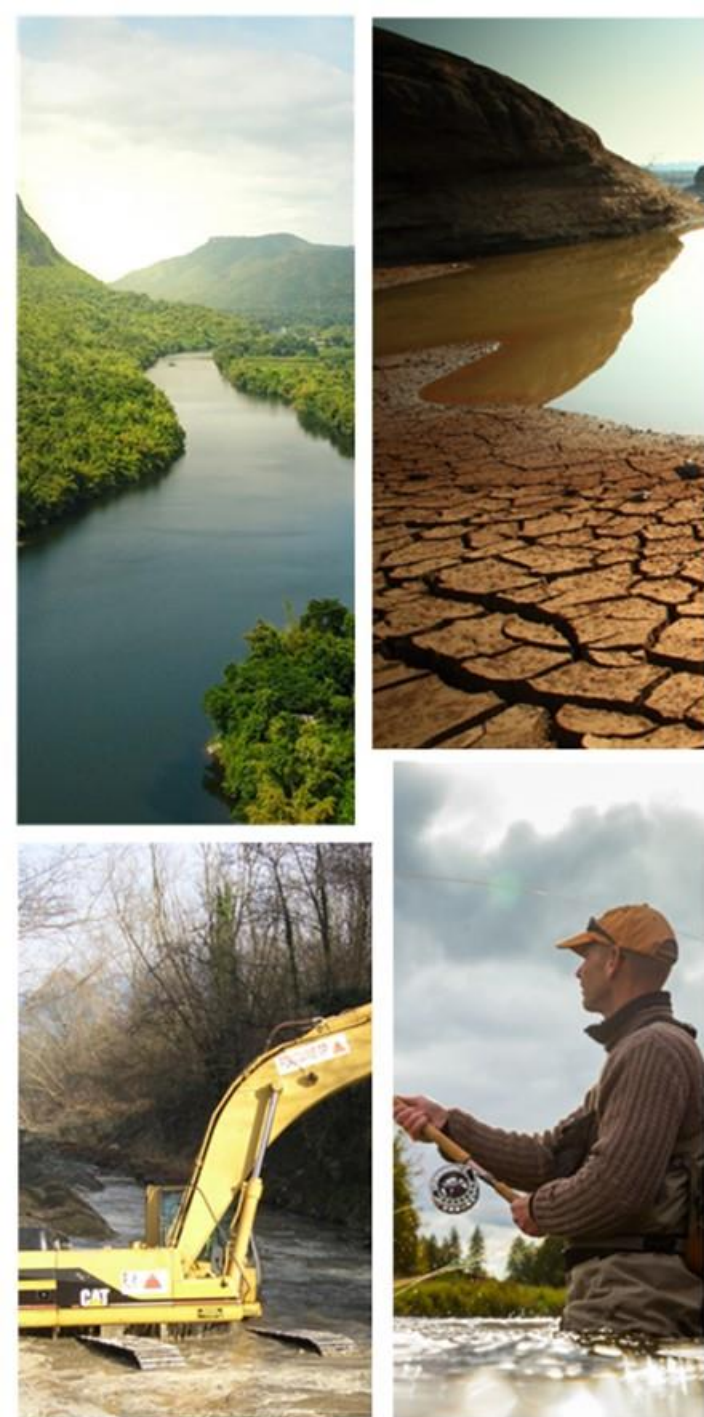


Long and short term effects of anthropogenic developments on the riparian communities of the Rhône

Janssen Philippe¹, Piégay Hervé² & Evette André¹

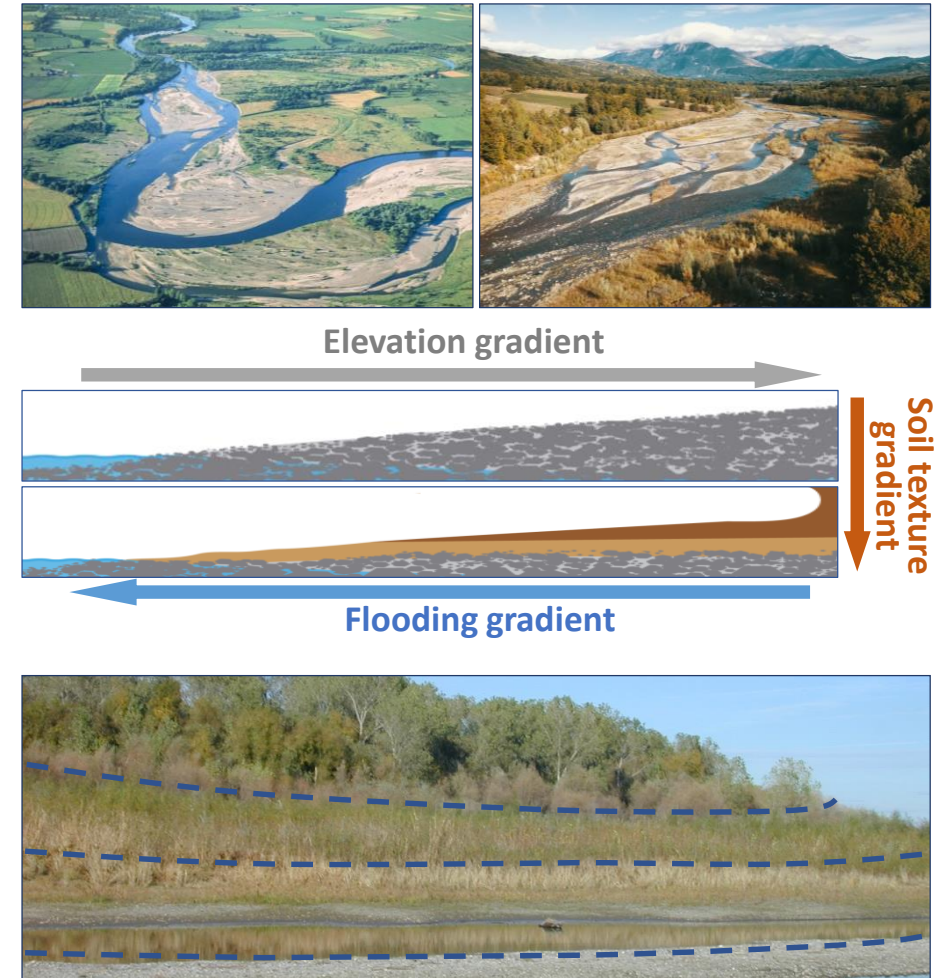
¹Univ. Grenoble Alpes, INRAE, LESSEM, Grenoble, France

