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& the Emys-R Consortium[3]

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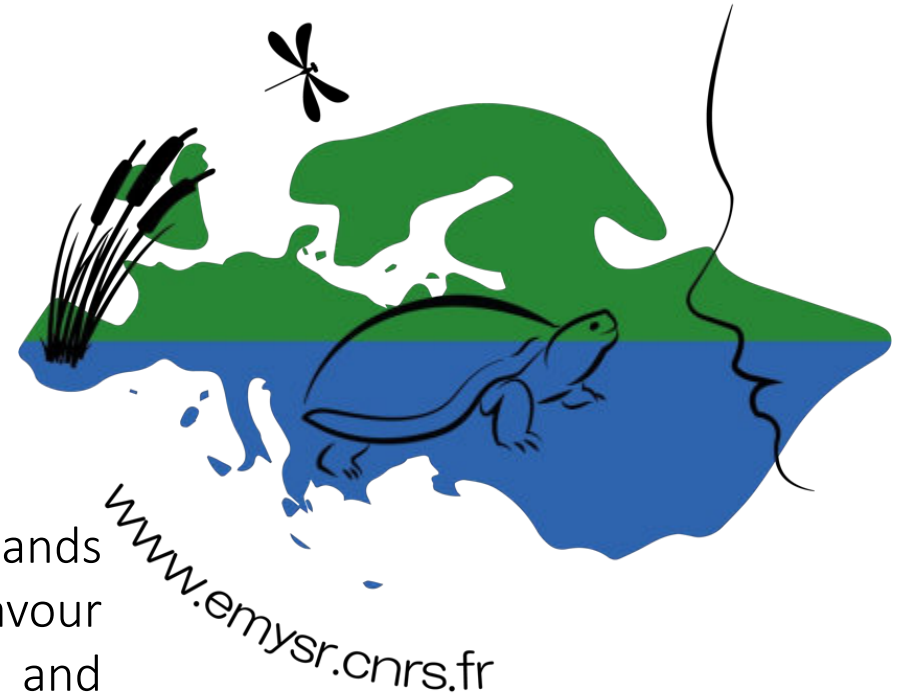
[3] https://emysr.cnrs.fr/

EMYS-R: Who we are

- 3-yr international transdisciplinary action-oriented research project
- Biodiversa+ & Water JPI funded (2022-25)
- 70 people (incl. 4 PhD candidates)



→ A socio-ecological evaluation of wetlands restoration and reintroduction programs in favour of the emblematic European pond turtle and associated biodiversity: a pan-European approach

Context: Anthropocene, wetlands, biodiversity

- 6th biodiversity crisis
- Wetlands are hotspots of biodiversity and ecosystem services
- Since 1700s, wetlands have vanished by 90% worldwide due to mismanagement

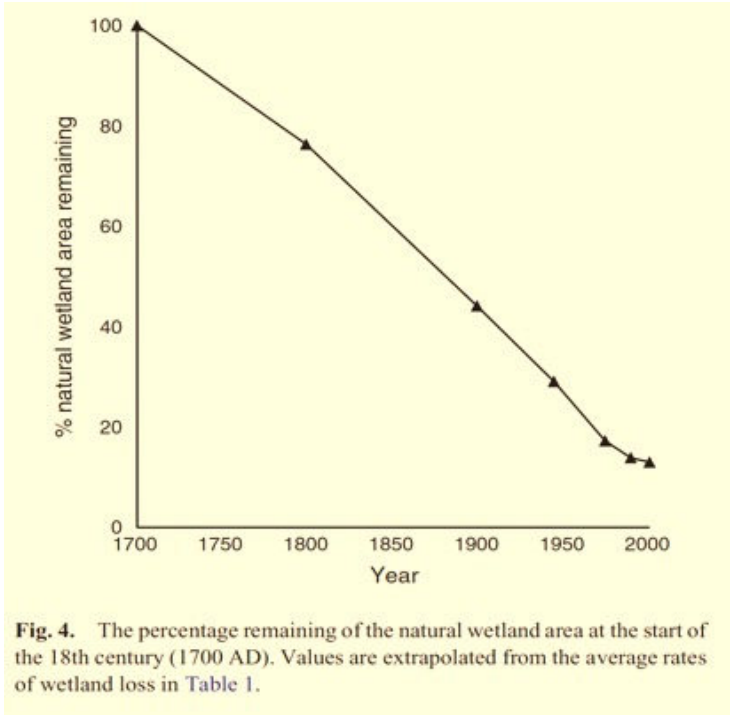
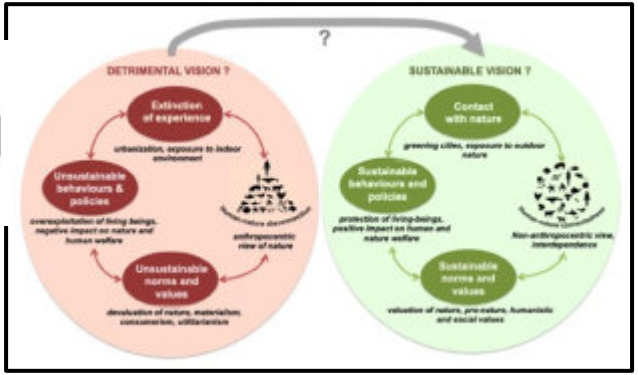


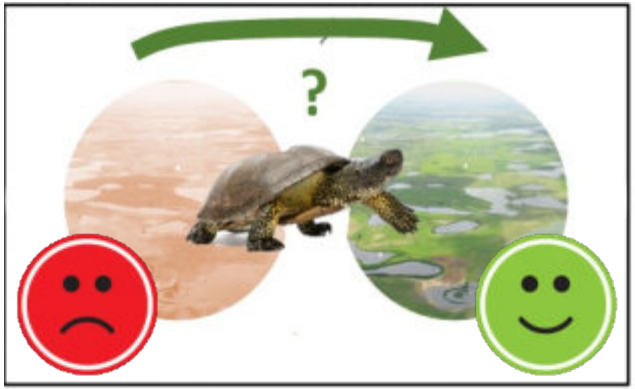
Fig. 4. The percentage remaining of the natural wetland area at the start of the 18th century (1700 AD). Values are extrapolated from the average rates of wetland loss in Table 1.

Context: Anthropocene, wetlands, biodiversity

- A potential remedy
  - Habitat restoration & species reintroduction
    - Species reintroduction: deliberate release of individuals of a species at places it used to live (IUCN Guidelines 2013)
    - Human-nature connectedness as a pathway to sustainability (Barragan-Jason et al. 2021 *Cons Lett*)
- The study case of Emys-R
  - Wetlands and turtles: two opposite perceptions of nature

→ ***Can the European pond turtle Emys be an emissary (Emys-R) of wetlands for reconnecting people and nature?***

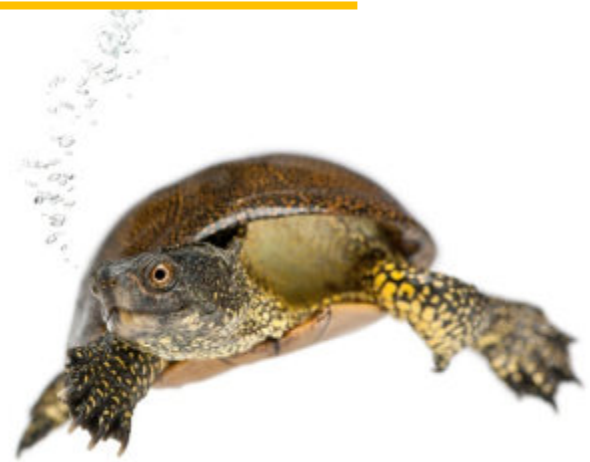




The European pond turtle *Emys orbicularis*

- Small-sized freshwater turtle
  - Max body size: 20 cm long, 1 Kg
  - Habitats: ponds and lentic waterbodies
  - Diet: opportunistic at all trophic levels
  - Distribution: Europe and Northern Africa
- Conservation status
  - Most dramatic decline for reptiles in Europe
  - Numerous reintroductions throughout Europe
- Results poorly disseminated

