



HAL
open science

Biodiversity conservation and fish production in ponds: a contradiction?

Léo Girard, Joël Robin, Soraya Rouifed, Mathieu Guérin, Alexander Wezel,
Pieter Lemmens

► To cite this version:

Léo Girard, Joël Robin, Soraya Rouifed, Mathieu Guérin, Alexander Wezel, et al.. Biodiversity conservation and fish production in ponds: a contradiction?. Symposium for European Freshwater Sciences (SEFS13), Freshwater Biological Association, Jun 2023, Newcastle, United Kingdom. hal-04808225

HAL Id: hal-04808225

<https://isara.hal.science/hal-04808225v1>

Submitted on 28 Nov 2024

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.



Distributed under a Creative Commons Attribution - NonCommercial 4.0 International License



Biodiversity conservation and fish production in ponds: a contradiction?

Girard Léo¹, Robin Joël¹, Rouifed Soraya¹, Guerin Mathieu¹, Wezel Alexander¹, Lemmens Pieter²

¹ ISARA, Agroecology and Environment Unit, University of Lyon, 69364 Lyon, France

² Laboratory of Aquatic Ecology, Evolution and Conservation, KU Leuven, Leuven, Belgium

SS06. Ponds as integral part of aquatic and terrestrial landscapes

SEFS13, 19/06/2023, Newcastle



Introduction

In the Dombes region, ponds for fish production

Originally a wetland, transformed during the Middle Ages by monastic communities to create ponds (Avocat, 1975; Guichenon, 1650 cited in Sceau, 1980).

Several objectives:

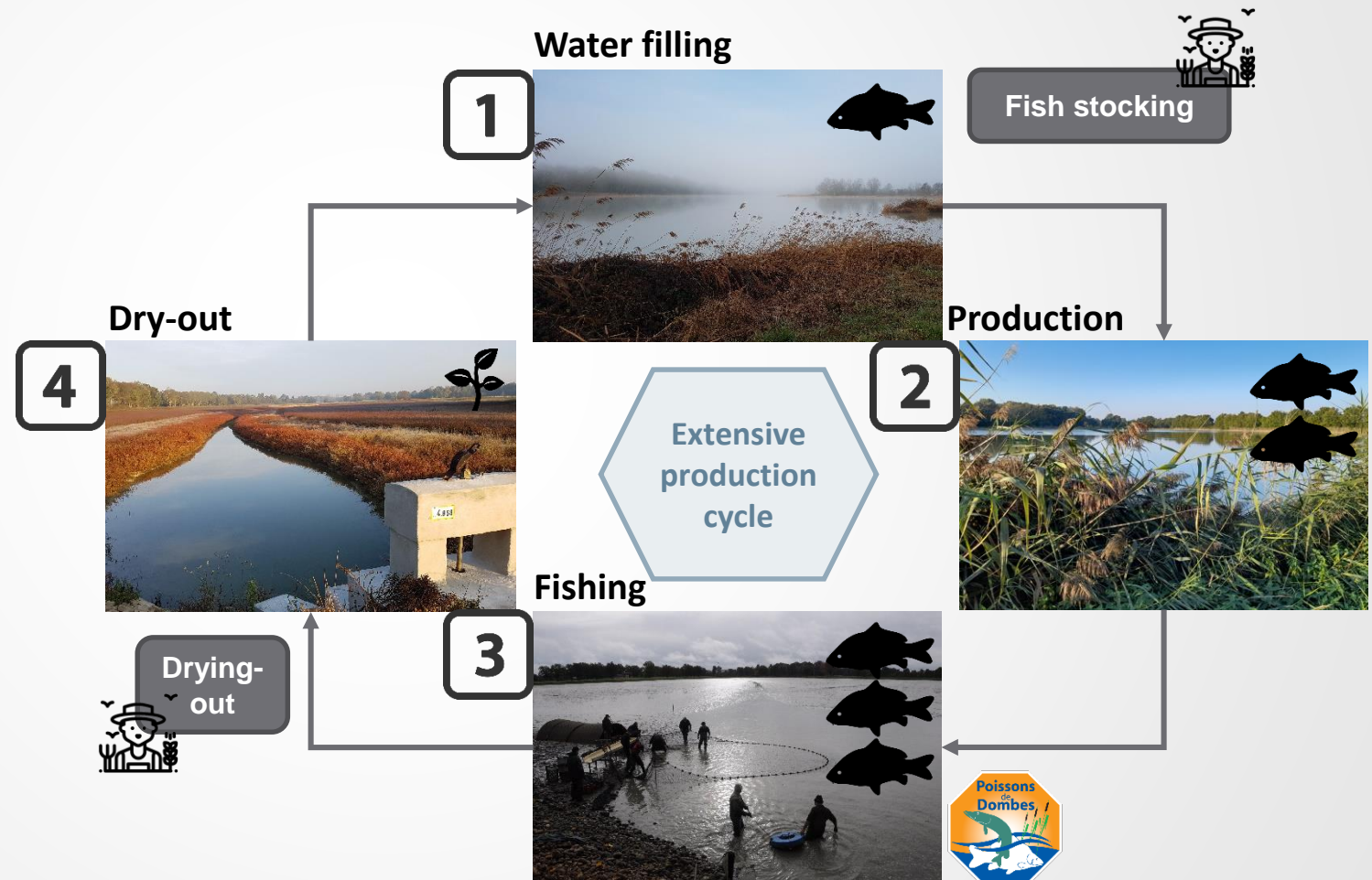
- Drain areas to cultivate land
- Create ponds to produce fish
- Sanitation and diseases control

