Assessment and Prospects for the Impact of Invasive Fish on Native European Amphibians

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General context

The decrease in amphibian populations in Europe is a serious ecological problem that is being driven by a combination of factors, including habitat loss, climate change, pollution, and the spread of invasive species.

Invasive fish species, such as the Chinese sleeper ***Perccottus glenii*** and the pumpkinseed ***Lepomis gibbosus***, pose a significant threat to native amphibian populations in Europe. These predators can decimate amphibian populations and disrupt delicate aquatic ecosystems.

Perccottus glenii

Scientific context

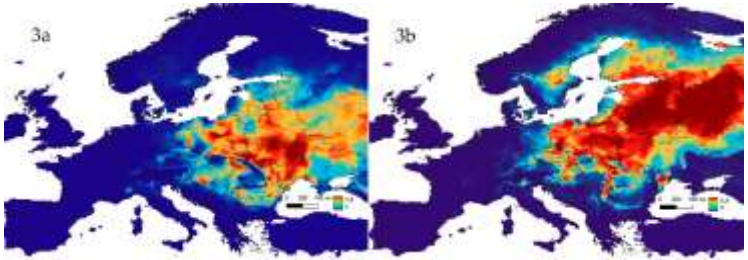
A key issue: to evaluate the impact of invasive fish species on European amphibian populations.

To research the decline of amphibian populations in Europe using a multifaceted approach (including GIS modeling) that includes habitat restoration, climate change mitigation, pollution control, and the management of invasive species.

Perccottus glenii

The following methods were used for the research:

- Occurrence data collection: Monitoring, creating/updating databases
- Environmental data - Bioclimatic Variables: 18 out of 35 variables from the CliMond (1975 and 2050)
- **GIS-modelling:** MaxEnt and Bioclim were used to determine the potential range of invasive species
- Analysis, Evaluation
- Recommendation
- Saving biodiversity data

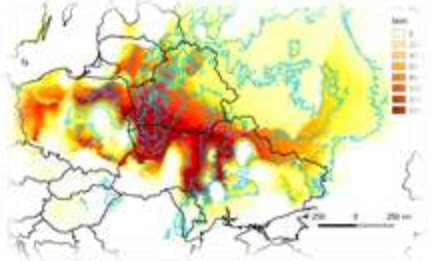


Perccottus glenii

The main ecological consequences include:

1. Predation: Invasive fish often consume amphibian eggs, larvae, and even adults, leading to significant population decline.

2. Competition: Invasive fish compete with amphibians for resources like food and shelter, reducing amphibian survival and breeding success.



3. Ecosystem Alteration: The presence of invasive fish can trigger cascading effects, such as uncontrolled algae growth due to reduced amphibian, impacting the entire ecosystem.

1. Predation: Invasive fish

Field observations show that *P. glenii* injures adult newts and consumes their eggs and larvae, leading to population declines of protected amphibian species.

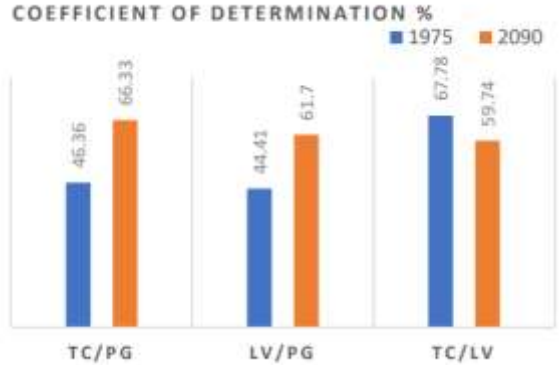
Field monitoring in Latvia, France and Ukraine confirms a decrease in newt populations where these alien fish species expand.

Often tadpoles (larvae) are injured by invasive fish

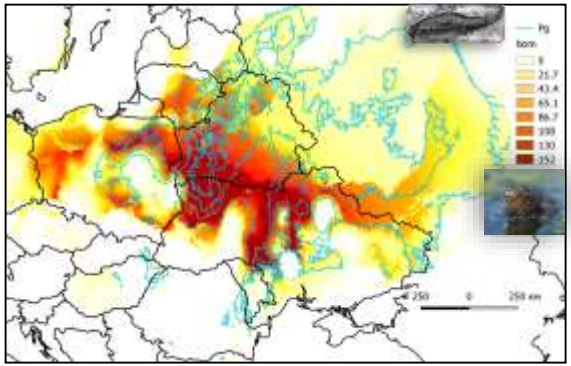
2. Competition: Invasive fish compete with amphibians

The predicted increase in habitat overlap between the invasive *P. glenii* and two native newt species (*T. cristatus* and *L. vulgaris*) in Eastern Europe is from 44% to 66% by 2090.

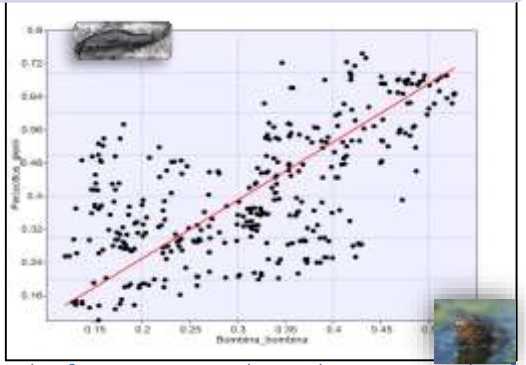
A fairly high correlation (r=0.636; t=15.3) was found between the distribution of *B. bombina* and *P. glenii*, indicating a significant overlap of areas with suitable habitat conditions for them.



Maxent model dependence graphs of grid SDM different species (HS, Coefficient of determination % R2 , Saga): LV—*L. vulgaris*; TC—*T. cristatus*; PG—*P. glenii*.