→ ***which protocols lead to reintroduction success?***



Emys-R study sites

- Three study sites with contrasted socio-ecosystemic contexts

Natura 2000 + Biological Reserve
5km from town, poorly frequented
Emys and associated biodiversity

Natura 2000
Urban, highly frequented
Emys as a communication tool

Natura 2000 +Natural Park
No man's land (LV-BY border)
Emys and associated biodiversity

- National Action Plan

YES, coordinated actions

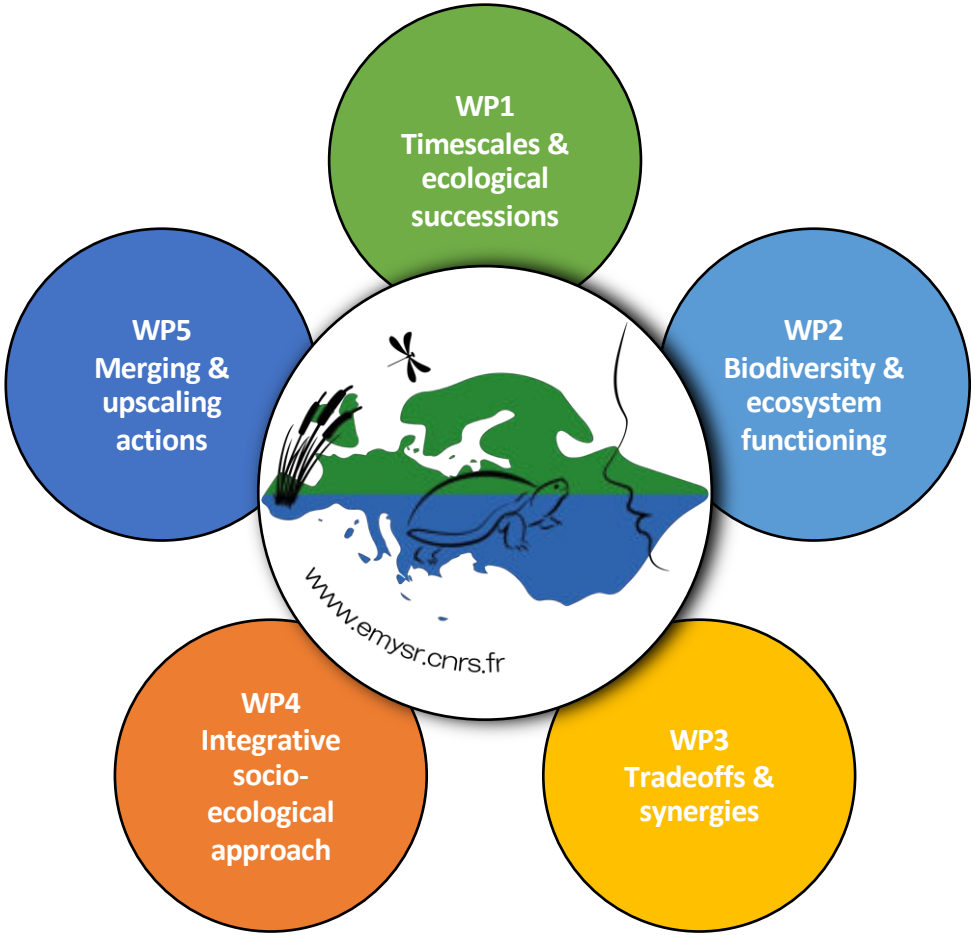
NO

YES, coordinated actions

Emys-R goals

Defining and disseminating

- the most efficient, socially-supported, ecological methods to restore wetlands
- in favour of *Emys* reintroduction and associated biodiversity
- throughout Europe


WP1
Timescales & ecological successions
WP2
Biodiversity & ecosystem functioning
WP3
Tradeoffs & synergies
WP4
Integrative socio-ecological approach
WP5
Merging & upscaling actions
www.emysr.cnrs.fr

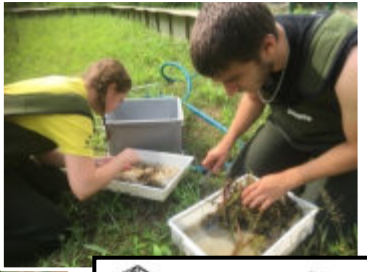
EMYS-R: WP1 – temporal approach

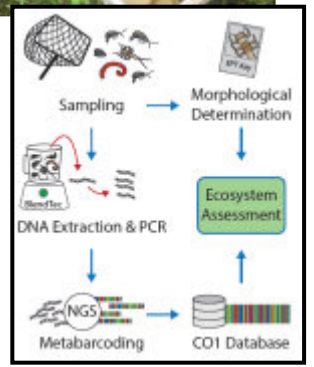
WP1 Timescales & ecological successions

- T1.1. Chronosystemic frames (1900 – today)
- T1.2. Degree of recovery

→ **Historical use and land cover assessment**
Archives and orthophotos

→ **Biocenotic indices of water bodies**
Biodiversity surveys + eDNA metabarcoding





Kari-Anne van der Zon (*ecological successions*)

EMYS-R: WP2 – functional approach

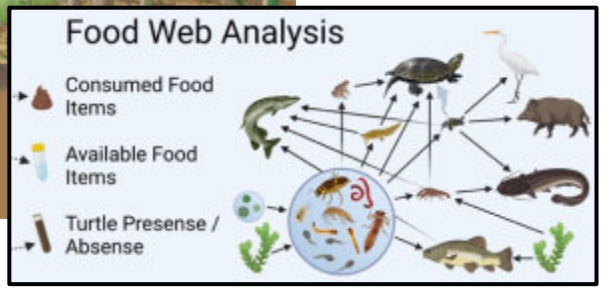
WP2 Biodiversity & ecosystem functioning

T2.1. Emys population monitoring

T2.2. Wetland ecosystem functioning

→ **Determinants of Emys released population trends**
Survival, health, dispersion, reproduction

→ **Food web analysis**
eDNA in prey-predator feaces



Carolin Eichert (*Emys microbiome*)
Johannes Meka (*Emys trophic ecology*)

