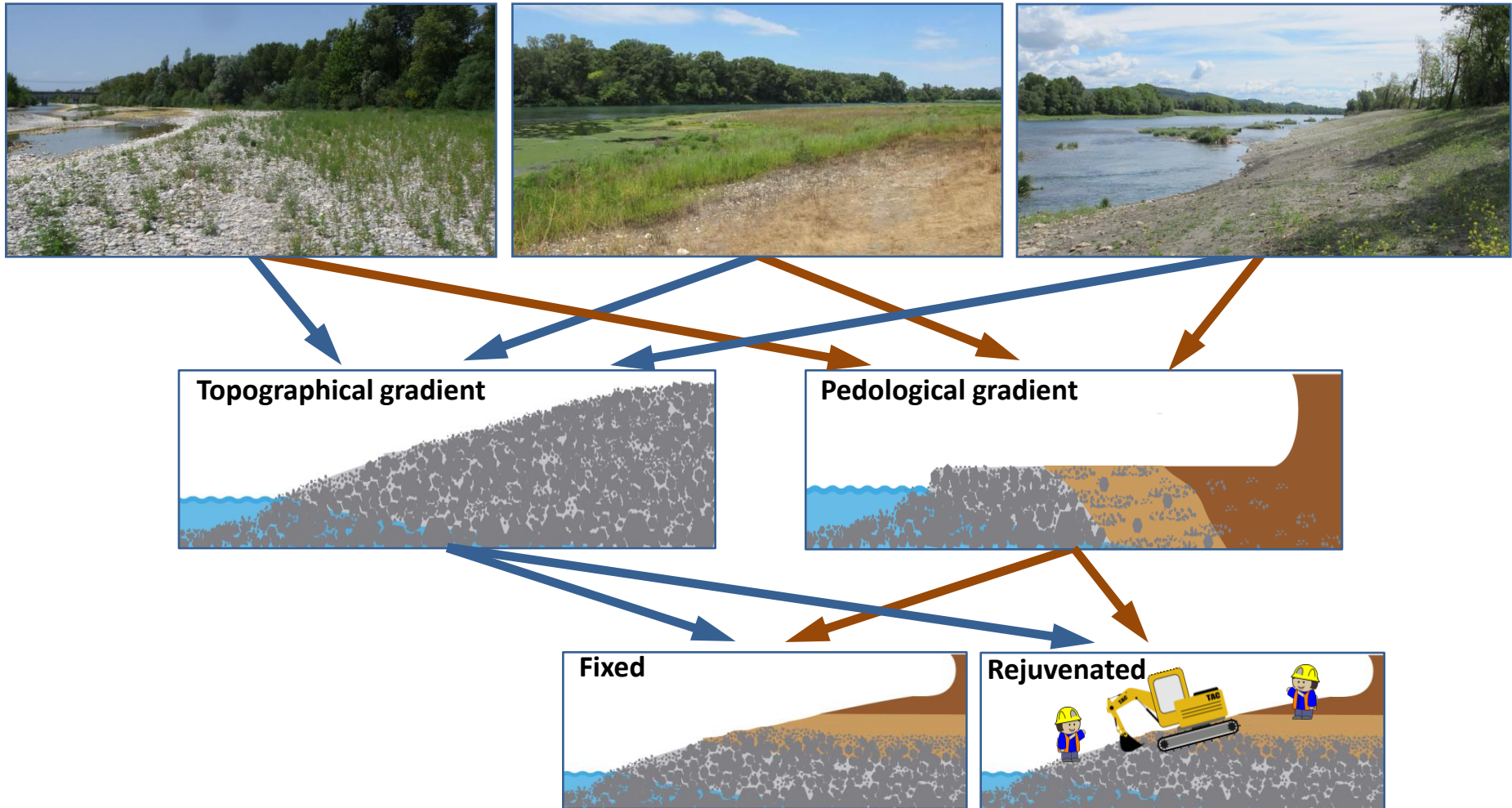
# Effect of maintenance operations



