

Europe - a small and unpleasantly changing continent from an amphibian perspective



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INTRODUCTION



- Contemporary mass-extinction is speeding up, despite frequent attempts started decades ago to stop, or, at least, minimize deleterious effects of anthropogenic activities.
- Different authors agree that habitat fragmentation, degradation and destruction as one of the major threats to biodiversity nowadays (Diamond, 1989; Soule, 2009).
- Human interventions on natural habitats in a way which degrades, fragments or destroys them, directly cause decrease of carrying capacity level, and decrease of population size of local species. And that is the beginning of the vortex of extinction...

This is Europe...

Total area: 10.18 million km²

Total number of inhabitants: 746,4 millions

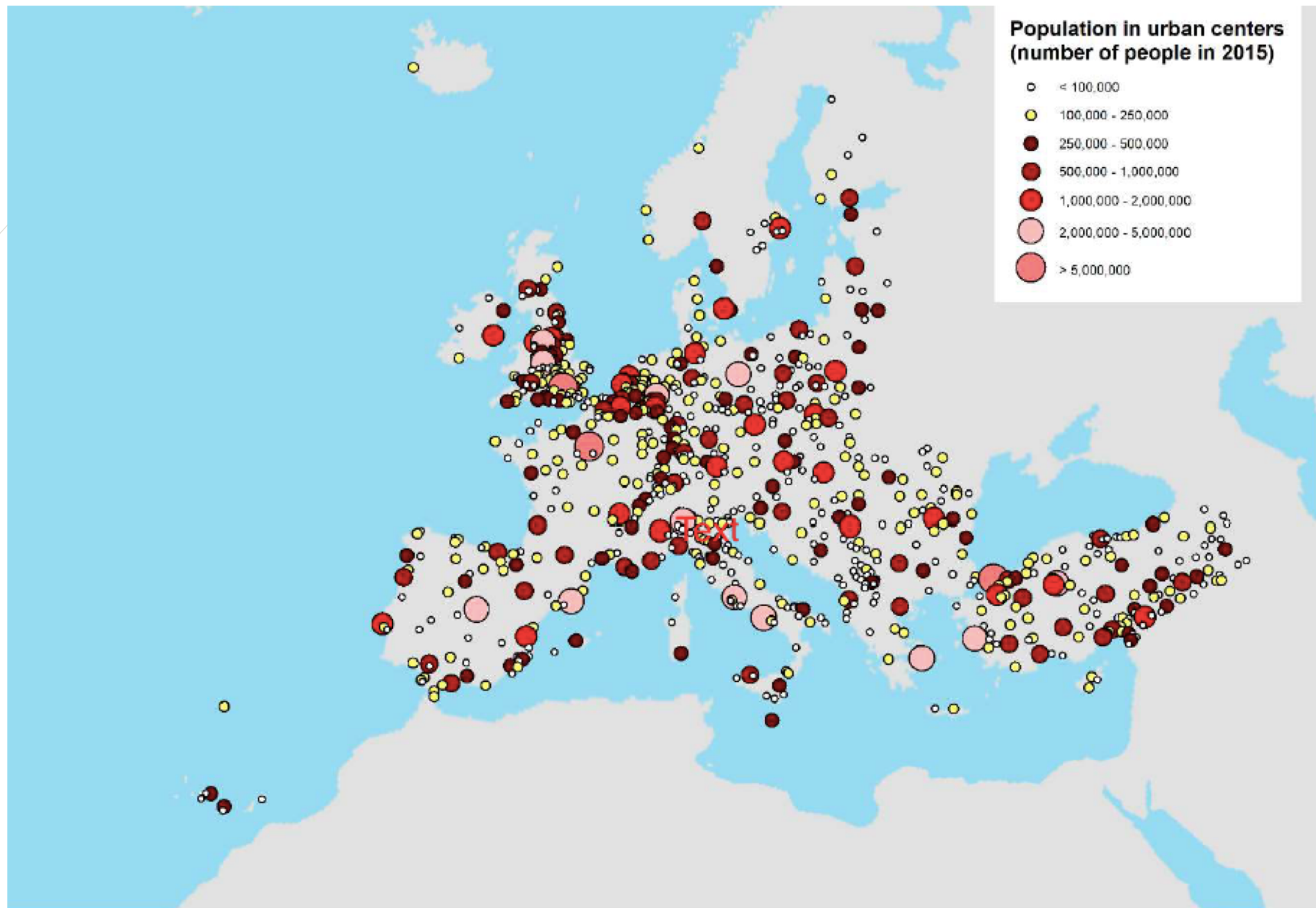
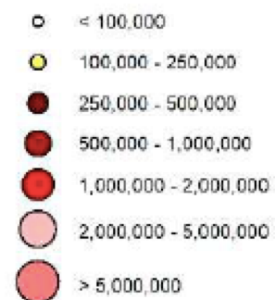
The destruction of woodlands started from about 800 and 1300 CE; only in the north and below the snow line of Alpine mountains have forests of large value survived.

