The transdisciplinary approach on coastal hydrogeosystems : tracing back socioenvironmental trajectories and water policies evolution to improve their management and adaptability

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1 Coastal lagoon : a wealth to preserve

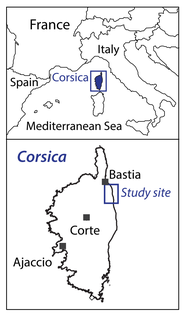
Coastal lagoons are the 2nd reservoir of **ecological diversity & biological productivity**

They provide a wide range of **ecosystem services** such as habitat, coastal protection, fishing, aesthetic, recreational areas..., associated to **high economic** potential.

Yet, **70%** of world's coastal wetlands have been **lost** during the 20th century due to human activities.

In the face of this, a growing awareness of the need to **protect, preserve & even restore** these environments has been observed but, a major question arose : **How can ecosystems be restored** ?

In Europe, the **European Water Framework Directive** was established to **improve the ecological and physico-chemical status & to assess recovery trajectories** lagoons & aquatic ecosystems. To this end, an **ecosystem based approach** has been developed on the Biguglia lagoon.



The Biguglia lagoon is (Fig.1) :
- the **largest wetland of Corsica** Island (14.5 km²)
- recognized as a **RAMSAR site & Nature Reserve**
- the result of **strong interaction between human & his natural environment over time** (Fig.2B).

Fig.1: Aerial view & location of the Biguglia lagoon watershed.

2 Recovery trajectory : the Biguglia lagoon study case

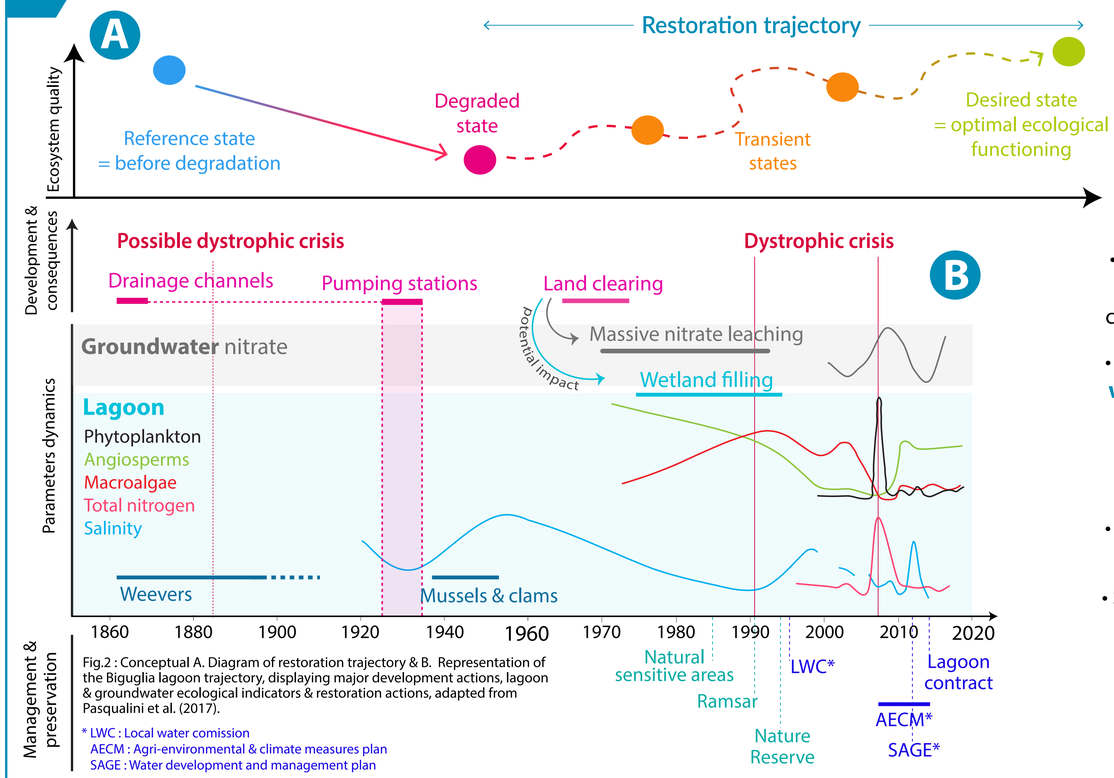


Fig.2 : Conceptual A. Diagram of restoration trajectory & B. Representation of the Biguglia lagoon trajectory, displaying major development actions, lagoon & groundwater ecological indicators & restoration actions, adapted from Pasqualini et al. (2017).