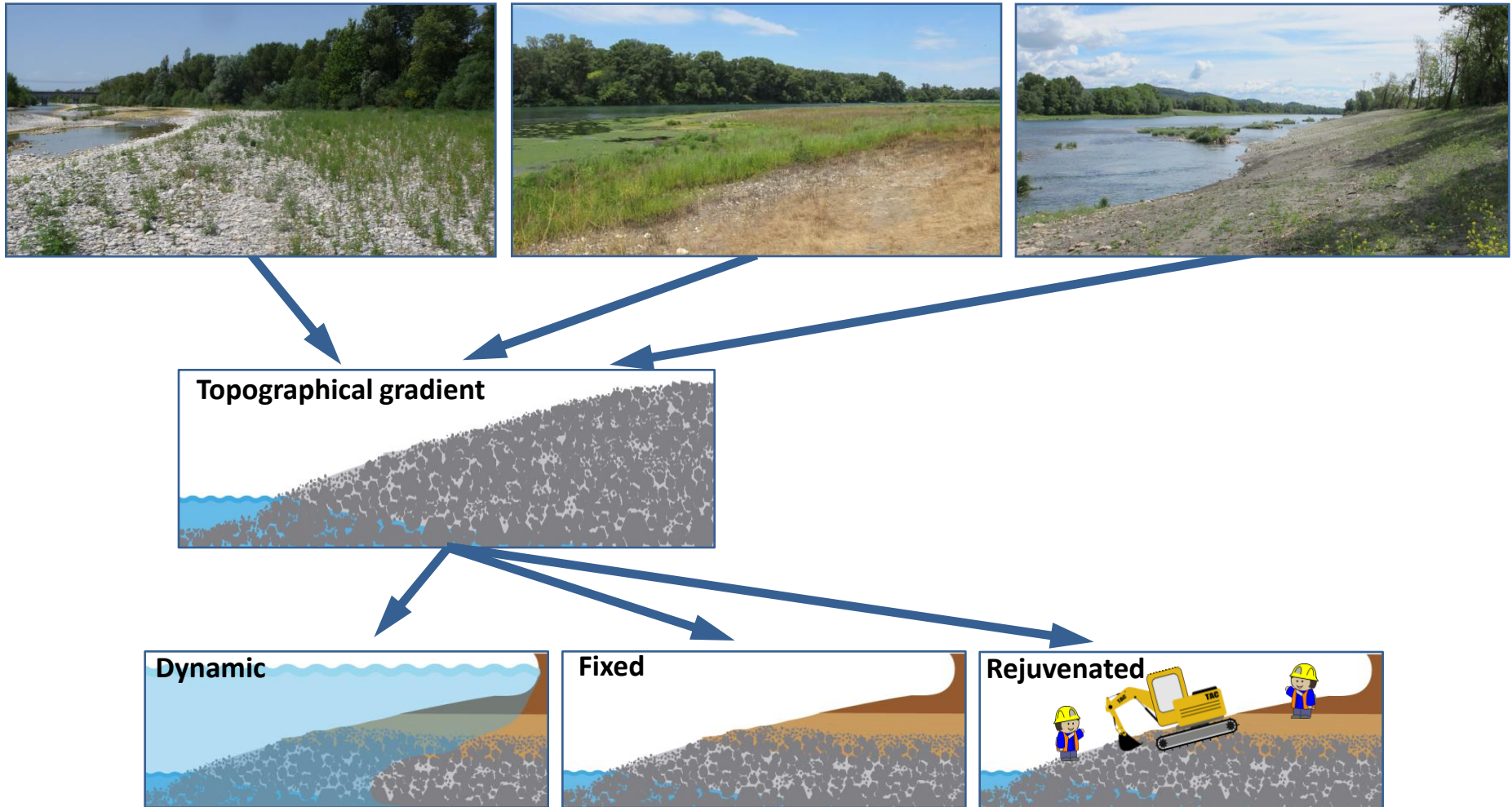
# Effect of restoration operations



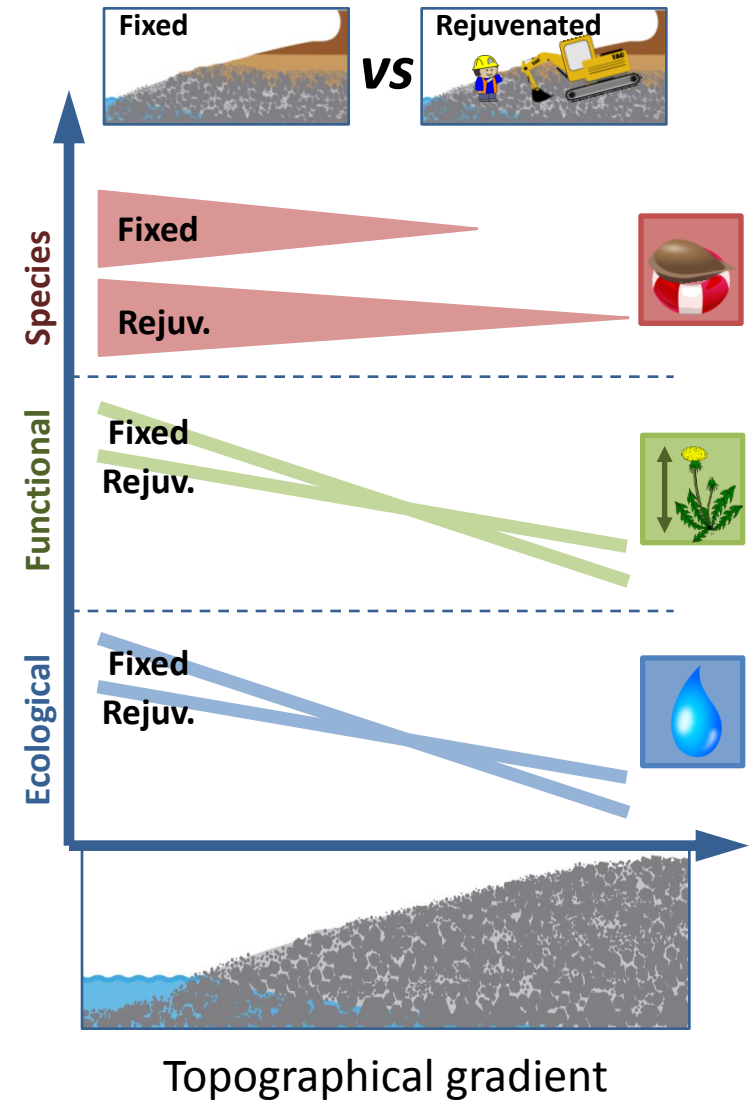