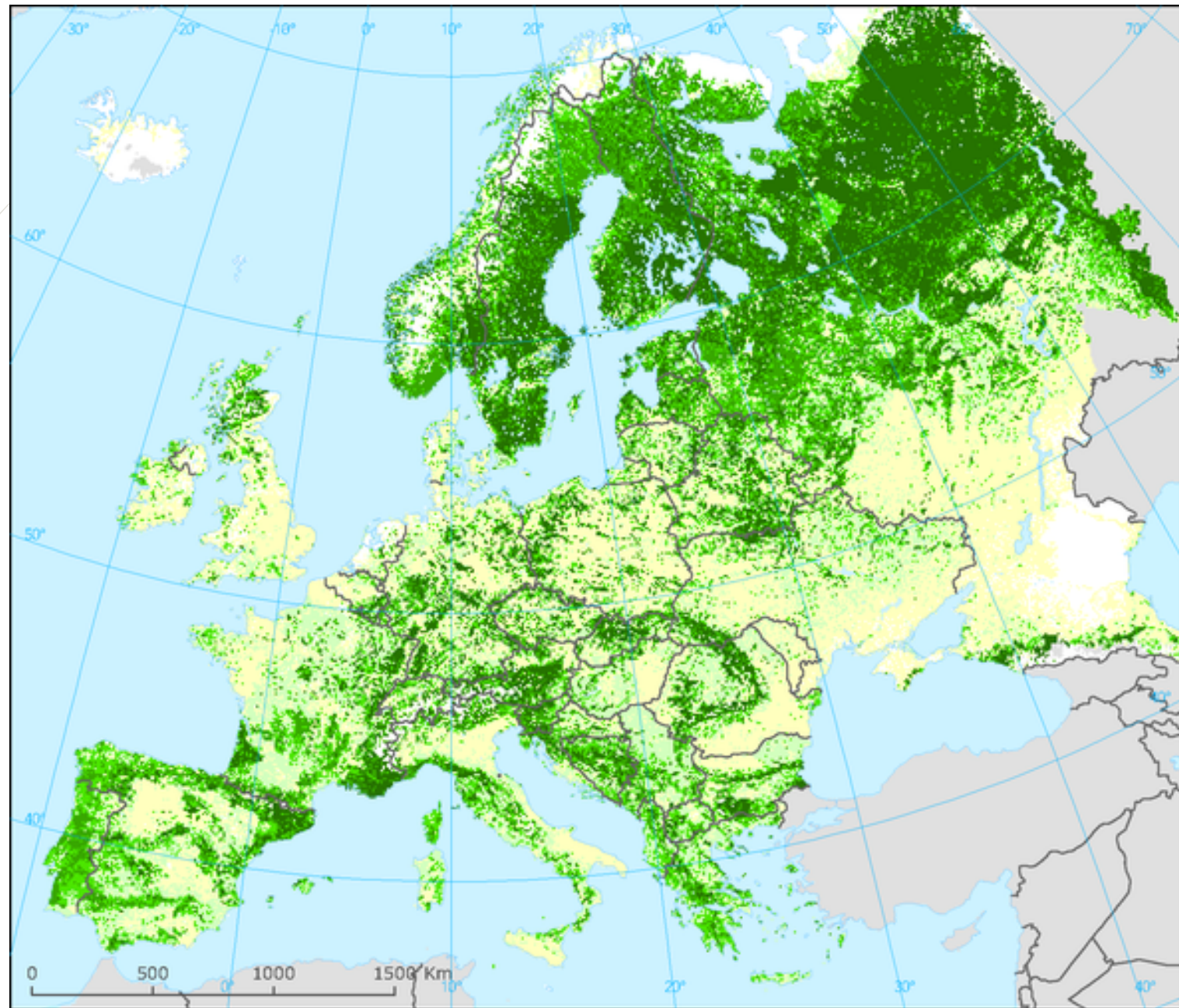


- Europe has long been a populous part of the world. Although its estimated population numbered only one-third of Asia's in 1650, 1700, and 1800, and increased to one-fourth of the global human population by 1900, when Europe's total population just exceeded 400 million. By the early 21st century, Europe's population had fallen to about one-tenth of the world total.



**Population in urban centers
(number of people in 2015)**





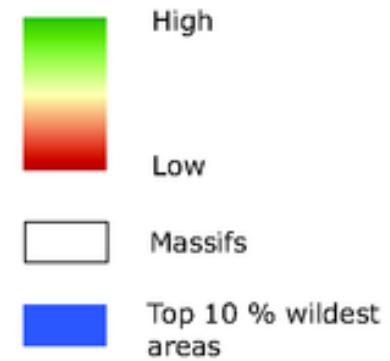
**Proportion of
total forest from
total land area**