A “productive pondscape”:

Around 1,100 ponds for 10,000 ha of water (average of 10 ha and 80 cm deep)
Between 600 and 1,000 tons of fish produced per year

- Artificial and managed environments (Hansson et al., 2005)

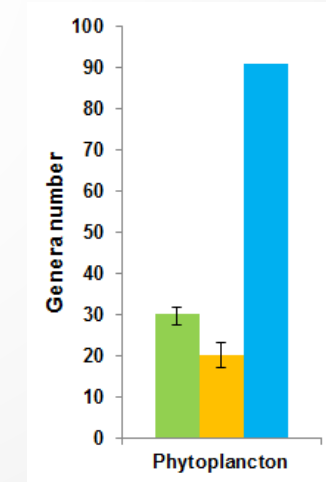
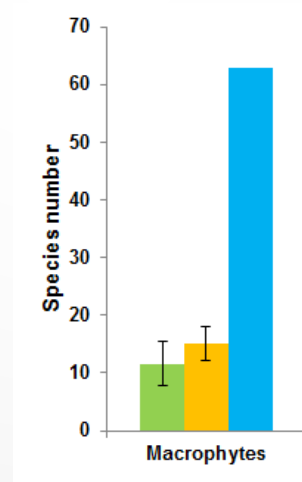
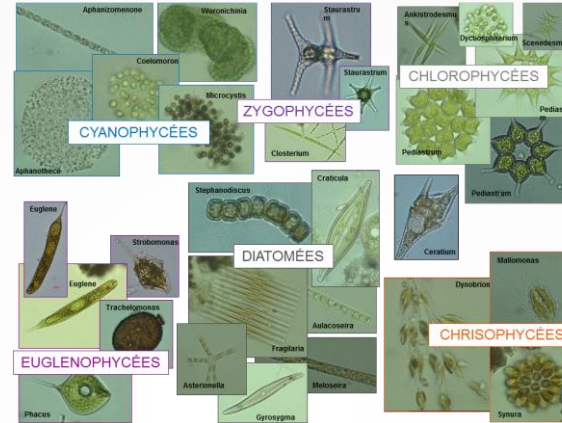
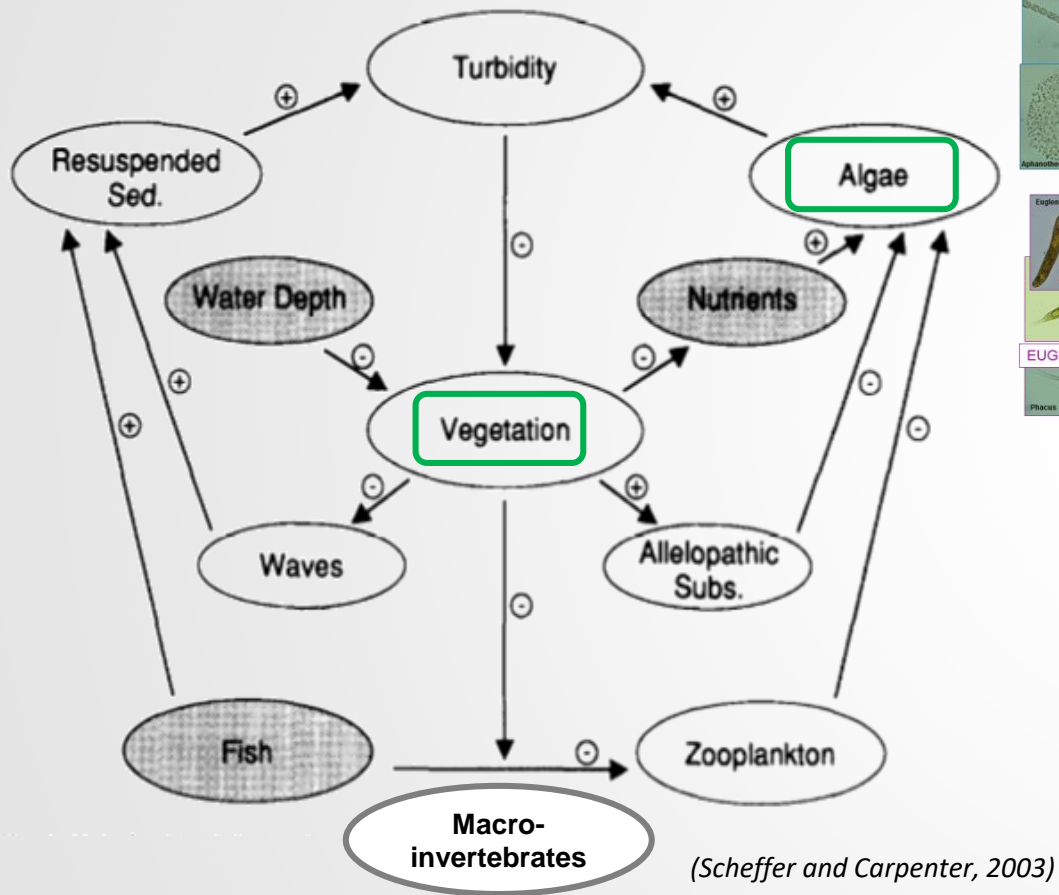
but also...



➔ two historical practices = intermediate levels of disturbances ?

Introduction

Ecosystem functioning and biodiversity



■ Alpha
■ Beta
■ Gamma

(Wezel et al., 2013)