²CNRS, UMR 5600 Environnement Ville Société, Lyon, France



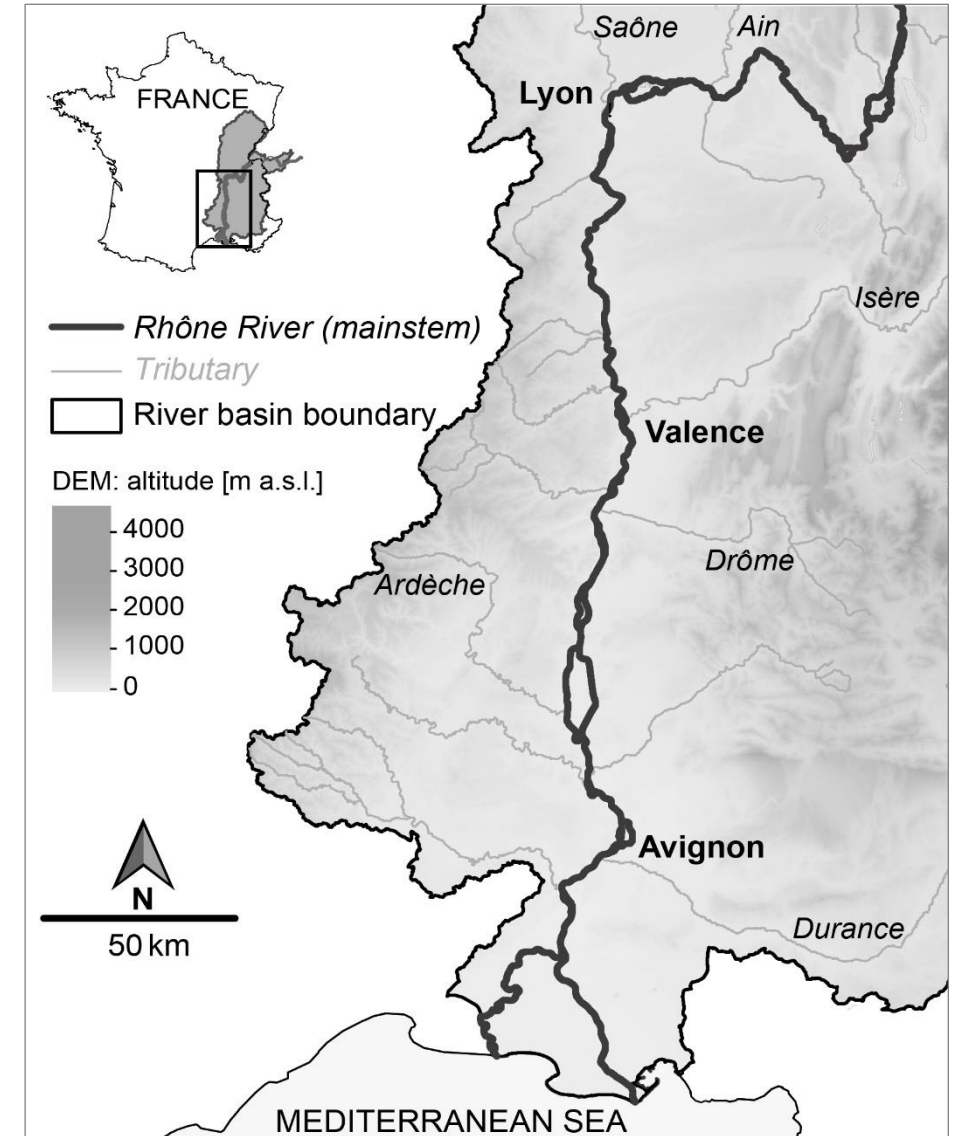
Introduction: Riparian ecosystems

- Interface habitat between aquatic and terrestrial environments
- Home to a very rich biodiversity and provides many ecosystem services
- Very dynamic environment with strong environmental gradients
- Spatial and temporal structuring of riparian plant communities



Introduction: the Rhone River

- A large and powerful River
 - total length = 810 km
 - watershed area = 96 500 km²
 - mean flow = 1 700 m³/s