% at 1 x 1 km resolution

- Water
- No data
- 0-1
- 2-10
- 11-25
- 26-50
- 51-75
- 76-100



**Wilderness Quality Index
(including terrain
ruggedness) for Europe**



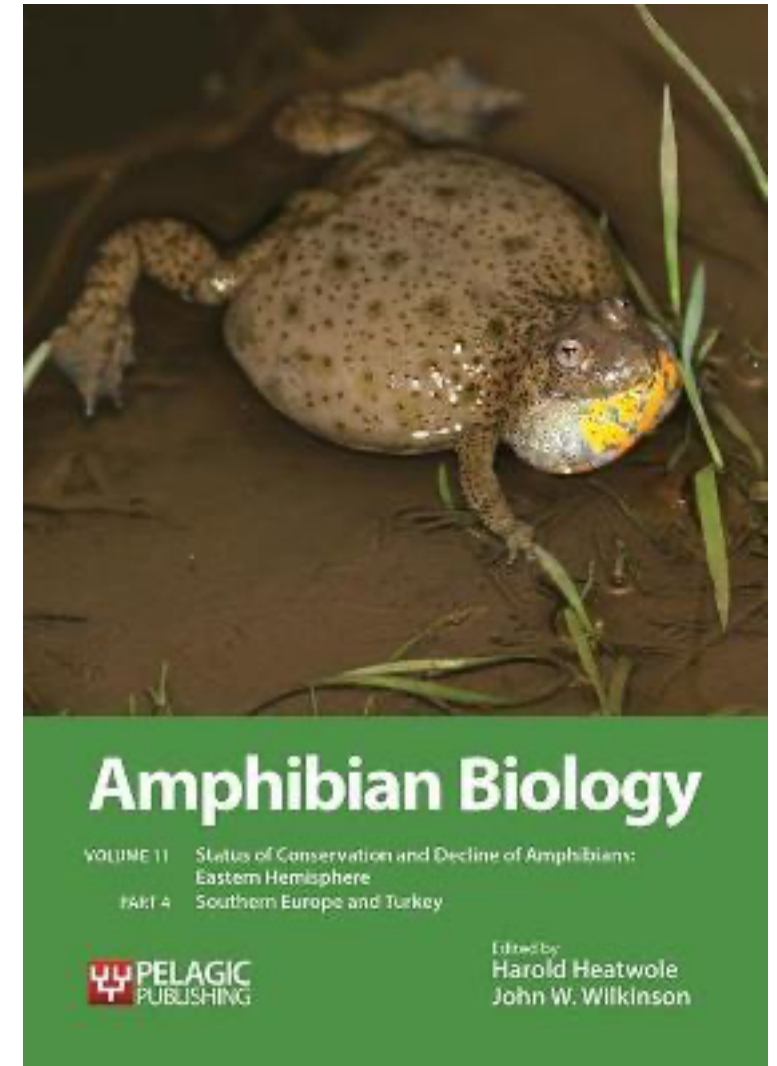
INTRODUCTION



- ▶ Europe provides space for 73 endemic, 26 non-endemic and 2 allochthonous amphibian species.
- ▶ Majority of them are considered Least Concern (LC) on IUCN Red List, mostly due to its large distribution areas and lack of or incomplete evidence on impact of severe threats.
- ▶ By analyzing trends for multiple species across a broad spatial scale, Falaschi et al. (2019) identified alien species, climate change, and habitat changes as the major drivers of European amphibian and reptile decline. When excluding the two commonest species, habitat loss was the main correlate of negative population trends for the remaining species.

INTRODUCTION

- Only about 21% of European territory is consisted of protected areas, while the remaining are more-or-less human altered habitats.
- Anthropogenic impact on habitats is reflected also in the apparent degree of deforestation, land conversion, destruction of small water bodies and degradation of mountain rivers.
- A study on conservation status and declines of amphibians in Southern Europe and Turkey (Heatwole and Wilkinson, 2015) revealed that, at least there, habitat alteration, drying out/destruction of aquatic sites and establishment of various types of dams were the most frequently mentioned threats to amphibian habitats.



Major threats for European amphibians

- Habitat degradation or destruction
- Fragmentation of the habitat
- Spread of pathogens and parasites
- Injection of harmful chemicals into their habitats
- Introduction of alien species
- Global warming and climate change
- Global trade

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Habitat degradation and destruction

Agressive urbanization as a threat

- “Urbanisation and progressive changes in land use are considered to exert some of the strongest influences on amphibian populations worldwide.
- Adverse human activities, such as urban expansion, development of dense road networks without provision of compensatory solutions, and increased runoff contribute to the widespread loss or degradation of habitats, water pollution, isolation, and other unrecognised threats”