EMYS-R: WP3 – tradeoff approach

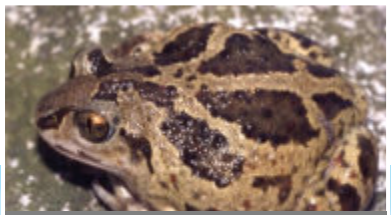
WP3 Tradeoffs & synergies

T3.1. Not-target species monitoring

→ **Protected & invasive species**
Occurrence, distribution and abundance

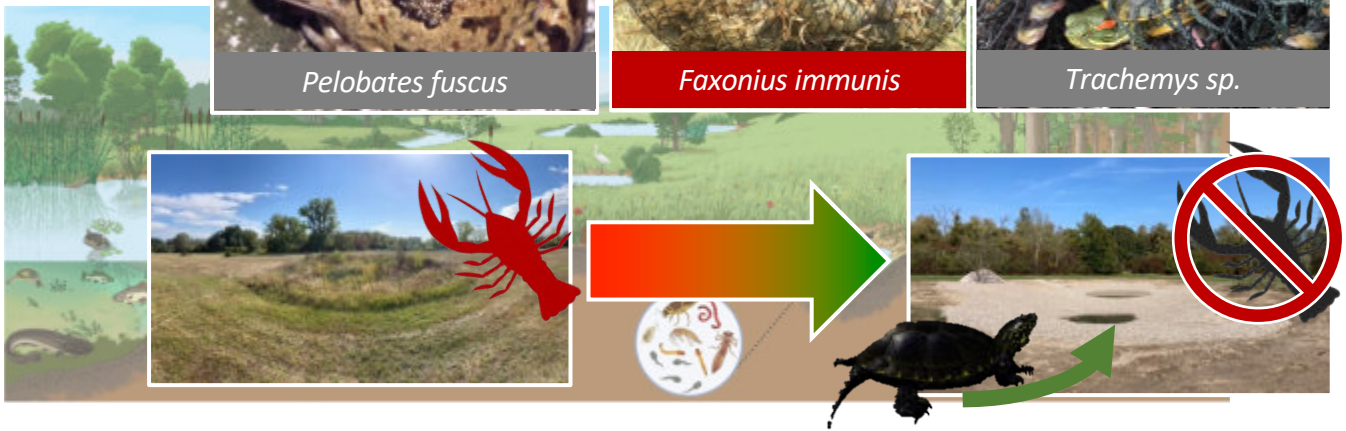
T3.2. Adaptive management

→ **Emys-friendly invasive-proof habitats**
Experimental pond


Pelobates fuscus


Faxonius immunis

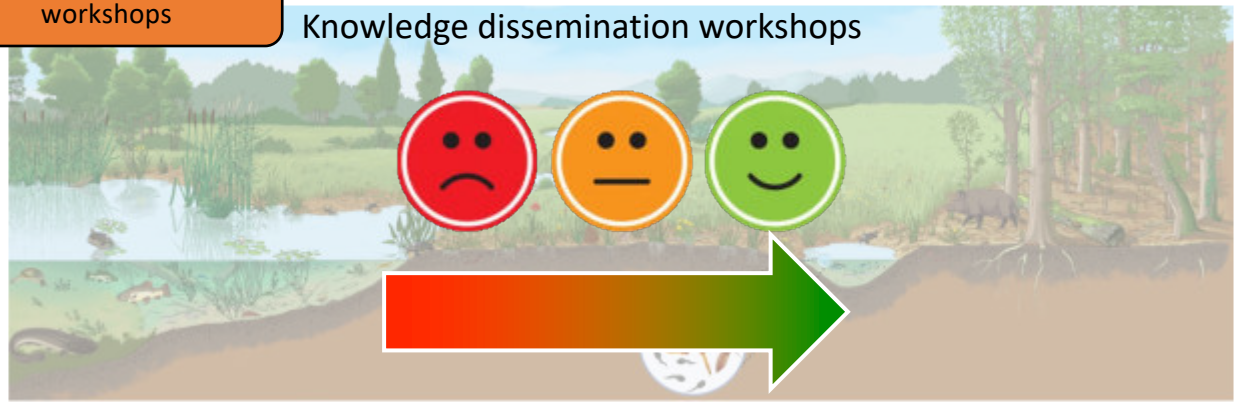

Trachemys sp.



EMYS-R: WP4 – sociological approach

WP4 Integrative socio-ecological approach

- T4.1. Economic benefit analysis
  → **Restoration economic benefits**
  Adapted habitat evaluation procedure
- T4.2. Public perception assessment
  → **Perception, motivation, behaviour**
  Ethnographic survey
- T4.3. Public seminars
  → **Public awareness and engagement**
  Participatory deliberative reflection
- T4.4. Participatory workshops
  → **Participative policy guidelines**
  Knowledge dissemination workshops



Patrycja Romaniuk (*environmental sociology*)

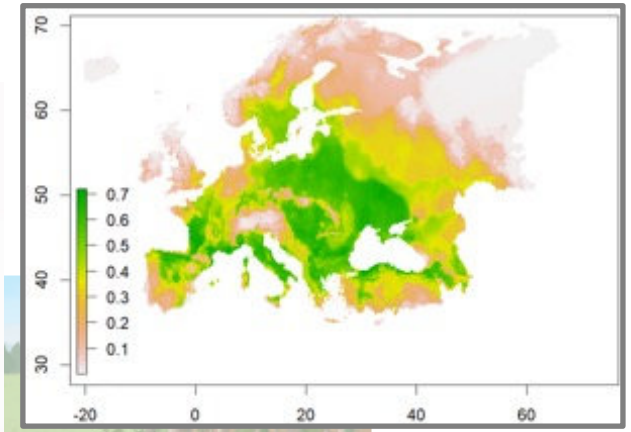
EMYS-R WP5: integrated approach

WP5 Merging & upscaling actions

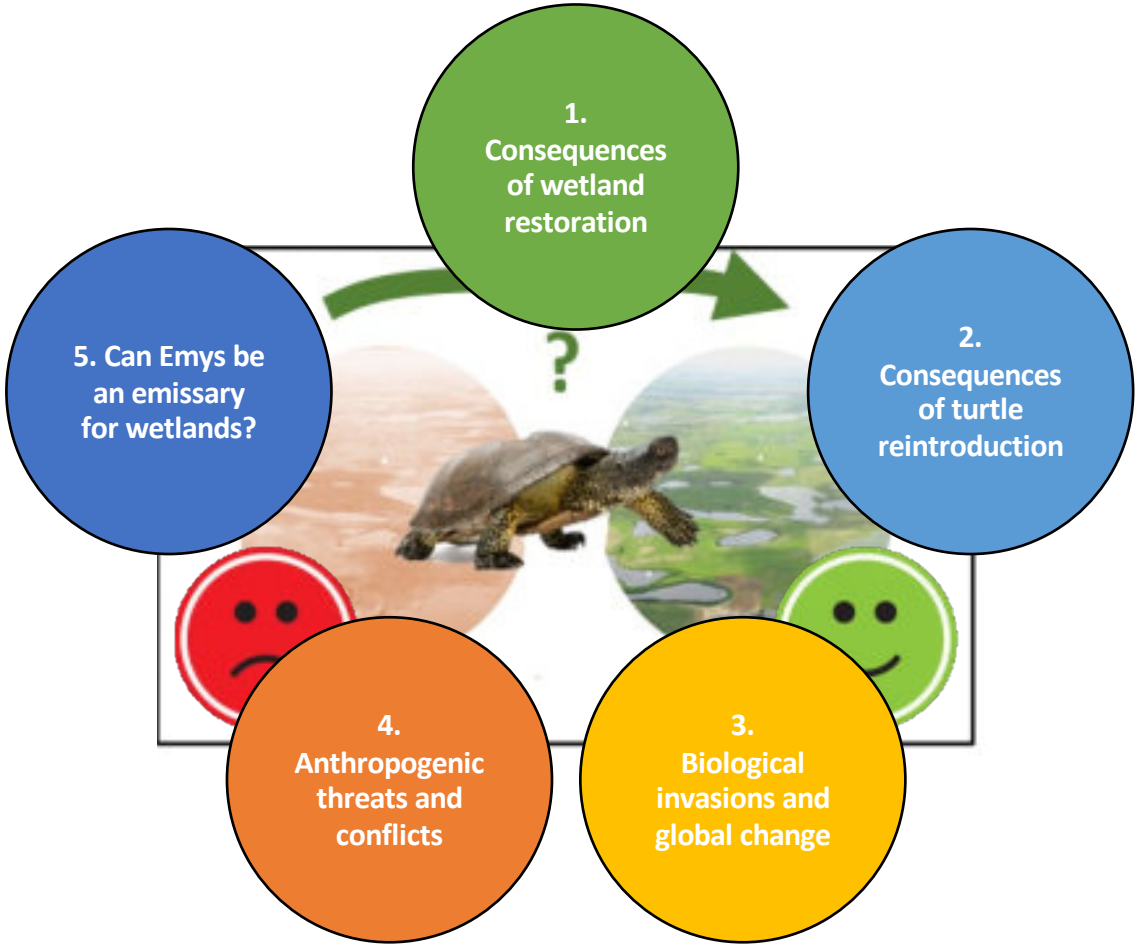
- T5.1. Literature review
- T5.2. Bioclimatic modelling
- T5.3. Guidelines of best practices

→ **State of the art**
Wetland restoration, Emys reintroduction, long term monitoring