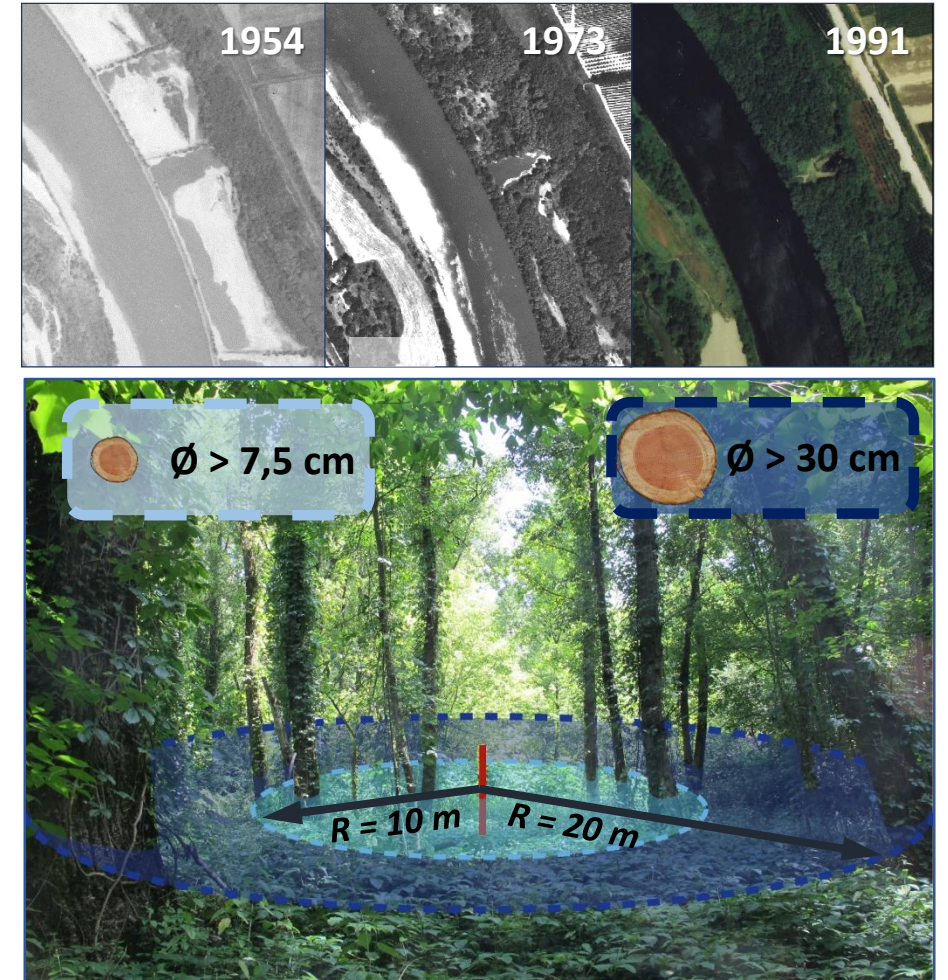
Introduction: the Rhone River

- A large and powerful River
 - total length = 810 km
 - watershed area = 96 500 km²
 - mean flow = 1 700 m³/s
- A highly degraded hydrosystem
 - rectification phase in the 19th century
 - derivation phase in the 20th century
- A history of development that has long and short-term impacts on riparian plant communities



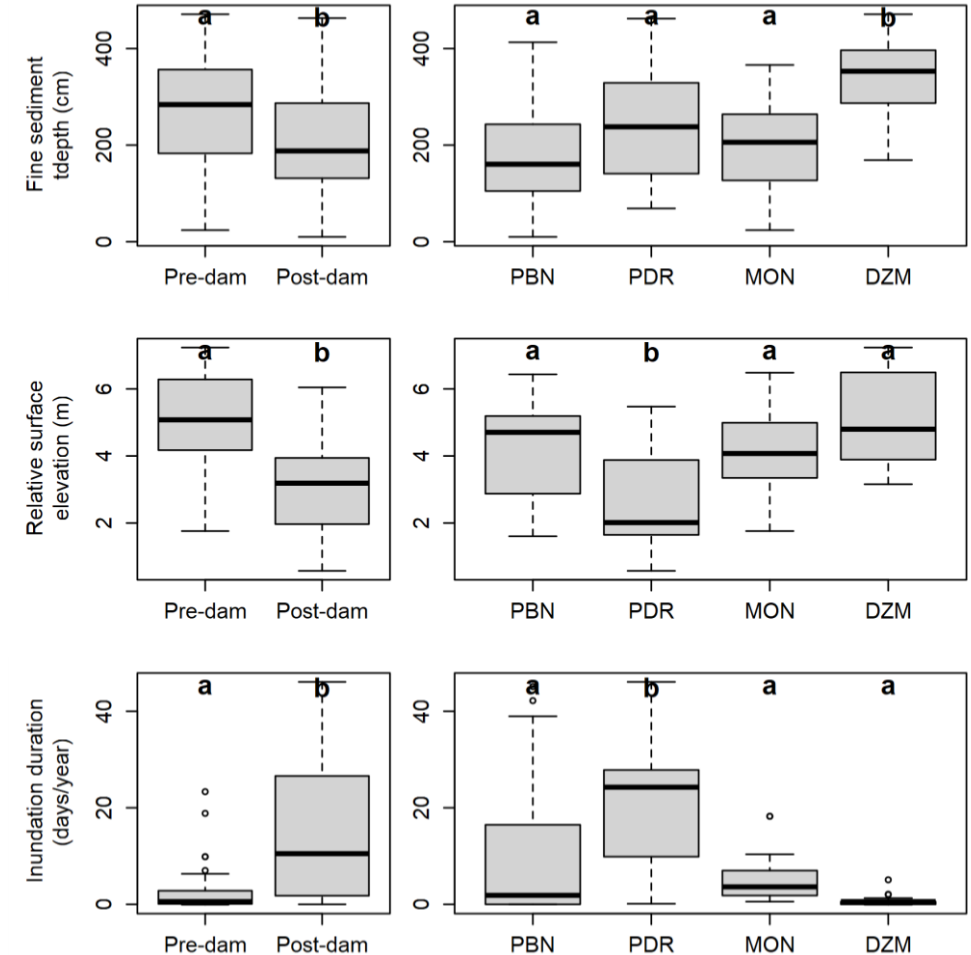
Long term effects of developments on riparian forests

- Structure and composition of dike field forests on pre- and post-dam surfaces
- 82 forest stands sampled :
 - 42 pre-dam surfaces + 40 post-dam surfaces
 - Four bypassed reaches : Pierre-Bénite (21), Péage-de-Roussillon (20), Montélimar (20), Donzère-Mondragon (21)
- Effects of derivation and position on:
 - Environmental conditions ?
 - Forest stands attributes ?