 - (Konowalik et al., 2020)

Habitat degradation and destruction

Agressive urbanization as a threat

- “Current data on the occurrence of amphibians in European urban areas is still insufficient. Although the faunistic approach is still predominant, studies are increasingly being focused on the influence of habitat features on amphibian richness and distribution.”
(in: Konowalik et al., 2020).
- It is particularly important to check for metapopulation organization of local amphibian species and the possible presence of metacommunities in an area assigned to anthropogenic change – if minimum viable number of suitable habitat patches for specific metapopulation no longer exists, the entire metapopulation is doomed.

Habitat degradation and destruction

Agressive urbanization as a threat

- A case study:
- Brief comparison of number of amphibian species in the central districts of two big cities in Serbia before (before year 2000) and after democratic changes (2000 - 2016).
- Belgrade, the capital city of Serbia, has been suffering from aggressive urbanisation since the beginning of XXI century, while Niš, the regional center, was quite persistent until last few years.



Habitat degradation and destruction

Agresive urbanization as a threat

- A case study:
- In Belgrade, after year 2000 until year 2016, just 8% of overall number of amphibian species in the city area was registered in the central city parts;
- in Niš, after year 2000 until year 2016, 27% of overall number of amphibians in the city area were recorded in the central city parts (Crnobrnja-Isailović et al., 2016).



Habitat degradation and destruction

Agressive urbanization as a threat

- A case study:
- Agressive urbanization in Belgrade started after period of civil wars in the '90-ies and has been reflected in a fast replace of individual family houses with green backyards by densely distributed buildings without green corridors and/or green areas in between. This process, also named as „investors' urbanism“ is continuing, despite objections of ecological professionals and civil organizations.



Habitat degradation and destruction

Increased deforestation as a threat

- Comparing deforestation in Europe in two periods
 - 2011 to 2015 and 2015 to 2018 -it seems that it has risen some 49%,
and the loss of biomass increased 69%.