→ **Forecasting 2100+**
Forthcoming conservation initiatives

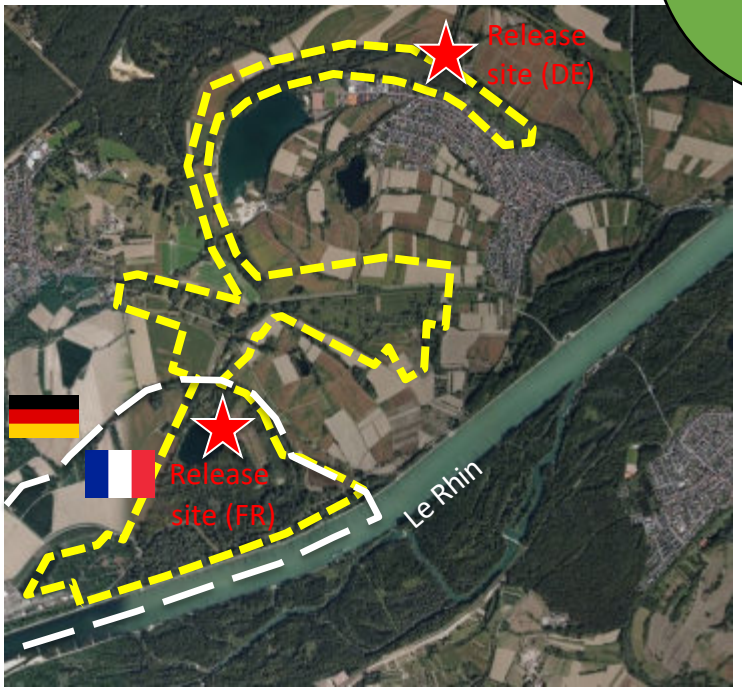


Dr Oksana Nekrasova (*modelling*)
Dr Oleksii Marushchak (*review*)


1.
Consequences
of wetland
restoration
2.
Consequences
of turtle
reintroduction
3.
Biological
invasions and
global change
4.
Anthropogenic
threats and
conflicts
5. Can Emys be
an emissary
for wetlands?
?

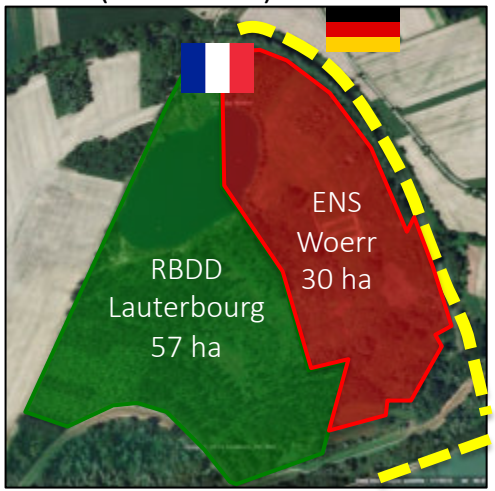
1. Consequences of wetland restoration

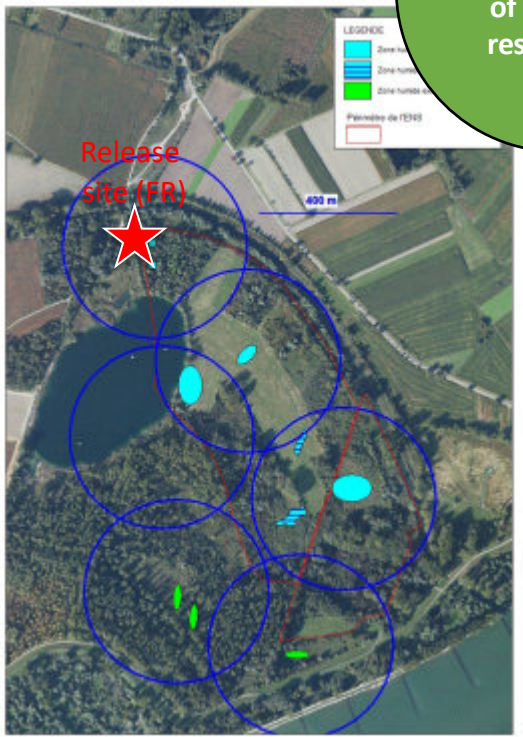
- The Woerr site (FR) at the FR-GER border
  - NE of France
  - INTERREG C12 (2009-2012)



1. Consequences of wetland restoration

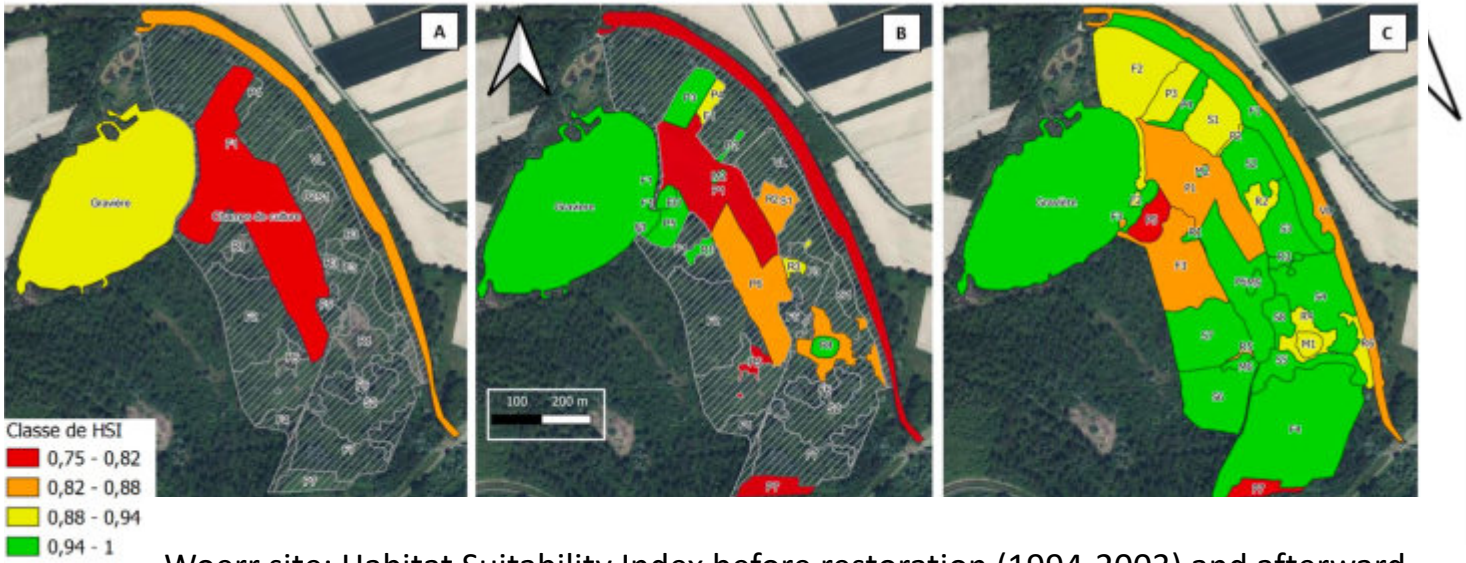
- The Woerr site (FR): restoration in action since 1994
  - Smoothing gravel pond edges (4500m^2)
  - Opening 2 reed ponds (3100m^2)
  - Creating 8 ponds (2100m^2)





1. Consequences of wetland restoration

- The Woerr site (FR): Ecological assessment of restoration
  - Habitat maps before restoration (1994-2003) and afterward



Woerr site: Habitat Suitability Index before restoration (1994-2003) and afterward

1. Consequences of wetland restoration

- The Silene site (LV)
  - Creation of connected & isolated ponds for amphibians
  - Occurrence of the invasive alien predatory fish Chinese sleeper *Perccottus glenii*