Long term effects of developments on riparian forests

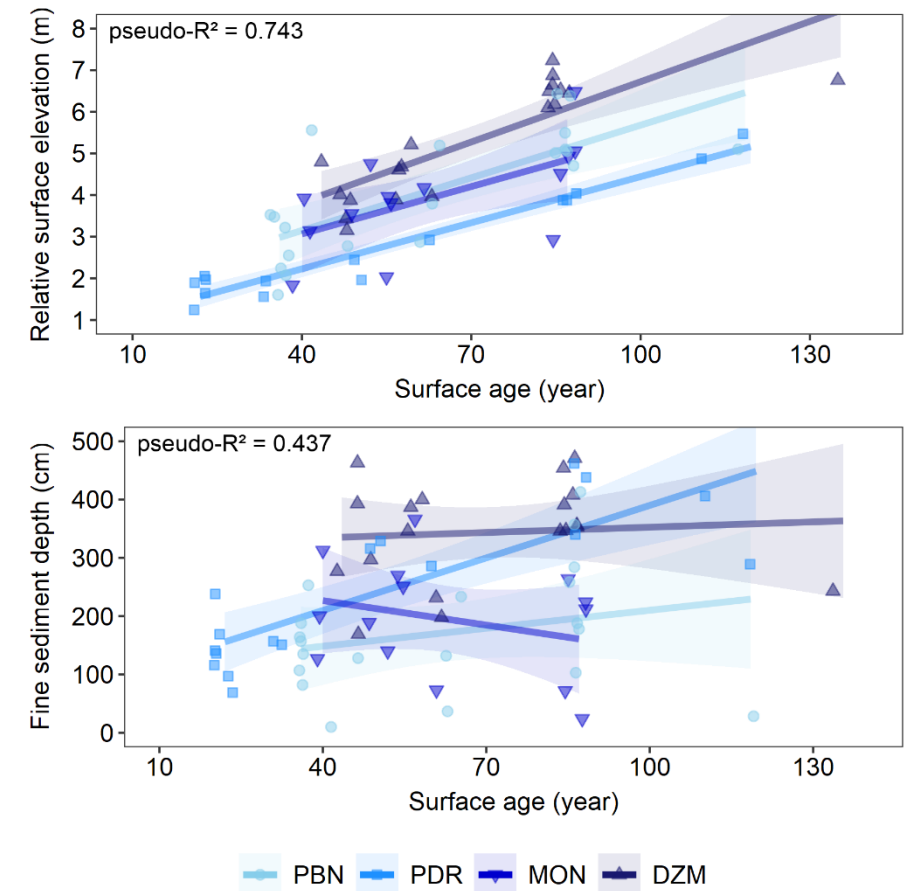
- High sedimentation rate and rapid disconnection on all 4 bypassed reaches
- Pre-dam surfaces have a greater thickness of sediment, are higher and less floodable
- Dike field elevation is lower at Péage-de-Roussillon while sediment thickness is greater at Donzère-Mondragon



Janssen et al. 2021. *Journal of Environmental Management*, 279, 111630

Long term effects of developments on riparian forests

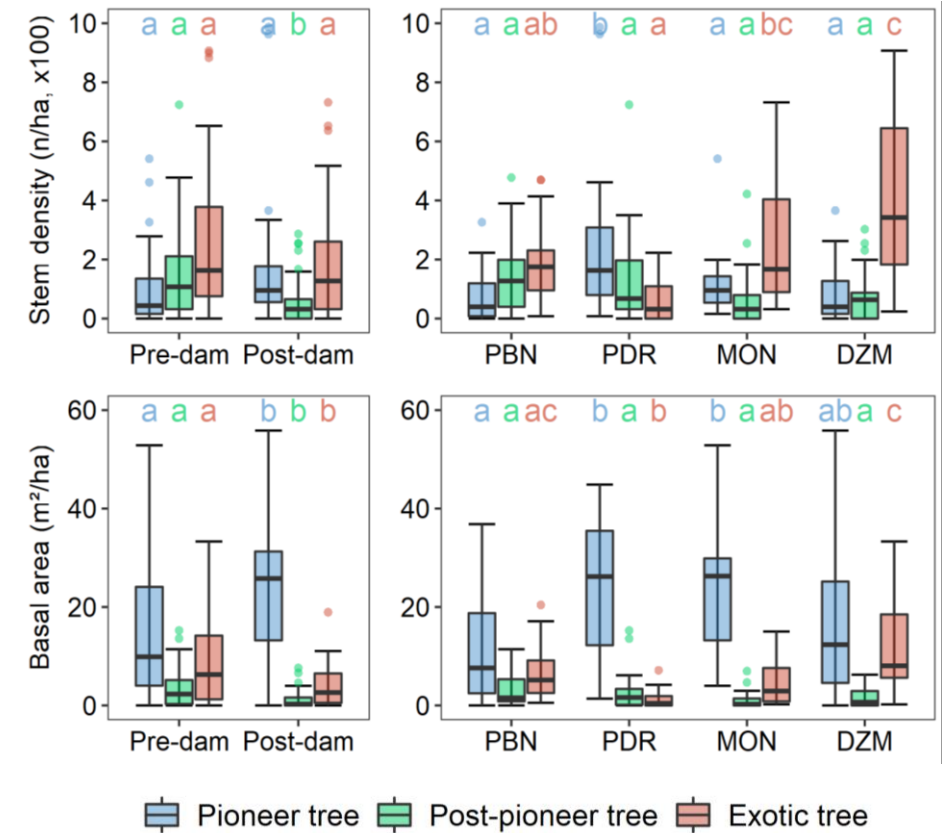
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- Pre-dam surfaces have a greater thickness of sediment, are higher and less floodable
- Dike field elevation is lower at Péage-de-Roussillon while sediment thickness is greater at Donzère-Mondragon
- Terrestrialization process results from both sedimentation and incision