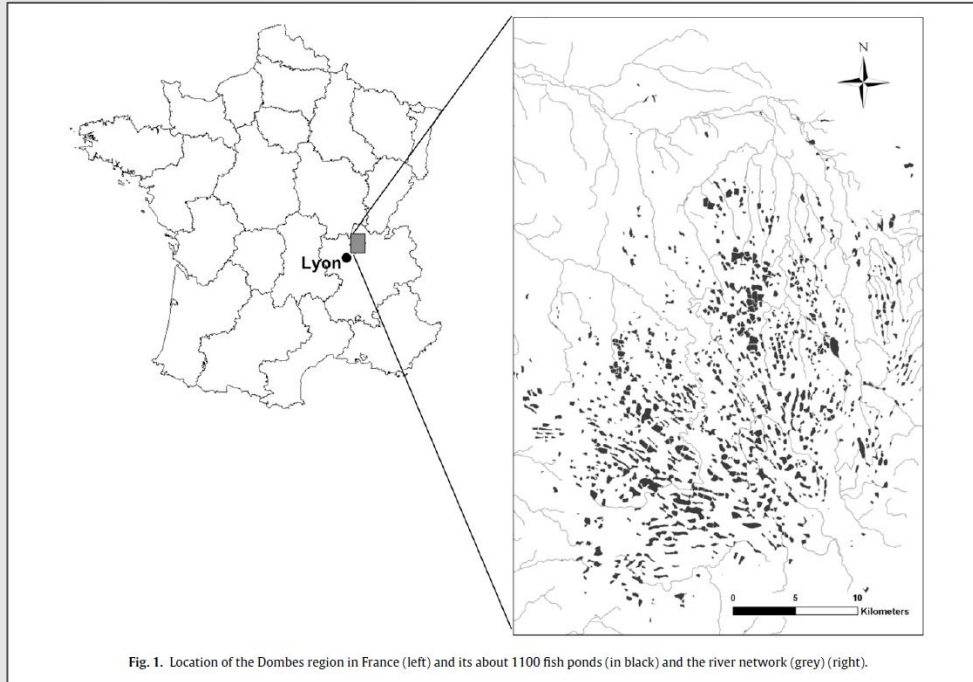
➔ **Two primary producers** at the base of food web functioning and energy: essential for **fish production** and **maintaining diversity**

➔ Fishponds = a **significant** contribution to **regional biodiversity**

How fish production practices affect biodiversity patterns ?

Materials and Methods

(Wezel et al., 2013)



Dombes

(Dombes Tourisme)

➔ Historical database of 85 fishponds from Dombes (2007-2014)

➔ PONDERFUL 2021 fishponds database from Dombes (France)



Midden-Limburg

and from Midden-Limburg (Belgium)