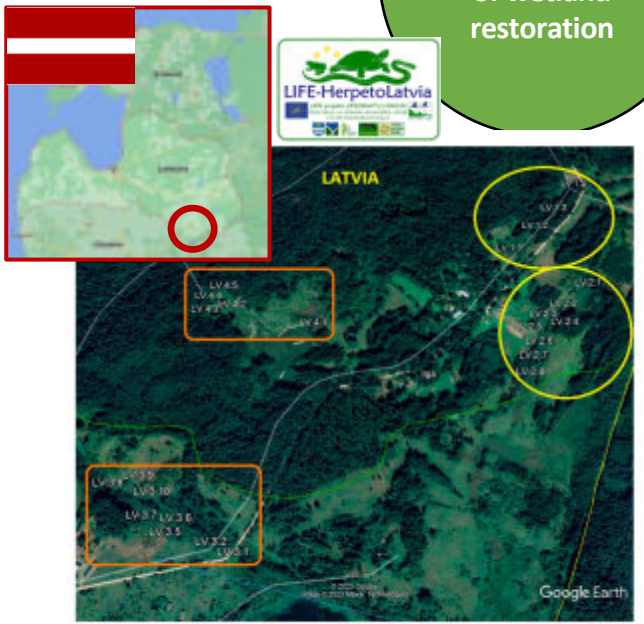
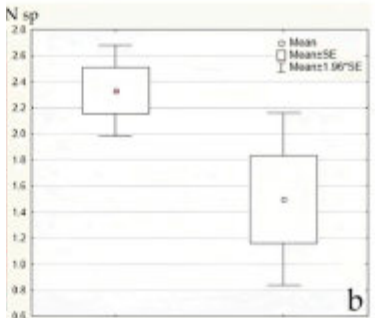


Figure 1. A map of the location of ponds in the Silene Nature Park, South East of Latvia: ye ovals—geographically isolated wetlands (GIW) (isolated ponds); orange rectangles—non-iso ponds (nGIW) (the green arrow indicates the location of the study area).

1. Consequences of wetland restoration

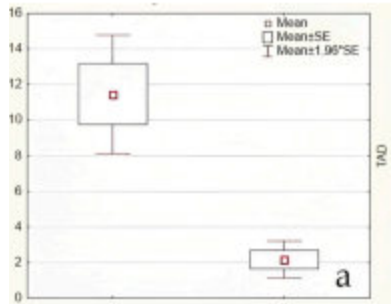
- The Silene site (LV): Ecological assessment after restoration
  - Geographically isolated wetlands are beneficial for amphibians due to preventing the Chinese Sleeper to spread (Pupins et al. 2022; 2023)

Nb of species



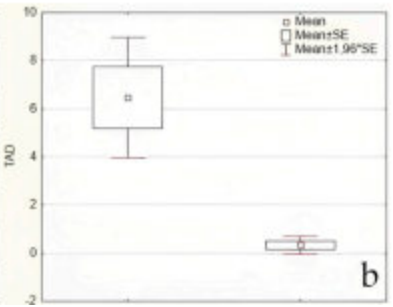
Isolated *vs.* connected

Nb of adults

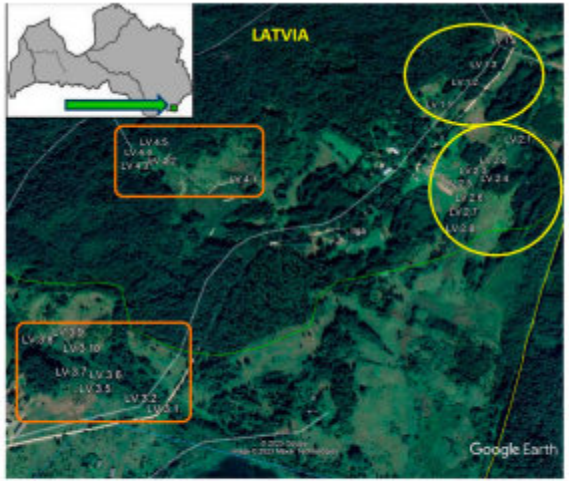


Isolated *vs.* connected

Nb of larvae



Isolated *vs.* connected



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1. Consequences of wetland restoration

Restoring landscape/pondscape connectedness is not always the solution

Key challenges

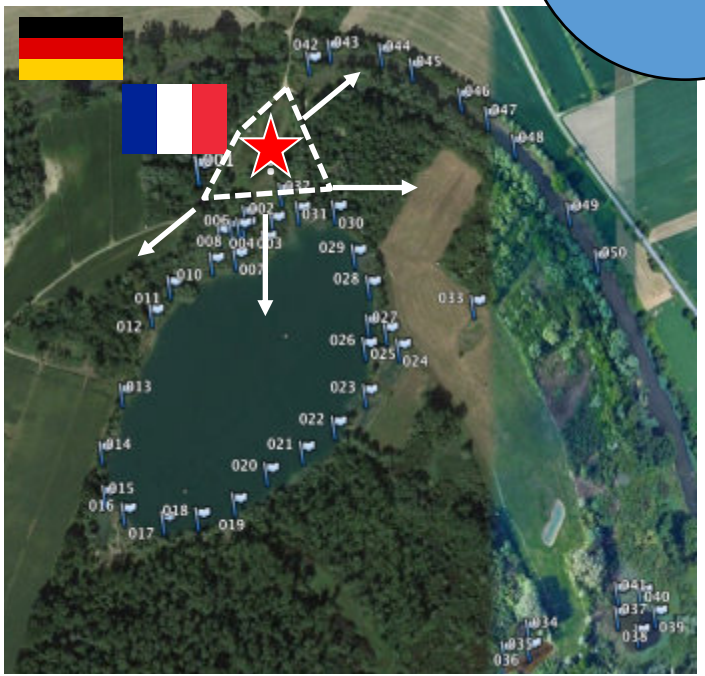
- Ensure integrated ecological assessment prior habitat restoration
- Support long-term monitoring of slow ecological succession processes
- Forecast and mitigate impacts of alien invasive species and climate change

2. Consequences of turtle reintroduction

- The Woerr site (FR) : *Emys* population monitoring
  - 2013-2023: 573 *Emys* soft-released in acclimatization site

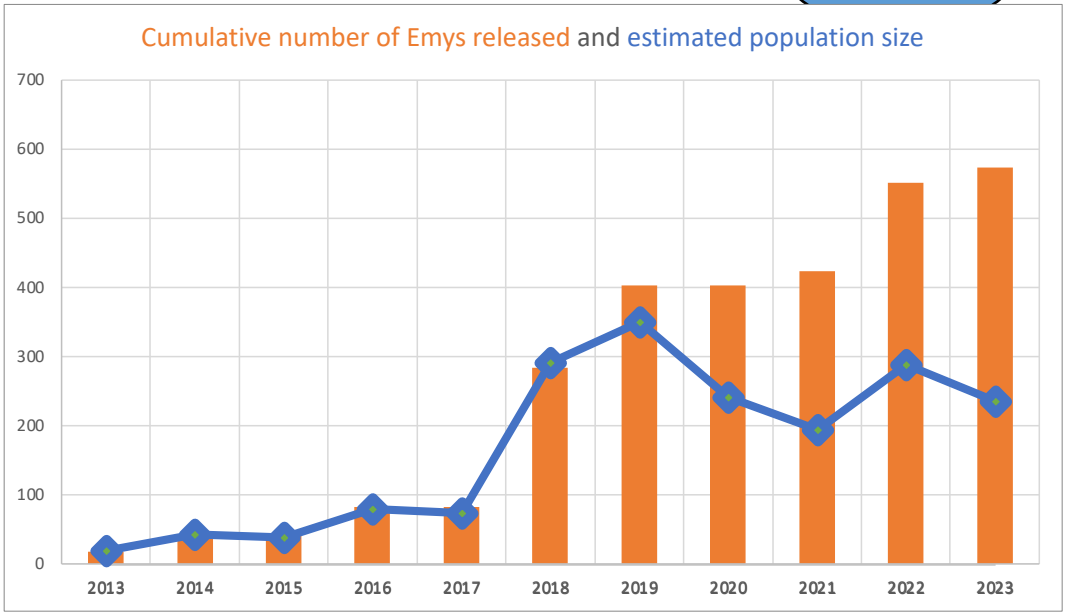
2. Consequences of turtle reintroduction

- The Woerr site (FR) : *Emys* population monitoring
  - 2013-2023: 573 *Emys* soft-released
  - Long-term capture-mark-recapture