Janssen et al. 2021. *Journal of Environmental Management*, 279, 111630

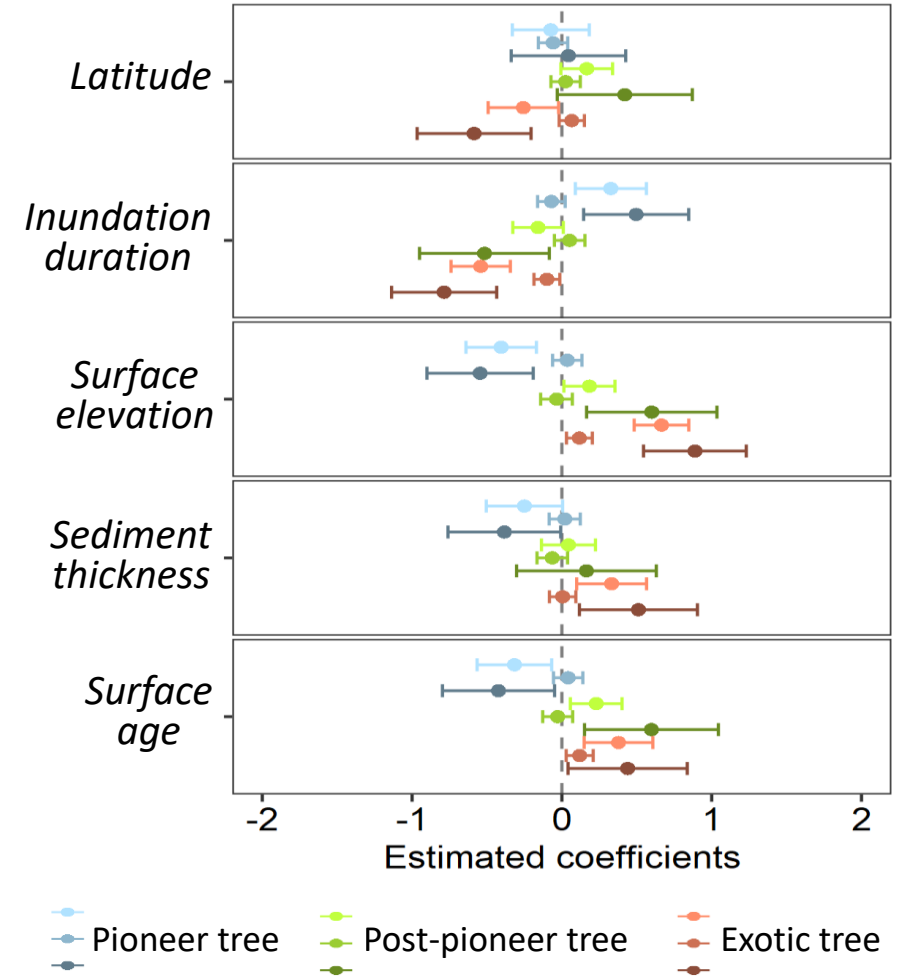
Long term effects of developments on riparian forests

- Post-pioneer and exotic trees dominate pre-dam surfaces
- Pioneer trees, represented by large aging individuals, dominate post-dam surfaces
- Pioneer trees still dominate the Péage de Roussillon stands, while exotic trees dominate those of Donzère-Mondragon.



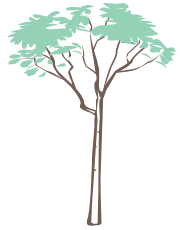
Long term effects of developments on riparian forests

- Post-pioneer and exotic trees dominate pre-dam surfaces
- Pioneer trees, represented by large aging individuals, dominate post-dam surfaces
- Pioneer trees still dominate the Péage de Roussillon stands, while exotic trees dominate those of Donzère-Mondragon
- Surface elevation best explains variations in the structure and composition

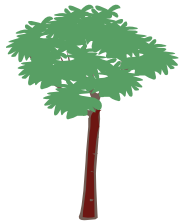


Janssen et al. 2021. *Journal of Environmental Management*, 279, 111630

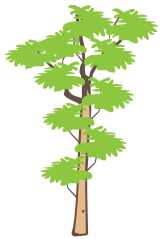
Long term effects of developments on riparian forests