➔ Macrophyte species richness and cover

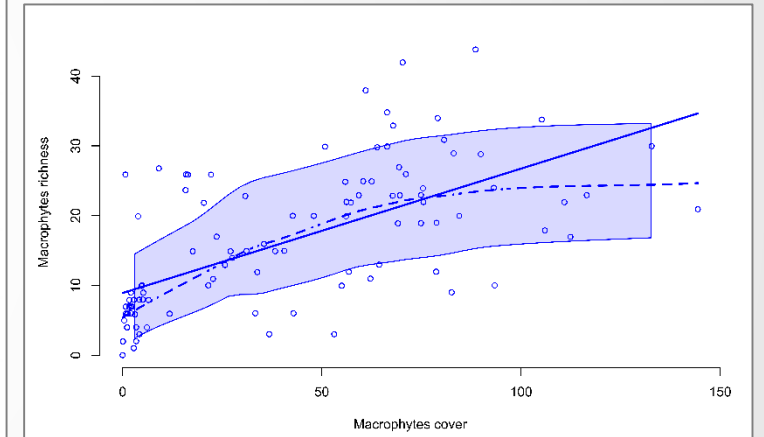
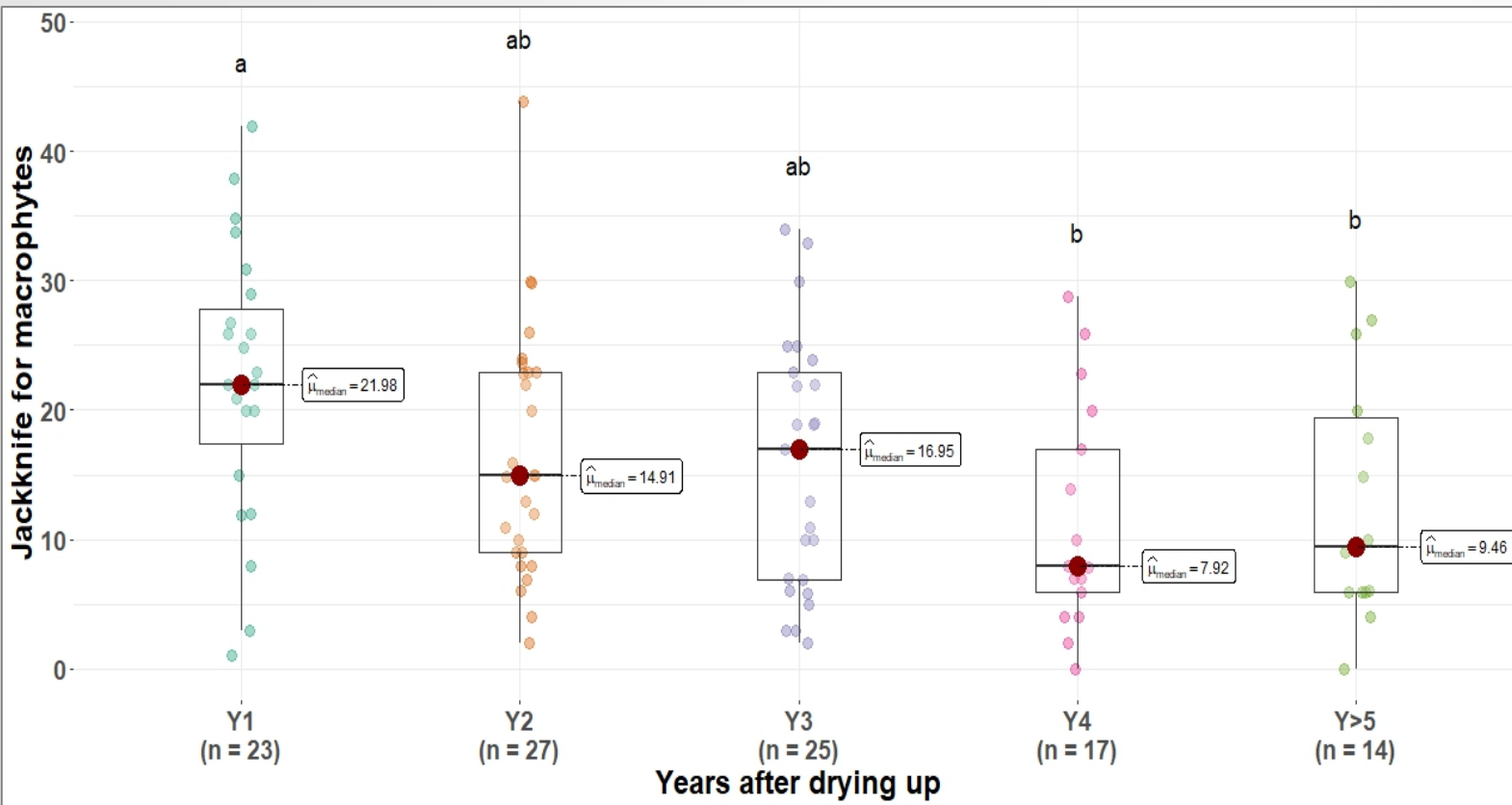
Phytoplankton richness and concentration

Management data (distance to last dry-out in Dombes and fish stock in both countries)



