RESILIENCE AND RECOVERY IN AQUATIC SYSTEMS
ASLO AQUATIC SCIENCES MEETING 2023
4–9 JUNE 2023 · PALMA DE MALLORCA, SPAIN

Abstract number: **4893**

Session: **SS092P** The Relevance of Small Systems: Pond Ecology in a Changing World

ECOLOGICAL RESTORATION PROMOTES ZOOPLANKTON NETWORK COMPLEXITY IN MEDITERRANEAN COASTAL LAGOONS

Daniel Hernández[1,2], David Cunillera-Montcusí[1,3,4] Maria Antón-Pardo[1,5], Miguel Cañedo-Argüelles[6], Maria Bas-Silvestre[1], Jordi Compte[1], Stéphanie Gascón[1], Xavier D. Quintana[1], Dani Boix[1,*]

(*) presenting author

[1]GRECO, Institute of Aquatic Ecology, University of Girona, Girona, Spain
[2]School of Biological Sciences, University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand
[3]Departamento de Ecología y Gestión Ambiental, Centro Universitario Regional del Este (CURE), Universidad de la República, Tacuarembó s/n, Maldonado, Uruguay.
[4]FEHM-Lab, Section of Ecology, Department of Evolutionary Biology, Ecology and Environmental Sciences. University of Barcelona, Diagonal, 643, 08028 Barcelona, Catalonia/Spain
[5]Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Valencia, Spain
[6]FEHM-Lab, Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Carrer de Jordi Girona, 18-26, 08034 Barcelona

Universitat de Girona
Institut d'Ecologia Aquàtica

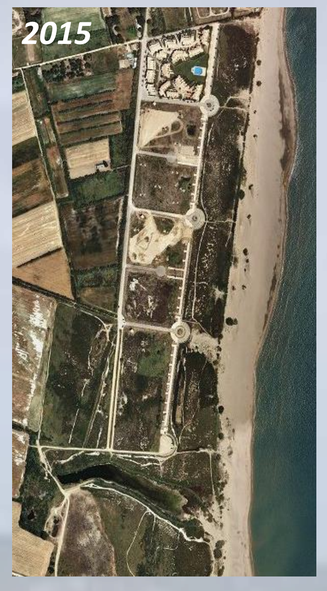
Ponderful
Horizon2020 European Union Funding for Research & Innovation

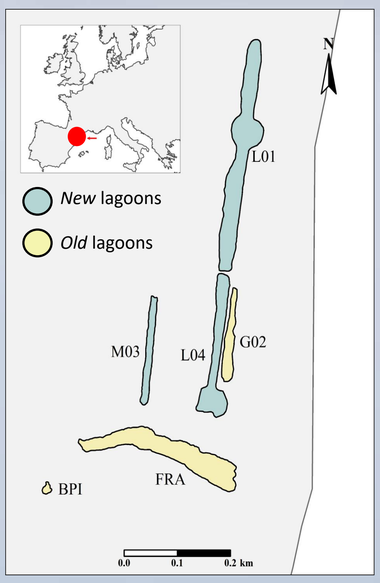
Grant **PID2020-114440GB-I00** funded by:
MINISTERIO DE CIENCIA E INNOVACIÓN
AGENCIA ESTATAL DE INVESTIGACIÓN

fun-METANET
Scan me!

INTRODUCTION.- Traditional metrics used to monitor ecosystem recovery after restoration (species diversity, species composition, or specific ecosystem functions) have been proven to be only partially useful. To address this issue, **Biotic Abiotic Interaction Networks (BAIN)** can be included in ecosystem management plans or be considered as conservation targets themselves, since their structure can be an indicator of ecosystem functionality, stability, and resilience.

AIM & HYPOTHESIS.- The aim was to compare zooplankton community structure and the biotic interaction network of natural and newly created lagoons for 4 years after restoration. Given the fast colonization rates of zooplankton species, we hypothesized that the community composition would be similar in old and new lagoons. However, a slower recovery of the BAIN structure was expected since species interactions tend to take longer to recover.





STUDY SITE.- Data were collected from **La Pletera (Baix Ter Wetlands)**, a salt marsh free from tidal influence located in the north-eastern Iberian Peninsula. A LIFE project (LIFE13NAT/ES/001001) took place between 2014 and 2016 to recover the ecological functionality by removing all the remaining urbanization structures and creating new water bodies (including L01, L04, and M03). In addition, the topography of pre-existing lagoons was altered to enhance the connectivity between water bodies during flooding events.