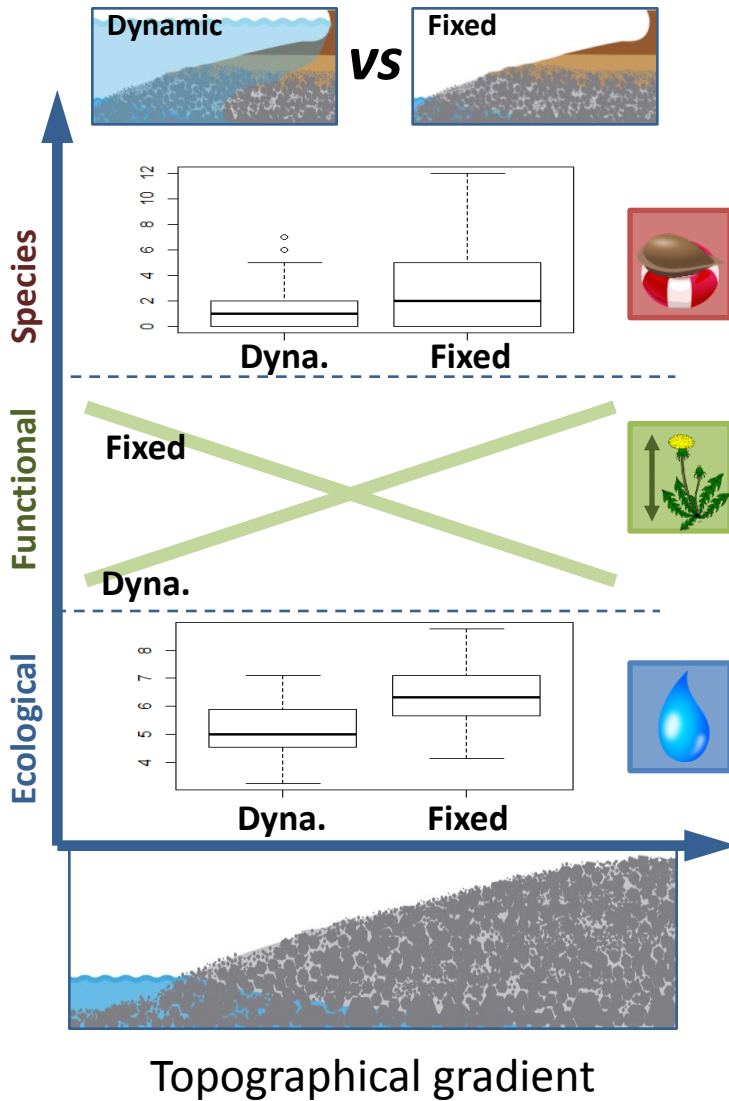
# Effect of restoration operations