2. Consequences of turtle reintroduction

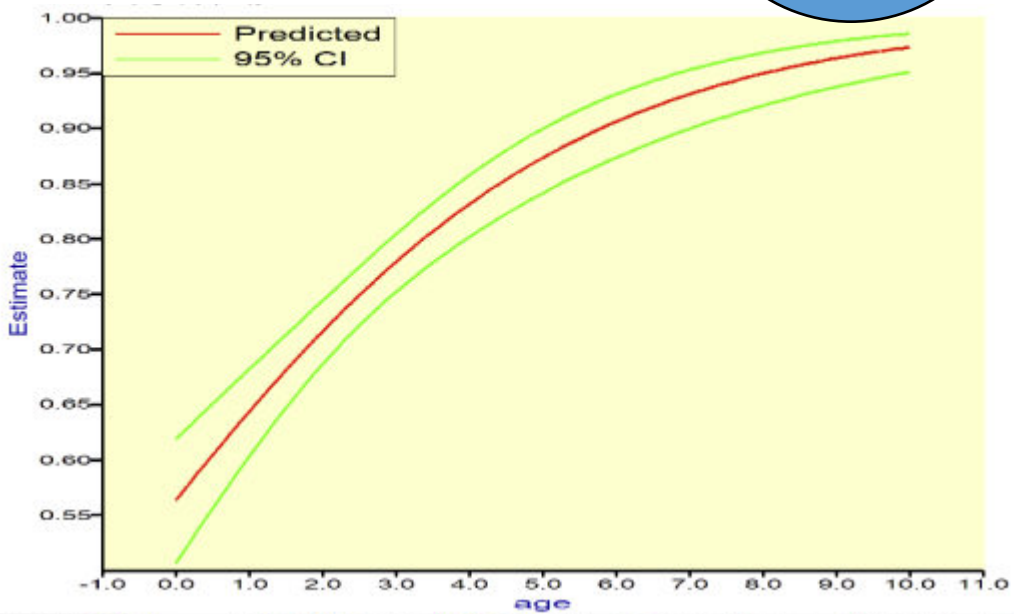
- The Woerr site (FR) : *Emys* population monitoring
  - 2013-2023: 573 *Emys* soft-released
  - Overall apparent survival ~37%
    - Spain: 30-40% (Bertholero unpubl.)
    - Italy: 67-91% (Canessa et al. 2016)



2. Consequences of turtle reintroduction

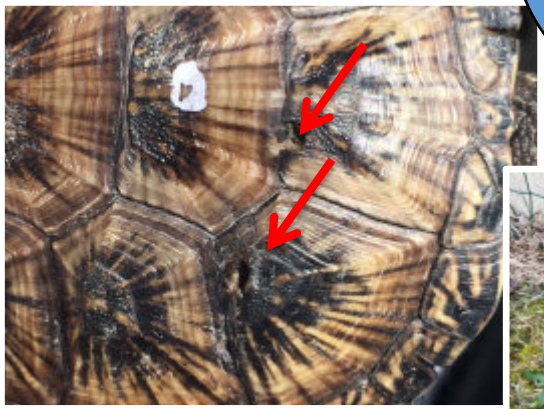
- The Woerr site (FR) : *Emys* population monitoring
  - 2013-2023: 573 *Emys* soft-released
  - Overall apparent survival ~37%
  - Survival determinants
    - Age at release >> body mass at release
    - Site of release
      - Acclim (76%) >> Gravel pond (44%)

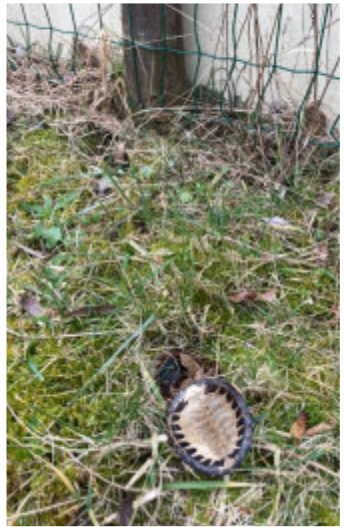
→ Soft release of old individuals!



2. Consequences of turtle reintroduction

- The Woerr site (FR) : *Emys* population monitoring
  - 2013-2023: 573 *Emys* soft-released
  - Overall apparent survival ~37%
  - Dispersion ~10%
    - Within site
      - Self-dispersion
      - Predatory-borne dispersion
      - Homing (back to acclim) ~30%





2. Consequences of turtle reintroduction

- The Woerr site (FR) : *Emys* population monitoring
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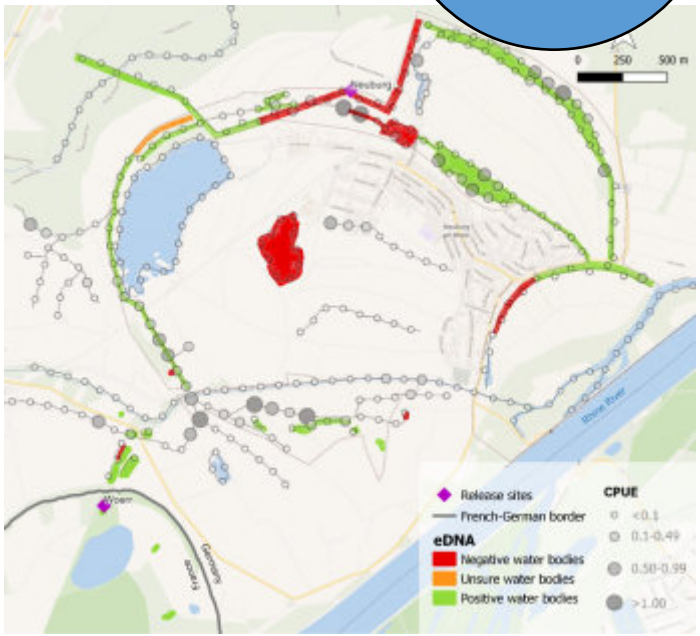
    - Within site
      - Self-dispersion
      - Predatory-borne dispersion
      - Homing (back to acclim) ~30%
    - Transbordering dispersion (FR ←→ GER)
      - Evidence from sediment eDNA (Graf et al. in prep)

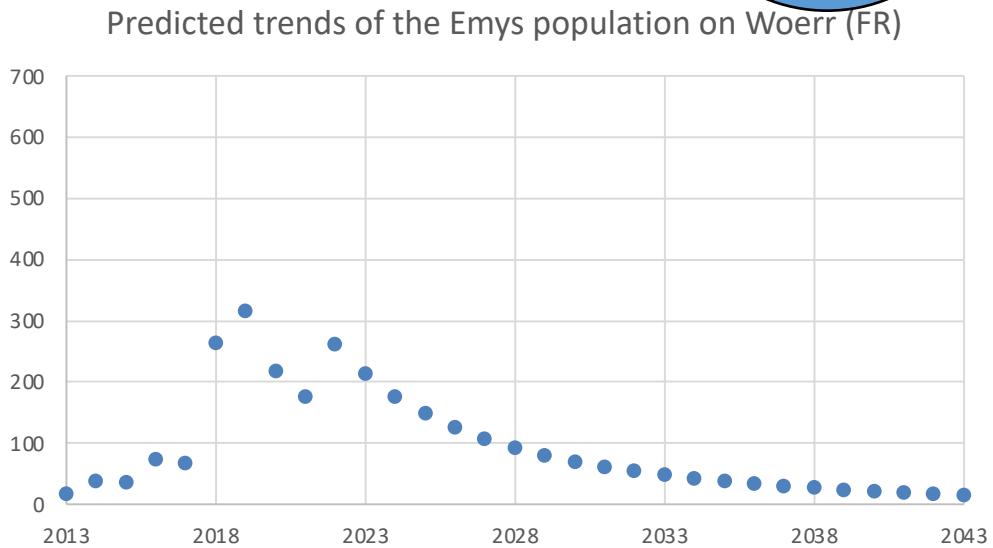


2. Consequences of turtle reintroduction

- The Woerr site (FR) : *Emys* population monitoring
  - 2013-2023: 573 *Emys* soft-released
  - Overall apparent survival ~37%
  - Dispersion ~20% (+ homing)
  - Reproduction < 2%
    - Spain: < 5%
    - Italy: not published