Results

Effects of drying-out on macrophyte richness and cover



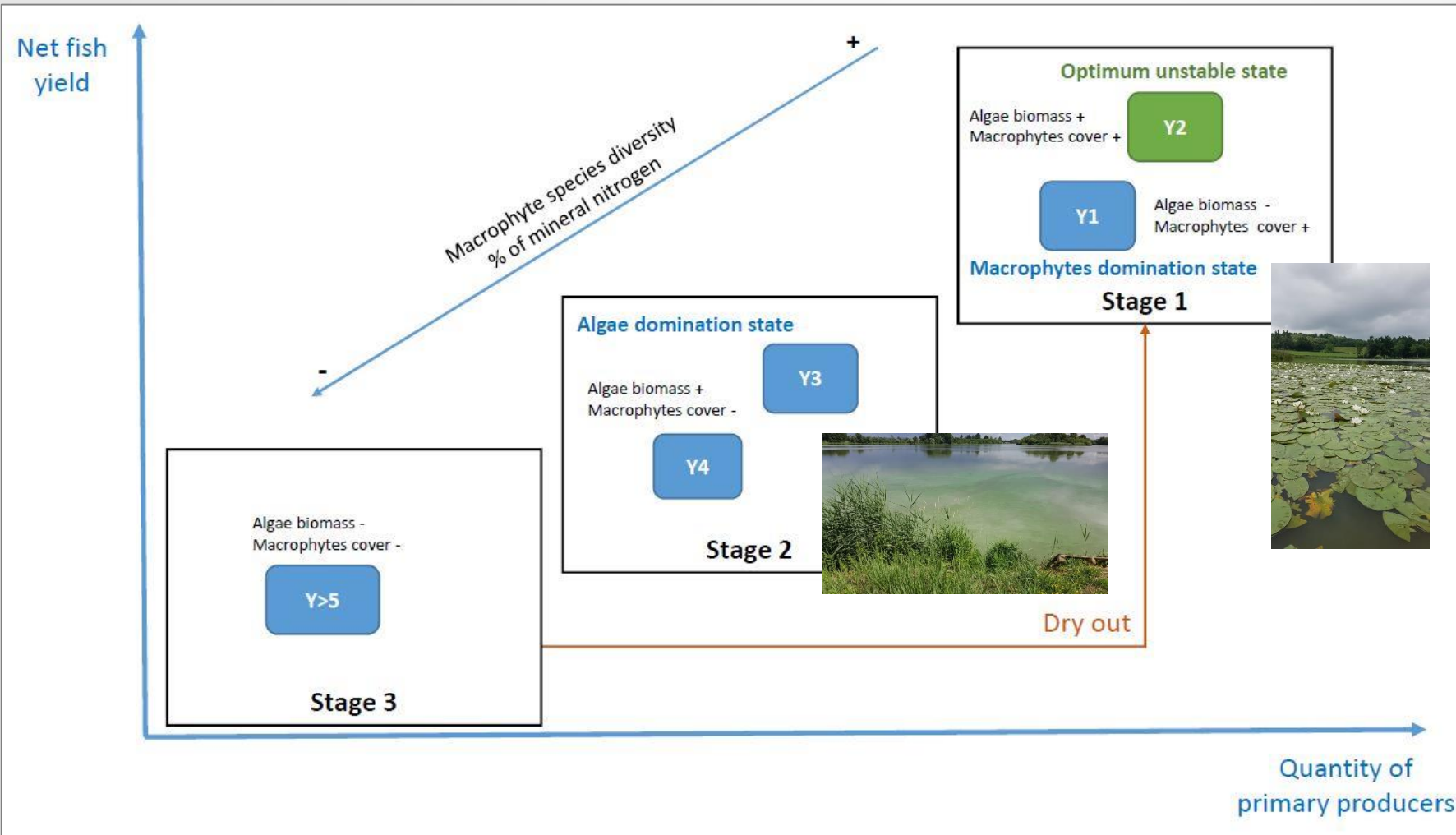
$(R^2 = 0.732, p < 0.0001)$

Same trends for species richness and cover

➡ Drying out encourage **macrophyte recolonization**

➡ Phytoplankton gradually dominate in following years, but the two primary producers are little present after 5 years and more

Discussion



➔ An **unstable state, optimal for fish production and the diversity of primary producers**, favoured by the practice of drying-out