* LWC : Local water comission
AECM : Agri-environmental & climate measures plan
SAGE : Water development and management plan

1. Restoration & reference state (Fig.2A)

• Restoration aims to achieve the **integrity & biological diversity at spatial & temporal scales**. To make sure that restoration actions are relevant, it's essential to define the **REFERENCE STATE** to rightly assess actions to reach the

2. Benefits of long-term approach (Fig.2B)

• The hydrosystem has been **managed over time**, mainly due to health issues & fishing activities. Measure improve sanitary conditions have **disrupted the lagoon hydrological behavior**.

• **Dewatering actions** to fight malaria --> **major inflow of fresh water to the lagoon**, impacting its physico-chemical conditions.

• **Land clearing** --> wetland landing & nitrate leaching to groundwater. Because of the groundwater inertial behavior, this **pollutant legacy are still impacting the water quality**.

• **Actions to favor lagoon water renewal** & avoid dystrophic crisis --> **ecosystem disturbance** (species dynamics & disparition)

• Since the 90's, labels/protection status have been accompanied by concrete management action to restore the ecosystem. Management actions (LWC, AECM, SAGE, Lagoon contract) have contribute to reduce pollutants fluxes towards the lagoon & the groundwater.

3 Historical information to support management actions

Historical archives bring old direct (figures) & indirect essential information. **HISTORICAL DATA** make it possible (Fig.3) :
- to assess **baseline conditions** of lagoon ecosystems,
- to **trace back the socio-envrionmental trajectories**
- to assess the **ecosystem responses** to actions/stressors

ECOLOGICAL STATE/RESILIENCE of lagoon ecosystem :
- is dependent of its **whole watershed**
- must include **adjacent ecosystems** : rivers & **GROUNDWATER** !
- can only be assessed by a **multidisciplinary approach**

Retracing **DEVELOPMENT AND MANAGEMENT ACTIONS** :
- the effectiveness/ineffectiveness of labels & protection status
- the preservation strategy (pedagogy, communication, isolation...)

SUSTAINABLE MANAGEMENT STRATEGIES :
- require a strong **collaborative decision-making** (researchers, managers & stakeholders) to define relevant restoration actions

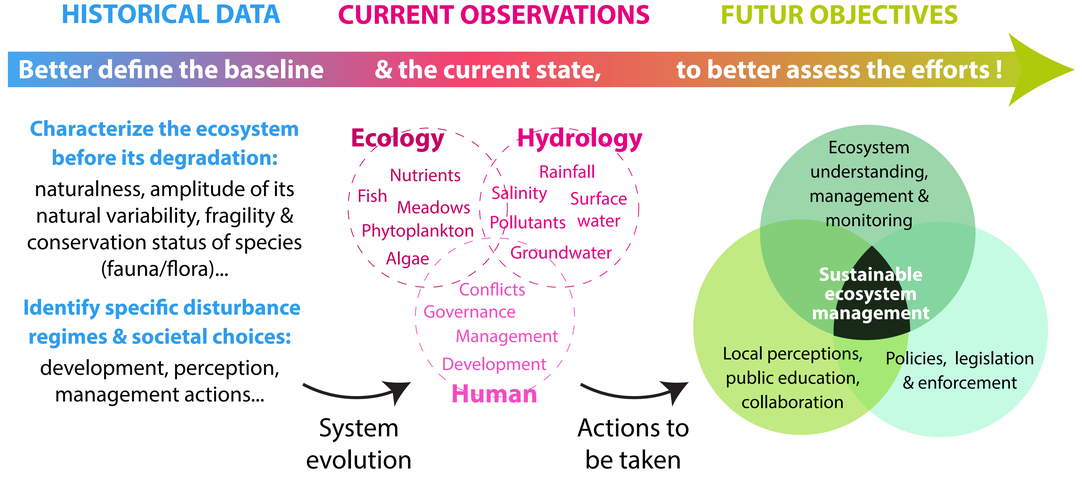


Fig. 3: How past & current knowledges can be helpful for lagoon ecosystems sustainable management.

4 Take home message

• Ecosystem management is grounded in the fact that **human activity** are inseparable from ecosystems.

• The **ecosystem responses** to past manage actions, human & climatic stressors can be assessed by the **long time study**.

• The **transdisciplinary approach** & the **collaborative decision-making** is essential for designing sustainable management strategies for coastal hydrosystems.

FOR FURTHER READING

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