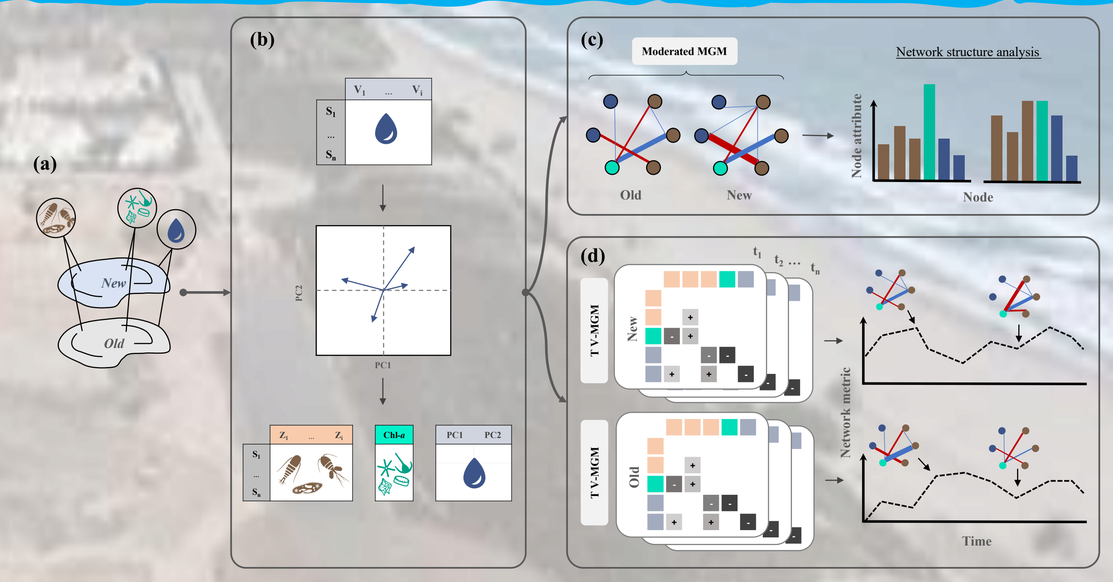
SAMPLING & DATA ANALYSES

(a) Three ecosystem components were measured for both pre-existing (*old*) and newly created (*new*) lagoons: zooplankton biomass (Z), environmental variables (V), and chlorophyll-*a* concentration as a proxy of phytoplankton biomass (Chl-*a*).

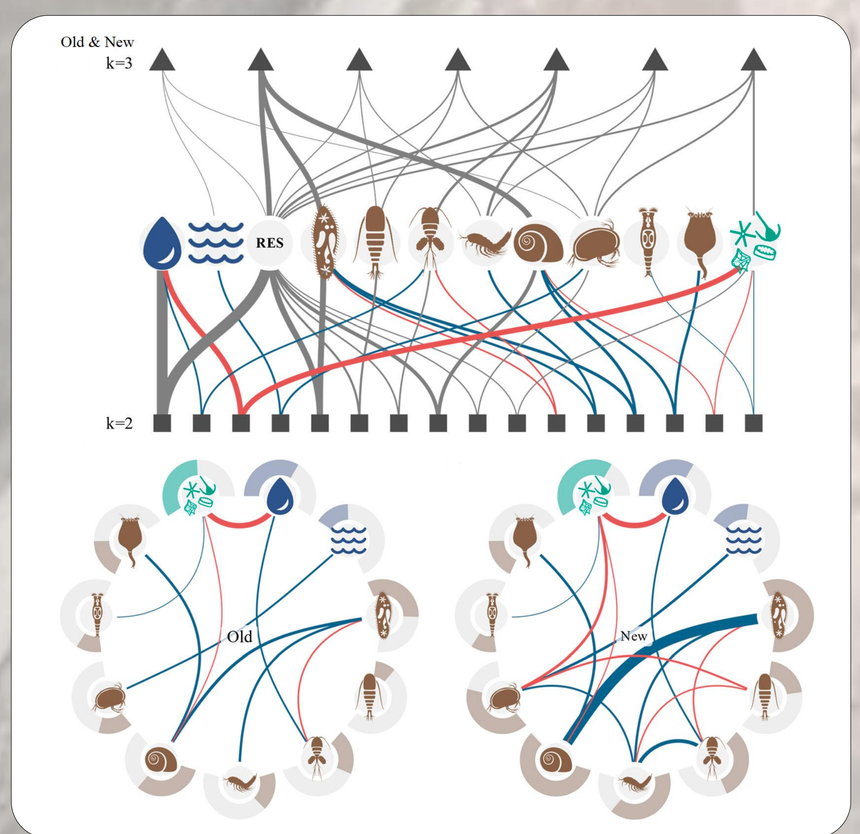
(b) Environmental variables were summarized into the first two axes of a PCA (PC1 and PC2).

(c) An M-MGM was fitted to the data. The model explicitly accounted for differences between old and new lagoons by setting the restoration factor (i.e. *new* or *old* lagoon) as a moderator. The M-MGM was then solved for both types of lagoons to obtain the respective networks. To build the network, each variable was represented as a single node and the edge weight between nodes was the partial correlation between variables.