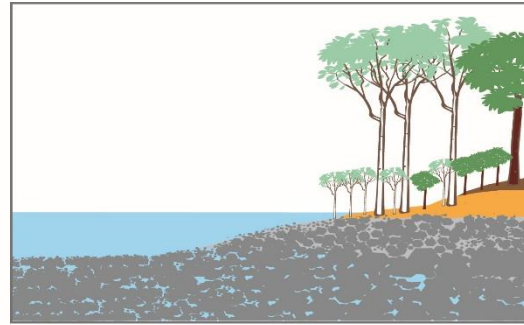
Pioneer



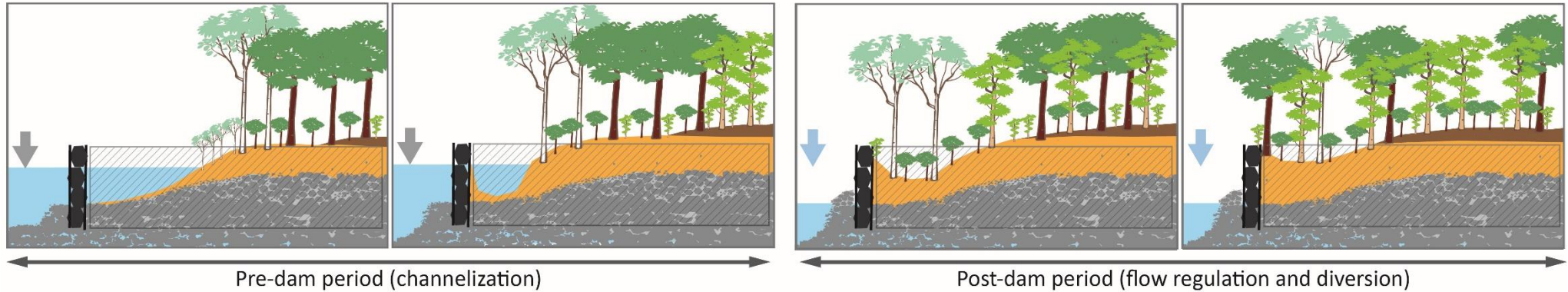
Post-pioneer



Exotic

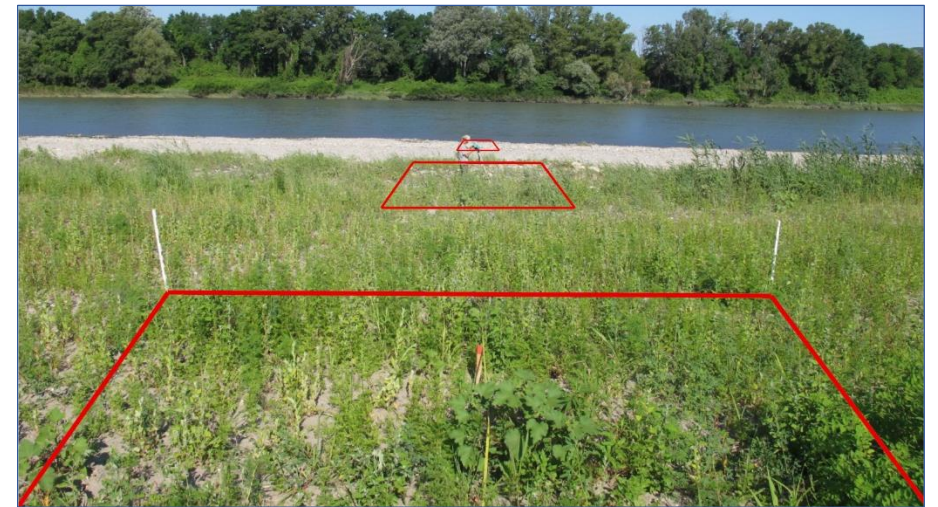


Pre-channelization/regulation period



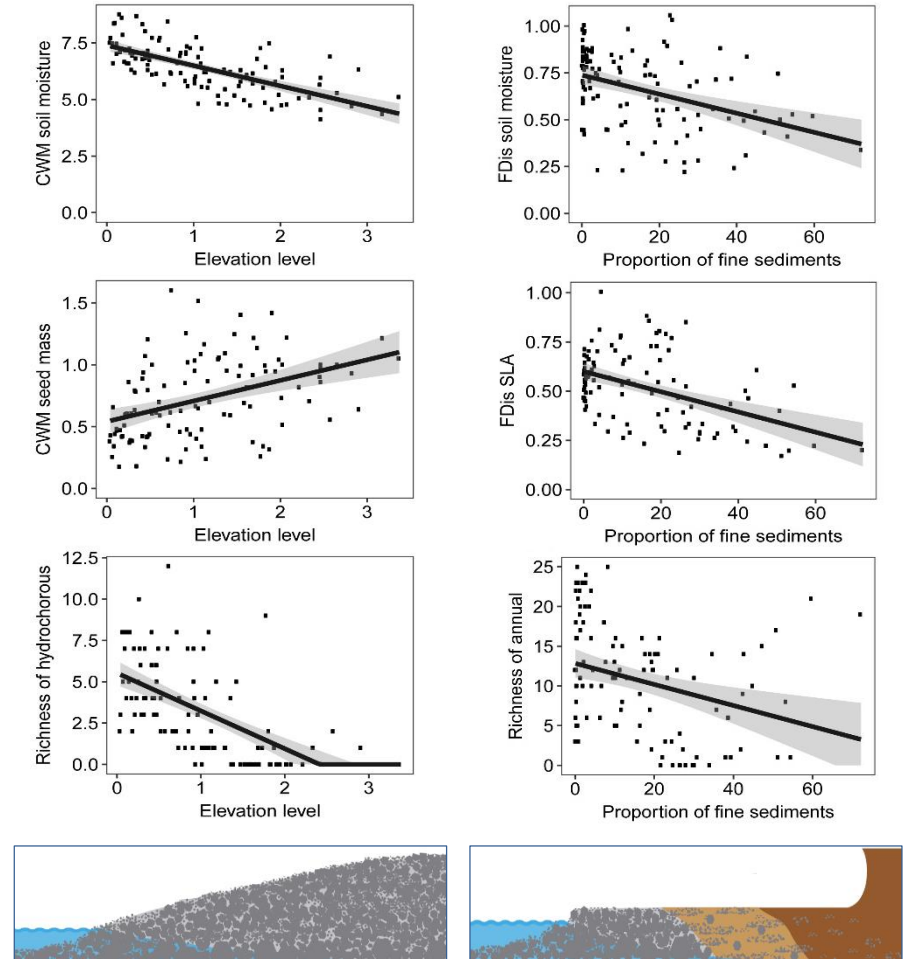
Short term effects of developments on herbaceous plants

- Herbaceous species have colonized gravel bars emerged following diversion
- Bars are managed by brush-clearing or plowing to prevent tree encroachment
- 20 gravel bars sampled (600 quadrats):
 - 3 transects of 4 quadrats per gravel bar
 - Temporal monitoring since 2017
- Effects of environmental gradients on:
 - Community structure ?
 - Community dynamics ?