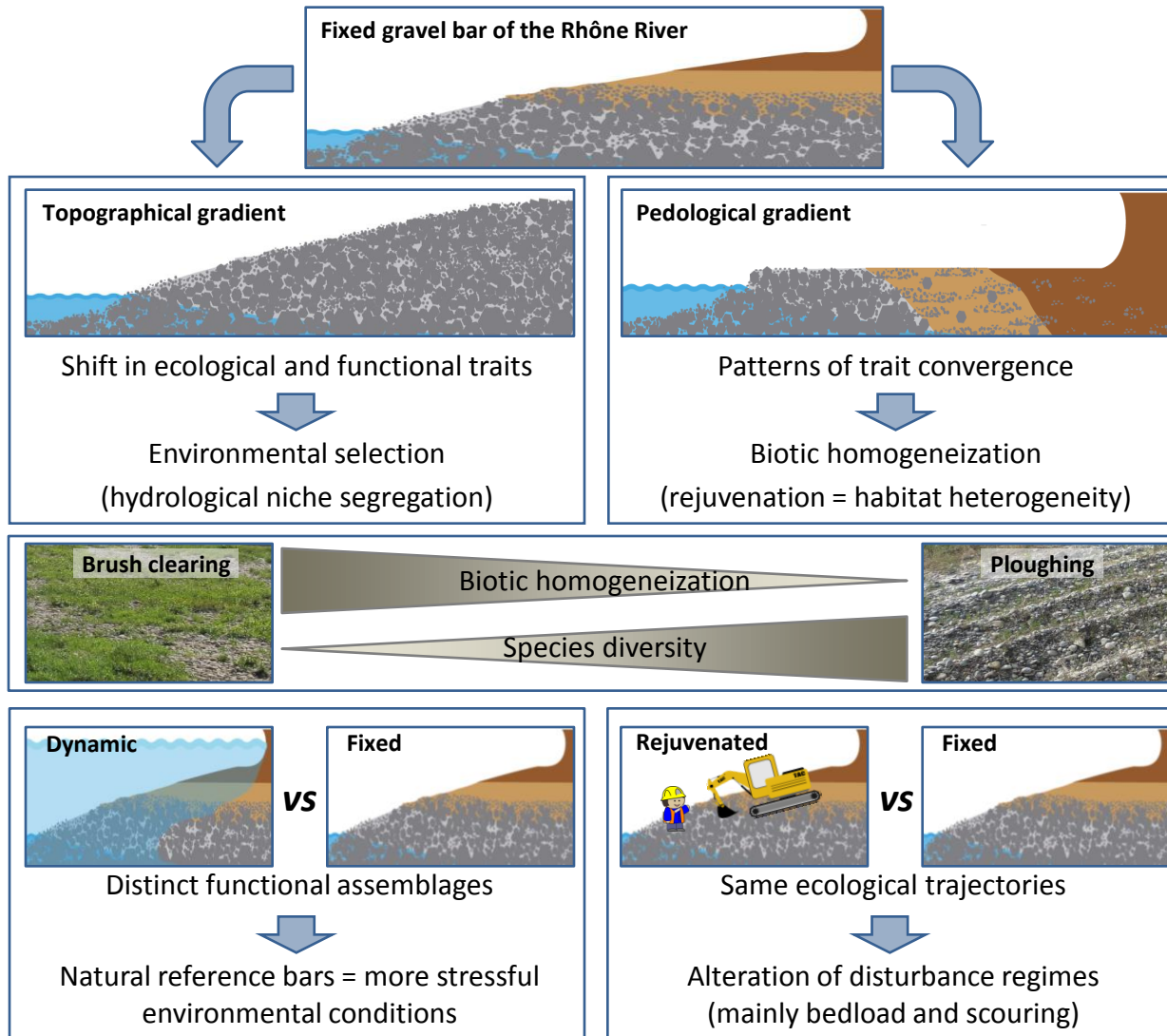
# Effect of restoration operations



# Effect of restoration operations



# Effect of restoration operations



# Take-home messages...

- Both gradients have strong effect on plant functional composition;
- Co-occurrence of species is higher on highly disturbed sites;
- Rejuvenation processes avoid biotic homogenization and promote habitat heterogeneity;
- Human activities mediate environmental gradients:
  - ploughing promote pioneer communities but also alien species;
  - dynamic gravel bars are more stressful environments;
  - rejuvenated surfaces follow the ecological trajectories of fixed ones.
- Effective ecological restoration strategies should imply:
  - reactivation of bedload transport and supply + greater variability of the minimum flow;
  - engineering operations that better mimic landform and soil properties of dynamic gravel bars.



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