(d) TV-MGMs were built for both types of lagoons to analyze temporal changes in the BAIN. The model was solved for each specified time (t).

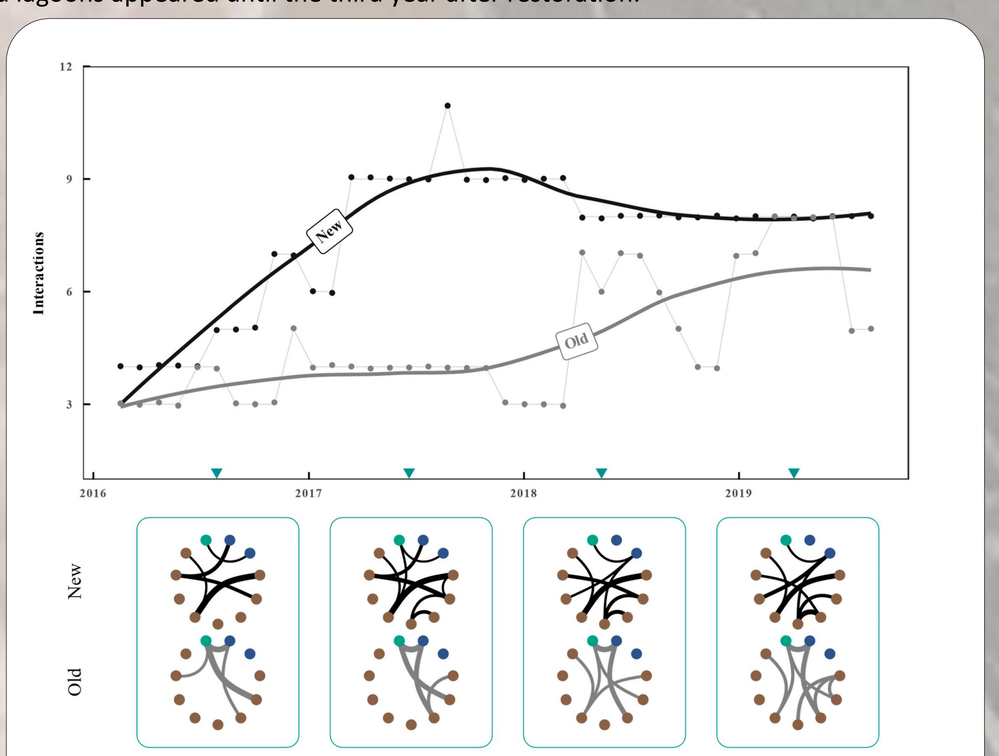


RESULTS (I): BAIN Comparison.- 23 interactions were detected between the 12 nodes included in the MMGM, which represent groups of zooplankton, environmental gradients, Chl-*a* concentration, and the restoration factor (i.e. *new* or *old* lagoon). The restoration factor had a direct effect (k = 2) on seven nodes and a moderating effect (k = 3) on seven edges. The strongest edge linked the restoration factor and PC1 corroborating that new and old lagoons present distinct environmental characteristics. The interaction between ciliates and gastropods was the most varying between lagoon types (*new* and *old*). The BAIN of new lagoons was more densely connected than the BAIN of old lagoons. There was no unique interaction in the old lagoon' BAIN.



Symbols represent ciliates, calanoid copepods, cyclopoid copepods, harpacticoid copepods, gastropods, filter-feeding rotifers, predatory rotifers, Chl-*a* concentration, PC1, and PC2.

RESULTS (II): Temporal Changes in the BAIN.- The BAIN in new lagoons increased its complexity throughout the first 2 years after restoration from 4 interactions (beginning of 2016) to a peak of 11 interactions (summer 2017). After this, the trend stabilized and no major changes in the network structure were detected. The network in old lagoons increased from three to eight interactions in spring 2019 (during the third year after restoration) and did not stabilize during the study period. Importantly, no shared interaction between the BAINs of new and old lagoons appeared until the third year after restoration.



MANAGEMENT IMPLICATIONS

1- The early resemblance but later differentiation between zooplankton community structures in new and pre-existing habitats highlights the importance of long-term monitoring programs after restoration actions in Mediterranean coastal lagoons.

2- Changes observed in the interaction network in pre-existing lagoons after the creation of new waterbodies suggest that restoration can affect natural communities when spatial connectivity is enhanced.

3- While practitioners typically focus on species diversity and community structure, the use of interaction networks could help assess restoration success by providing additional information about community complexity.

More details in: HERNÁNDEZ-CARRASCO, D., CUNILLERA-MONTCUSÍ, D., ANTÓN-PARDO, M., CAÑEDO-ARGÜELLES, M., BAS-SILVESTRE, M., COMPTE, J., GASCÓN, S., QUINTANA, X.D. & BOIX, D. 2023. Ecological restoration promotes zooplankton network complexity in Mediterranean coastal lagoons. *Restoration Ecology* e13920.