2. Consequences of turtle reintroduction

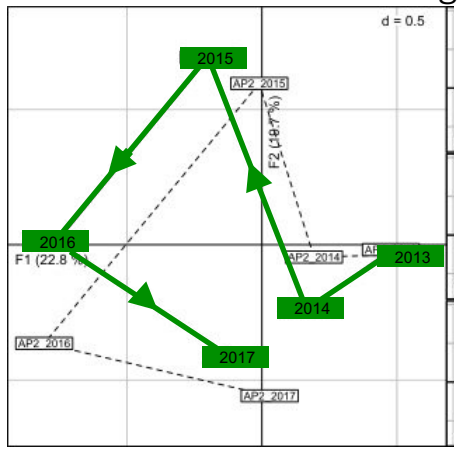
- The Woerr site (FR) : *Emys* population monitoring
  - 2013-2023: 573 *Emys* soft-released
  - Overall apparent survival ~37%
  - Dispersion ~20% (+ homing)
  - Reproduction < 2%



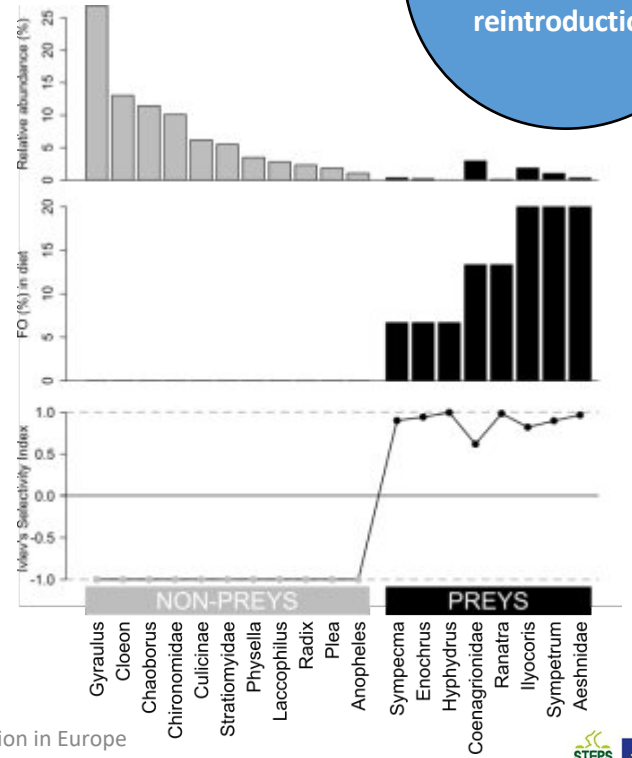
→ The population is not self-sustaining on the short term

2. Consequences of turtle reintroduction

- The Woerr site (FR) : *Emys* functional ecology
  - *Emys* as a predator (Meyer et al. in prep)
    - Main preys = aquatic macroinvertebrates (MI)
    - Prey selection = larger preys are preferred
    - No impact on overall MI communities throughout time

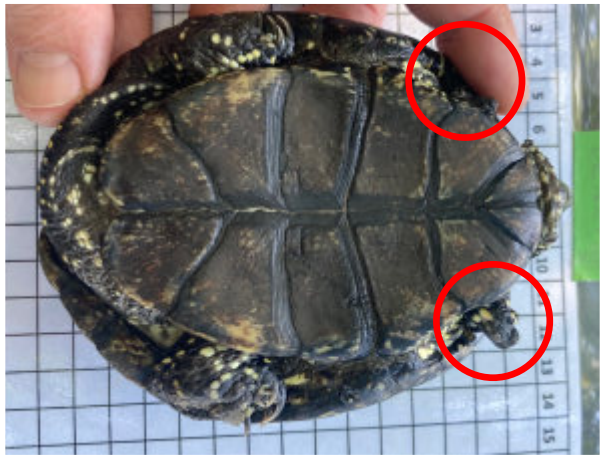


Changes in MI communities in pond **without** and with Emys



2. Consequences of turtle reintroduction

- The Woerr site (FR) : *Emys* functional ecology
  - *Emys* as a predator (Meyer et al. in prep)
  - *Emys* as a prey (Meka et al. in prep)
    - Local predators (eggs: badger, hatchlings: heron, adults: fox)
    - (New) invasive alien species (e.g. raccoon *Procyon lotor*)



2. Consequences of turtle reintroduction

The reintroduced population of *Emys* is not self-sustaining on the short term
If additional releases may occur, soft releases of oldest individuals with short residence should be preferred

Key challenges

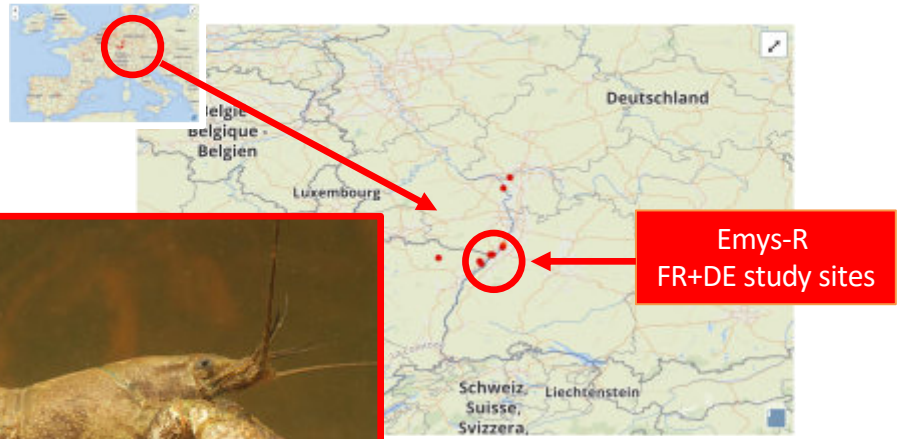
- Ensure suitable aquatic habitats for *Emys* growth and dispersion
- Provide suitable terrestrial habitats for nesting
- Limit risky seasonal (homing) migrations
- Mitigate predation risks

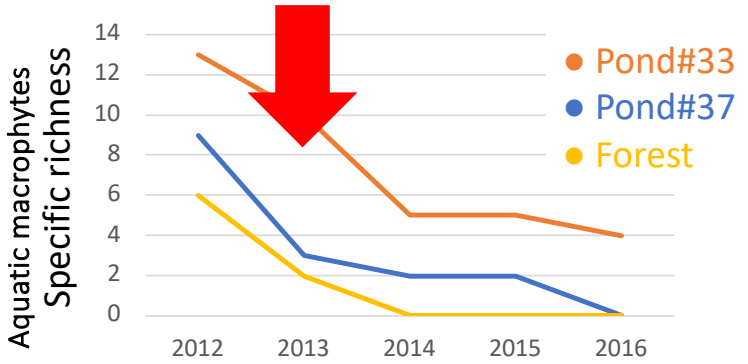
3. Biological invasions and global change

- Bycatch of invasive alien species during *Emys* monitoring

3. Biological invasions and global change

- The calico crayfish *Faxonius immunis*
  - A new invasive alien species



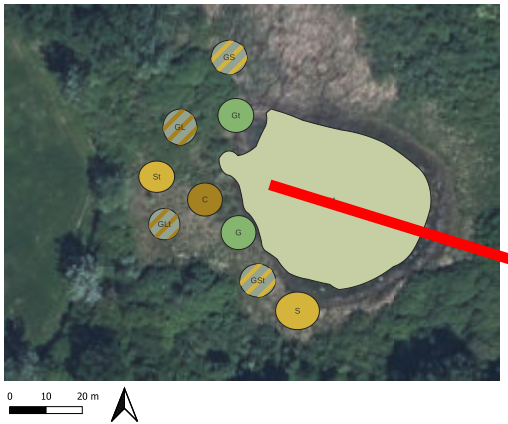


→ Presence of calico leads to unsuitable habitat for *Emys*

3. Biological invasions and global change

- The calico crayfish *Faxonius immunis*
  - A new invasive alien species
  - Co-creation of calico-proof, *Emys*-friendly, adaptive ponds (Combroux et al.)
    - Sept 2022: one adaptive pond in meadow
    - Feb 2024: nine adaptive ponds near reed pond