Visualization of potential distribution of *P. glenii* & *B. bombina* using the programs DIVA-GIS, QGIS.



Graph of Pearson correlation between grids of 0.166667° resolution representing predicted bioclimatic habitat suitability for *P. glenii* & *B. bombina in Latvia*.

Areas and habitats are very similar

3. Ecosystem Alteration: The presence of invasive fish can trigger cascading effects

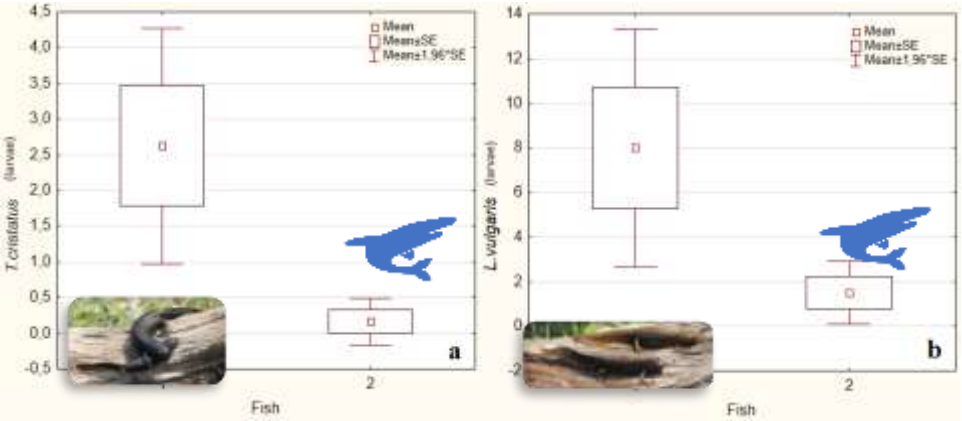
Invasive fish, by destroying amphibians:

- **lead to a deterioration in water quality,**
- **changes in trophic chains**
- **ecosystem connections.**

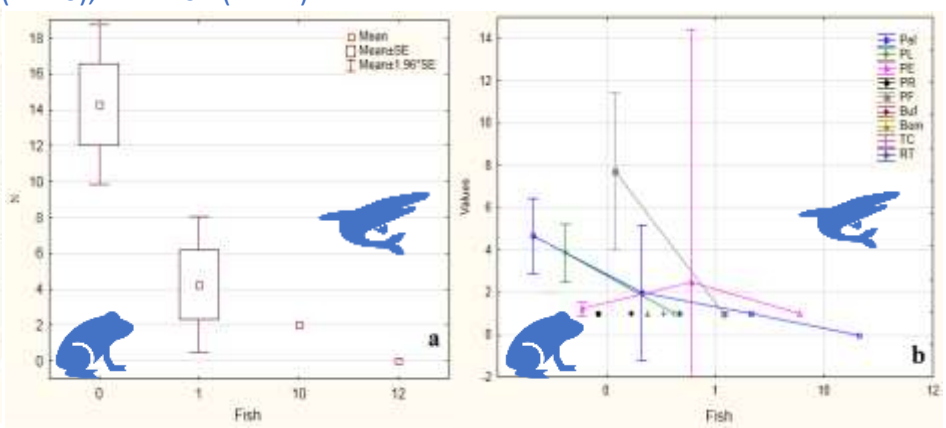
Perccottus glenii

Geographically isolated wetlands as a reserve for the conservation of amphibian biodiversity

Dynamics of the abundance of newts in Silene Nature Park, South East of Latvia, during the monitoring period 2018 and 2022 using method 2.2.1 (average number of individuals per 10 net sweeps per pond, mean/pond): a – *T. cristatus*, b – *L. vulgaris,* depending on the presence of alien predatory fish ("Fish"): 1 – no fish and 2 – presence of fish.



Dynamics of the abundance of amphibians in Silene Nature Park, South East of Latvia, in 2022 using method 2.2.3 (mean/pond): a – average number of individuals of 9 amphibian species (N – average number of individuals), b – the average number of individuals of each species separately (designations in the text), depending on the presence of alien predatory fish ("Fish"): 0 – no fish and 1 – fish (N=1), 10 – fish (N=10), 12 – fish (N=12).



The data from the study confirm the negative impact of invasive predatory fish on the abundance and diversity of amphibians (Pupins et al., 2023)

Recommendations

Monitoring and early detection: Regularly monitor water bodies for timely detection of invasive fish species. This will allow taking measures at the early stages of invasion.

Control and removal: The goal is to reduce the number or completely remove invasive fish from water bodies.

Protection and creation of barriers: Installation of physical barriers, such as nets, as well as the creation of geographically isolated water bodies can prevent the spread of invasive fish to new water bodies and protect amphibian habitats.

Public education and awareness: Engaging the public to participate in activities to protect amphibians.

Legislative measures: Development and implementation of laws and regulations governing the import, breeding, and release of invasive fish species. Tightening control over the trade in exotic fish.

International cooperation: Development of international cooperation and exchange of experience in combating invasive species, coordination of efforts to prevent their spread across borders.

Summary. Our models forecast:

1) An increase in the range of the thermophilic invasive fish species;

2) Significant declines in most native amphibians' natural ranges by 2090;

3) Native European amphibians will face increased pressure from invasive fish as breeding habitat loss intensifies;

Creating Geographically Isolated Wetlands (GIW) is crucial for amphibian conservation, as they harbor greater diversity and abundance while preventing predatory fish expansion. Urgent action is needed to protect amphibians, particularly newts, through reconstruction of GIW and simultaneous control of invasive predators.

Take home message

Addressing the decline of amphibians in Europe requires a multifaceted approach that includes habitat restoration, climate change mitigation, and the management of invasive species.

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More:

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