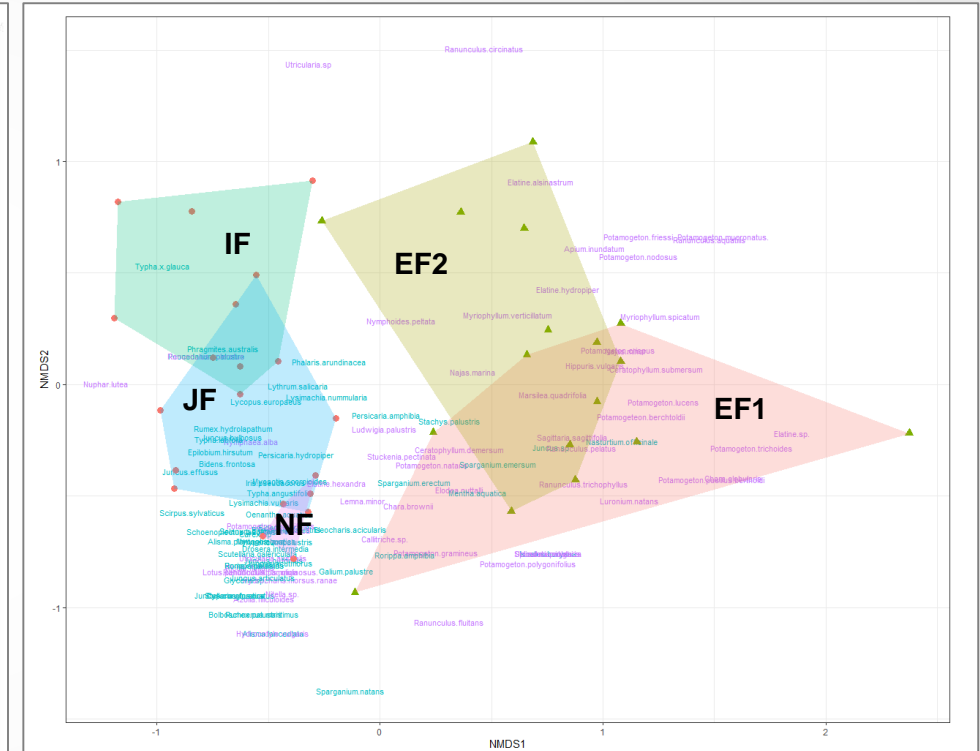
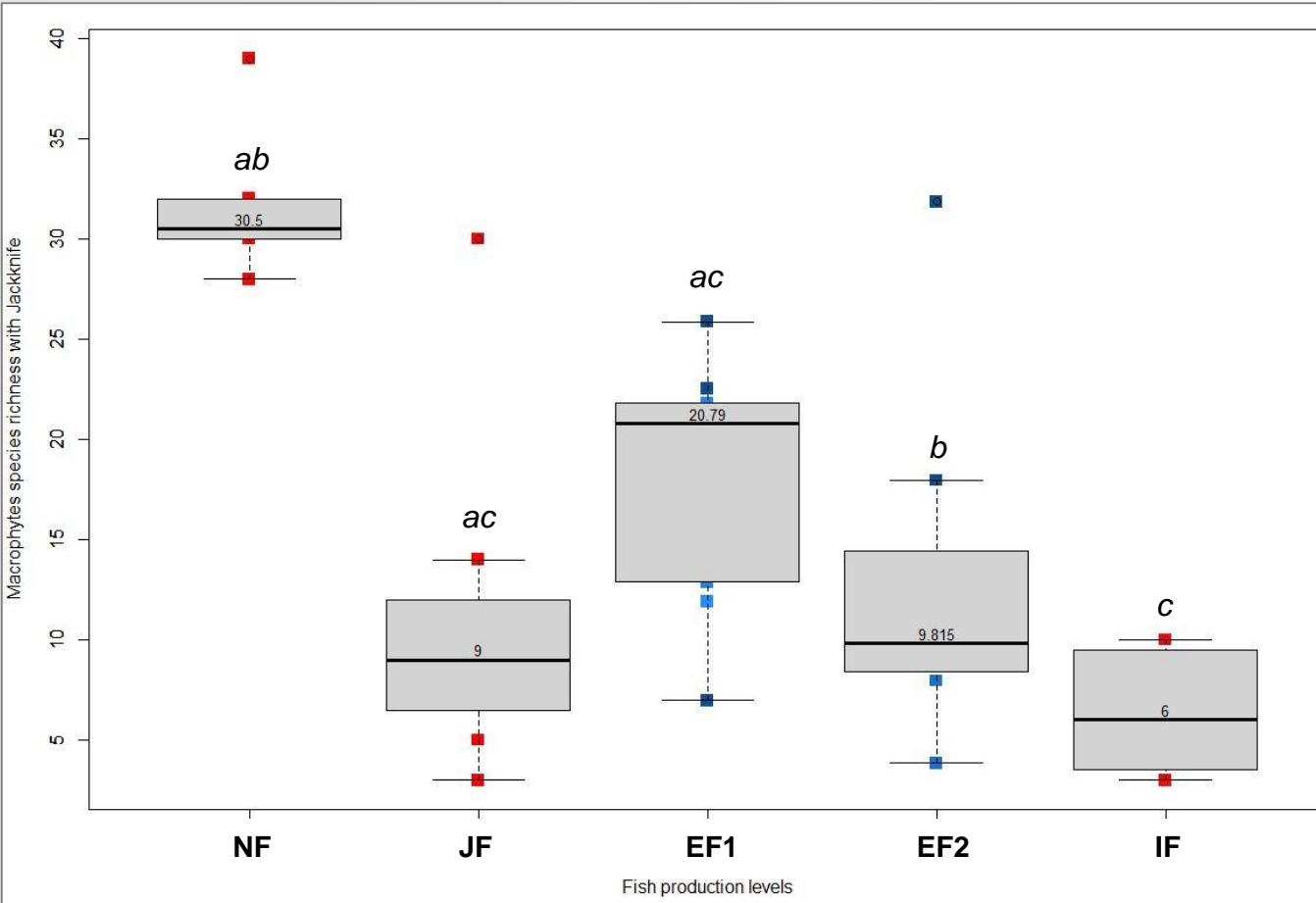
A **major agro-ecological practice** for extensive pond fish farming