Diagramm of the localisation of experimental crayfish ponds on the Woerr site



Map legend
- Gravel (G)
- Gravel- sand (GS)
- Gravel-silt (GL)
- Sand (S)
- Silt (C-control)
- M1

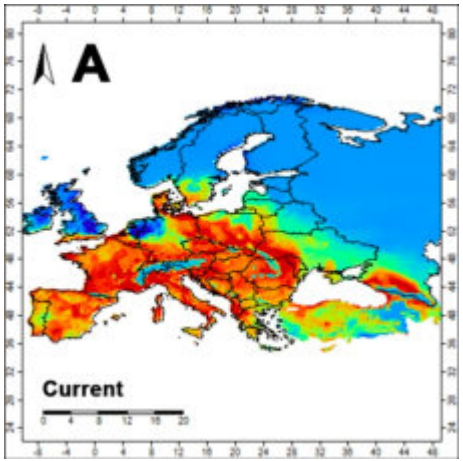
Vue aérienne du Bas-Rhin 67 - 2021

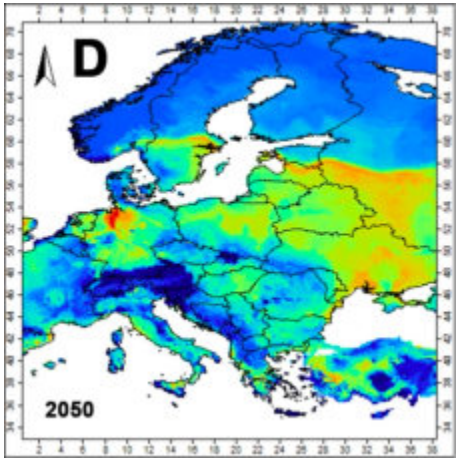
t = ponds with macrophytes transplantation

3. Biological invasions and global change

- The exotic freshwater turtles
  - Forecasting suitable areas for *Emys* without exotic conspecifics in Europe (Nekrasova et al. submitted)

Trachemys scripta elegans





A. Current areas of overlap between *Emys* and 7 exotic freshwater turtles

D. Forecasted areas suitable for *Emys* exempt of exotic freshwater turtles (by 2050)

IAS and global change have rapid, increasingly disrupting, long lasting impacts on restored wetland functioning and reintroduction success

Key challenges

- Prevent reintroductions turn into invasions
- Ensure integrated ecological assessment prior & after habitat restoration
- Prospect future suitable areas for threatened native biodiversity

4. Anthropogenic threats and conflicts

- The Neuburg am Rhein site (GER)
  - A Natura 2000 site entangled between unsuitable agricultural and urban areas
  - Potential nesting sites for *Emys* in private properties and unsuitable crop fields

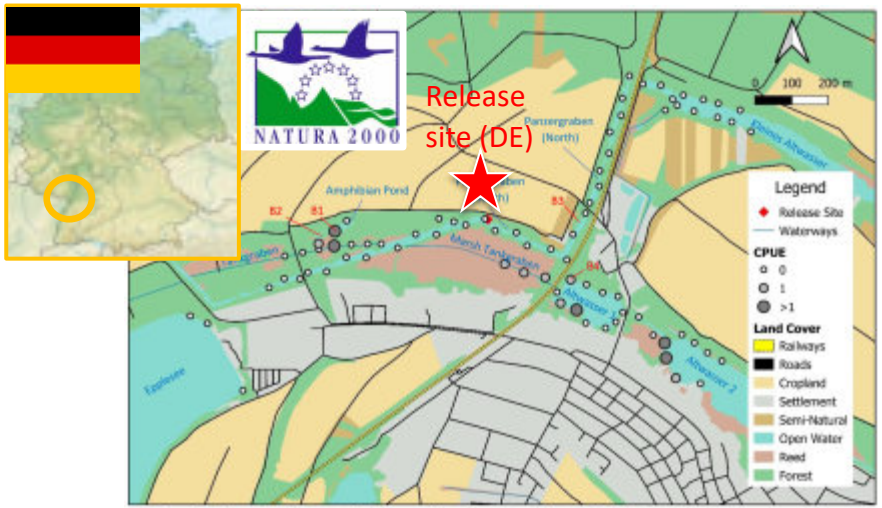


Figure 4. Map of study site with observed catch per unit effort (CPUE). Points indicate trap locations. B 1-4 indicate locations turtles were observed basking.

4. Anthropogenic threats and conflicts

- The Neuburg am Rhein site (GER)
  - 12-15 July 2021: massive European floods
  - Release of 10-d stagnant (anoxic) waters from crop fields to pond network
  - 1-5 August 2021: 40.000 – 80.000 dead fish (estimation, Georges & Theissinger, unpubl.)

Flooding in Rhineland-Palatinate (July 2021)

Georges & Theissinger (unpubl.)

4. Anthropogenic threats and conflicts

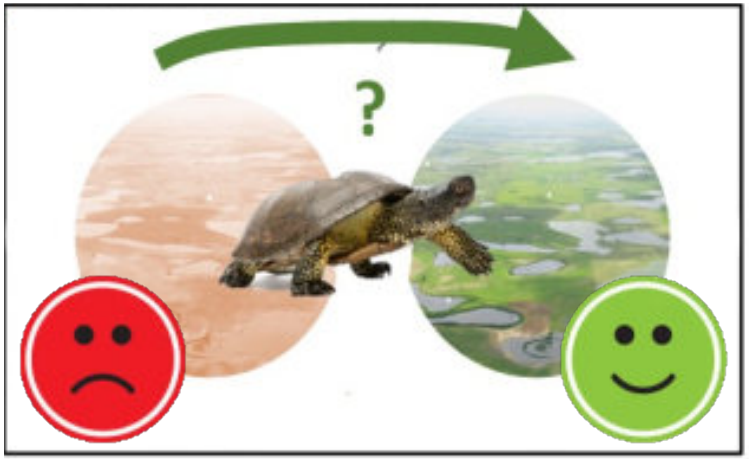
Protection status of reintroduction sites do not prevent mismanagement and deleterious anthropogenic hazards

Key challenges

- Address aquatic and terrestrial habitat suitability
- Make links with stakeholders, farmers and inhabitants before reintroduction

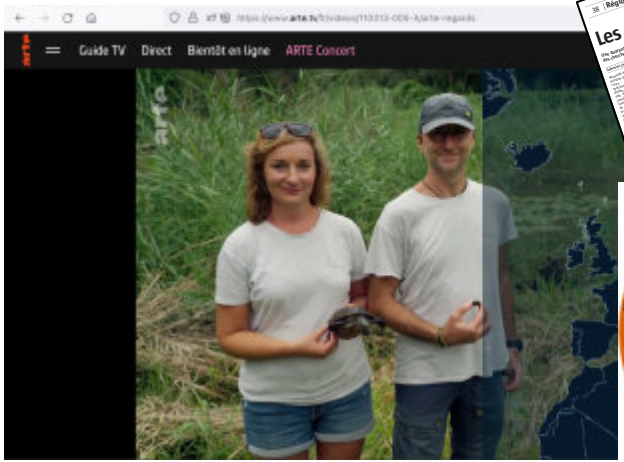
5. Can Emys be an emissary for wetlands?

- Mobilizing values of wetlands, its biodiversity and their conservation
  - Interviews: stakeholders, inhabitants
  - Public seminars: wetlands, biodiversity, functioning, conservation
  - Participatory workshops: sharing knowledge for sustainable governance



5. Can Emys be an emissary for wetlands?

- Mobilizing values of wetlands, its biodiversity and their conservation
- Public outreach actions
  - During release events
  - In medias (watch https://www.arte.tv/fr/videos/110313-005-A/arte-regards)



RHF
RESPONSIBLE HERPETOCULTURE FOUNDATION

Do species reintroductions globally make sense?

Ex-situ conservation measures such as habitat restoration and species reintroduction must follow IUCN guidelines yet can only be sustainable if accepted and supported by stakeholders and the broad public.

www.emysr.cnrs.fr

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