Short term effects of developments on herbaceous plants

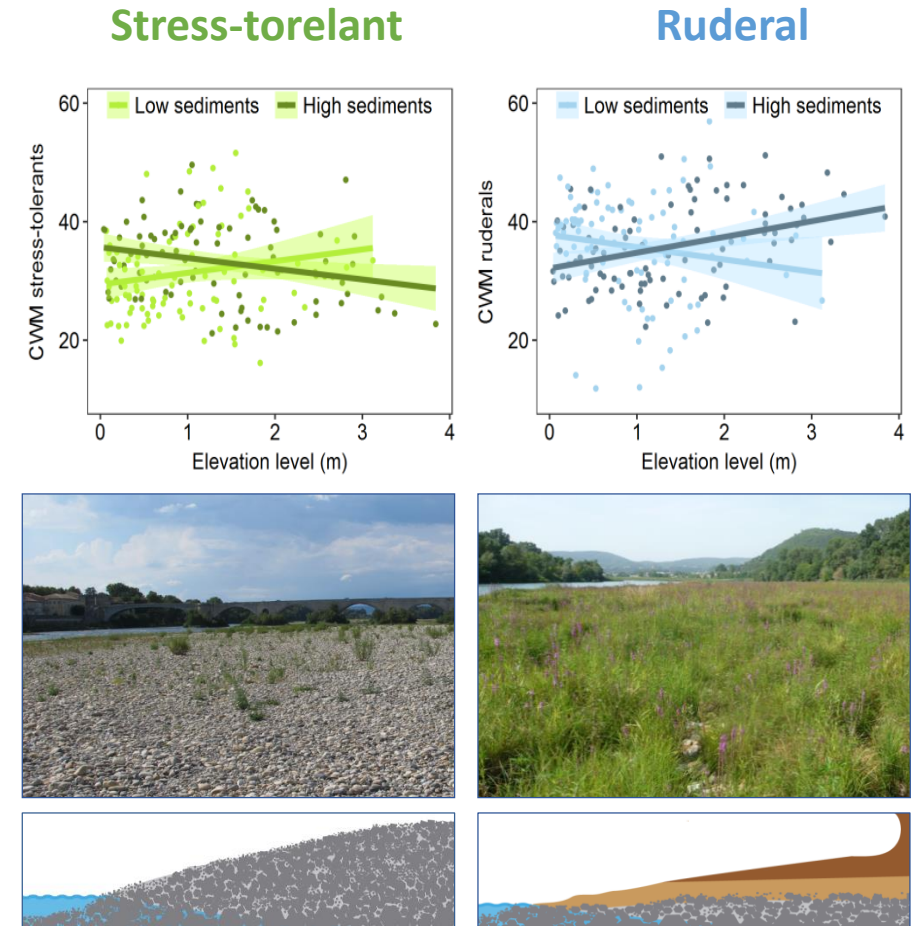
- Elevation gradient induces a shift in trait values due to environmental selection
- Fine sediment deposits induces a decrease in species richness and trait values



Janssen et al. 2019. *Science of the Total Environment*, 656, 1312-1325

Short term effects of developments on herbaceous plants

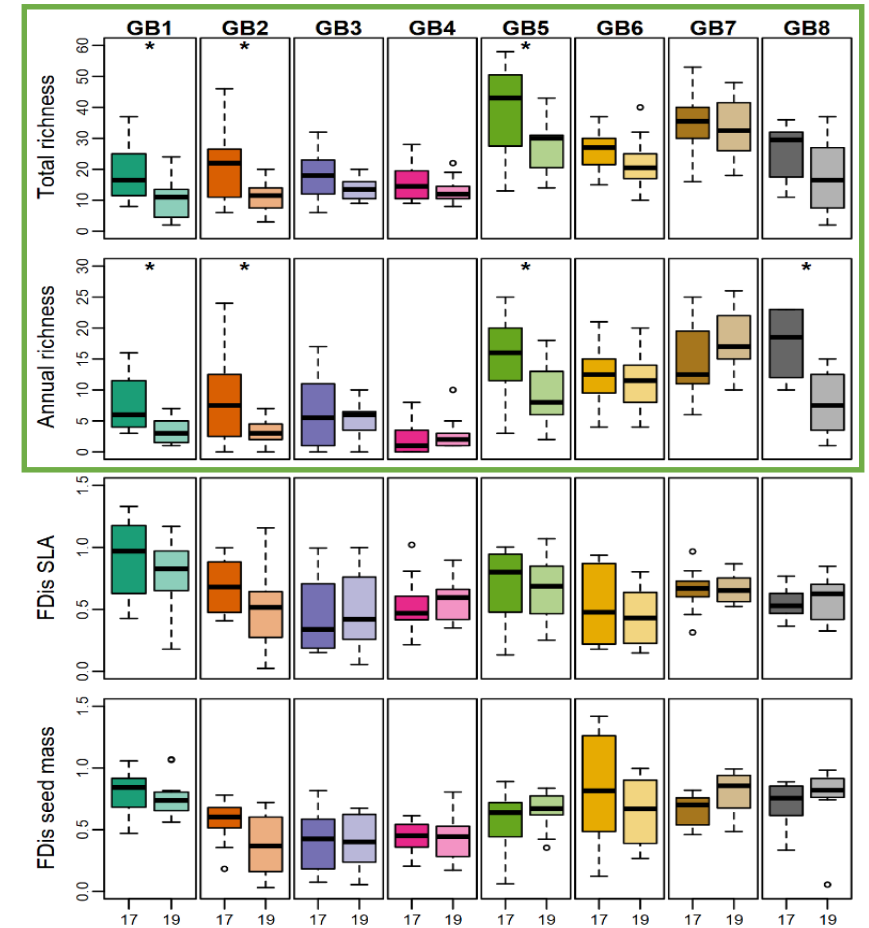
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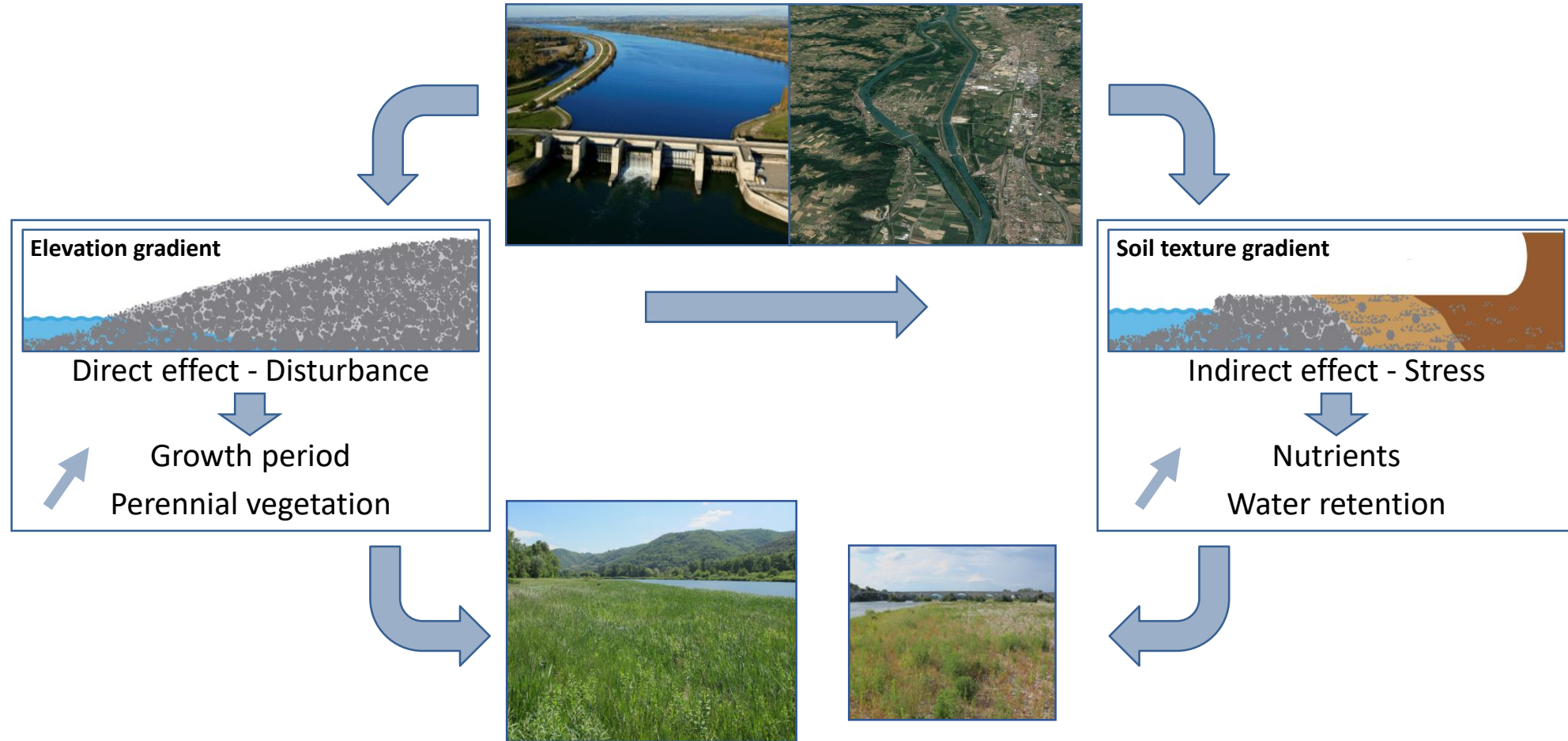
Janssen et al. 2020. *Applied Vegetation Science*, 23, 425-463