Hyper-eutrophic

Eutrophic

Results

Effects of fish stock on macrophyte richness and community structure



NF : No Fish (Low density)
JF : Juvenile Fish (200-400 kg/ha)
IF : Intensive (1200-1500 kg/ha)

EF1 : Extensive 1 (300-500 kg/ha)
EF2 : Extensive 2 (500-900 kg/ha)

➔ A clear "fish density" effect on macrophyte species richness

➔ Fish density also partly explains community structure. Extensive production areas have more variable communities.

Discussion and Conclusion

- Fishponds are **important biodiversity reservoirs** on a regional scale:
 - **High variability** at individual level
 - Number of macrophyte species **comparable to other pond types**
 - **Rare or protected species** on a European scale
- Fish farming practices create **intermediate levels of disturbance**
- They are **essential to maintaining these environments** and the **ecosystem services** they can provide:
 - Biodiversity conservation (support services)
 - Extensive, agroecological fish production (provisioning services)
 - Climate regulation ? (regulating services)



Biodiversity conservation and fish production are not contradictory !



Among all the ponds, fish ponds also have a role to play



Thanks for your attention!



Questions ?

References

- *Avocat C. La Dombes, milieu naturel ou milieu en équilibre ? Introduction à une éco-géographie de l'espace dombiste. geoca. 1975;50(1):35–58.*
- *Hansson LA, Bronmark C, Anders Nilsson P, Abjornsson K. Conflicting demands on wetland ecosystem services: nutrient retention, biodiversity or both? Freshwater Biol. 2005 Apr;50(4):705–14.*
- *Sceau R. Les étangs de la Dombes, fondements socio-économiques d'un système hydraulique. geoca. 1980;55(2):129–59.*
- *Scheffer M, Carpenter SR. Catastrophic regime shifts in ecosystems: linking theory to observation. Trends in Ecology and Evolution. 2003;18:648–56.*
- *Wezel A, Robin J, Guerin M, Arthaud F, Vallod D. Management effects on water quality, sediments and fish production in extensive fish ponds in the Dombes region, France. Limnologica. 2013 May;43(3):210–8.*
- *Zamora-Marín JM, Ilg C, Demierre E, Bonnet N, Wezel A, Robin J, et al. Contribution of artificial waterbodies to biodiversity: A glass half empty or half full? Science of The Total Environment. 2021 Jan;753:141987.*