Short term effects of developments on herbaceous plants

- Elevation gradient induces a shift in trait values due to environmental selection
- Fine sediment deposits induces a decrease in species richness and trait values
- Fine sediments deposits induces a destructuring of the communities along the elevation gradient
- Herbaceous communities on gravel bars are the most diverse and still shaped by flood events

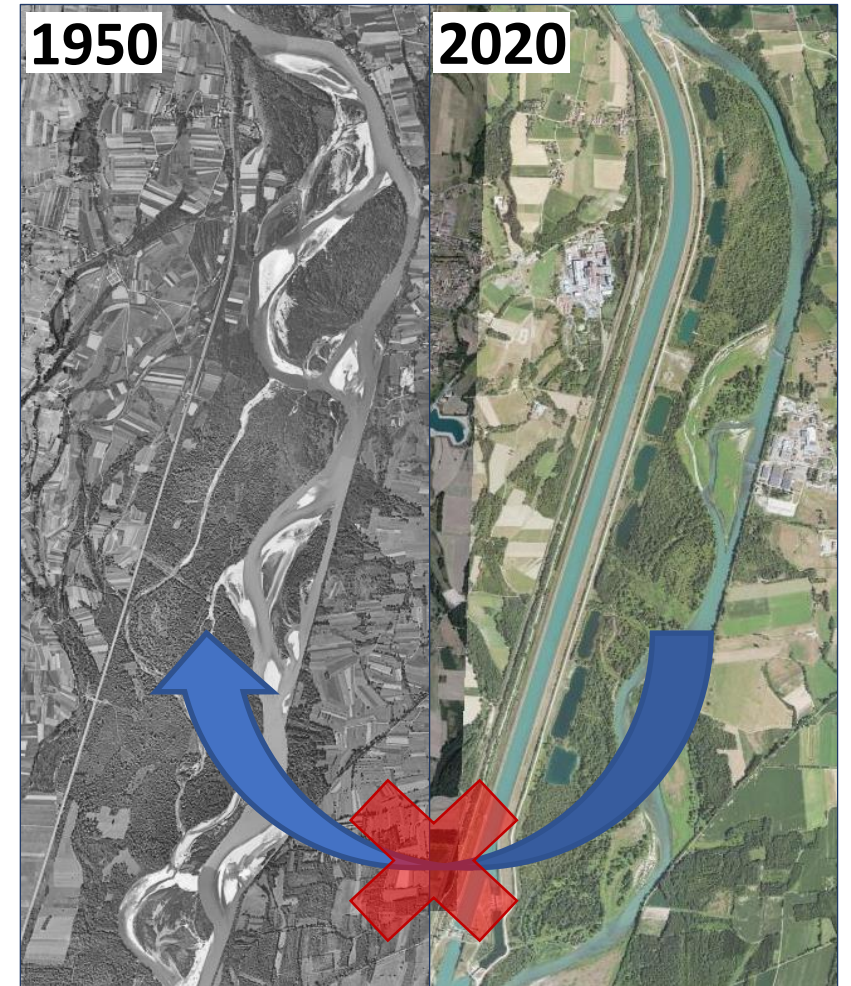


Short term effects of developments on herbaceous plants



Implications for management and restoration

- At the corridor scale, returning to a near-natural state is unrealistic and would require extreme interventions



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Implications for management and restoration

- At the corridor scale, returning to a near-natural state is unrealistic and would require extreme interventions
- At the reach scale, restoration should aim to reactivate bedload transport, re-naturalize flows and increase lateral connectivity
- At the site scale, restoration should promote gently sloping topographic profiles consisting of coarse-grained sediments



Acknowledgements

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