22 EU countries have increased their harvest rate.
The countries with the large old-grown forests,
including Sweden, Finland, Romania and Poland,
show some of the most dramatic rises.

(Ceccherini et al., 2020)

Habitat degradation and destruction

Increased deforestation as a threat

- This issue is tightly connected with the other topics of this conference
 - habitat fragmentation and climate change -, what results in increased average size of harvested forest patches by 34% and in the loss of quality and quantity of forests.

(Ceccherini et al., 2020)

Habitat degradation and destruction

Increased deforestation as a threat

- A case study:
- According to national data compilation by Vuković and Vuković-Mandić (2018), forests cover significant portions of Western Balkans – from 29% in Serbia to 60% in Montenegro.
- Despite knowledge on ecosystem services provided by the forests, their exploitation is showing tendency of increase, at least in some of the Balkan countries.



Habitat degradation and destruction

Increased deforestation as a threat

- A case study:
- *Bufo bufo* – generally considered as a forest species although persists also in degraded or altered forest habitats;
- however, specific breeding habits - apparent exposure of reproductive population to predators during breeding period which is considered as "explosive" (short) but in some populations can last more than two weeks, suggest that the canopy quality could be important during this sequence of annual phenology (Jovanović et al. 2020).



Habitat degradation and destruction

Loss of small lentic water bodies as a threat

- “Small standing water ecosystems (SWE) are mainly related to shallow water bodies (SWB), of either natural or artificial origin, perennial or temporary, dominate the global landscape, including pools, ponds, small lakes, and wetlands. SWE are defined variously regarding an area and depth, e.g.: (1) as shallow (relative depth < 3m) lentic water bodies, with a surface range of 103–106 m² [3]; (2) as shallow (<20 m deep) and small lentic water bodies ranging in surface between 1 m² and several hectares (1 ha = 10,000 m²), ≈10 ha...” (in: Špoljar et al., 2021).

Habitat degradation and destruction

Loss of small lentic water bodies as a threat

➤ A case study:

- In the Western Balkan countries, small water bodies are silently disappearing, due to either anthropogenic impact (intensive habitat alterations such as conversion to the agricultural land, motorway and highway constructions, opening of new mines for exploitation of rare or essential minerals, deforestation, etc), or natural causes (succession and/or change of climate) (Crnobrnja-Isailović et al., 2022).

Table 1. List of amphibian species in the countries of the Western Balkans which use SWB.

Species	IUCN	BERN	HABITATS	NCS CROATIA	NCS BOSNIA AND HERZEGOVINA	NCS MONTENEGRO	NCS ALBANIA	NCS SERBIA	NCS NORTH MACEDONIA
<i>Proteus anguinus</i>	VU	II	II, IV	SP	SP/P				
<i>Salamandra salamandra</i>	LC	III	-	-	-	SP	P	SP	-
<i>Ichthyosaura alpestris</i>	LC	III	-	-	-	SP	P	SP	-
<i>Lissotriton vulgaris</i>	LC	III	-	-	-	SP		SP	-
<i>Lissotriton graecus</i> ¹	NA	-	-	-	SP/-	SP	P	SP	-
<i>Triturus carnifex</i>	LC	II	II, IV	SP	SP/-				
<i>Triturus cristatus</i>	LC	II	II, IV					SP	
<i>Triturus dobrogicus</i>	NT	II	II	SP	SP/-			SP	
<i>Triturus ivanbureschi</i> ²	NA	II	II, IV					SP	P
<i>Triturus macedonicus</i> ³	NA	II	II, IV		SP/-	SP	SP	SP	P
<i>Bombina bombina</i>	LC	II	II, IV	SP	-			SP	
<i>Bombina variegata</i>	LC	II	II, IV	SP	SP/-	-	SP	SP	P
<i>Bufo bufo</i>	LC	III	-	-	-	SP	P	SP	-
<i>Bufo viridis</i>	LC	II	IV	SP	-	SP	SP	SP	P
<i>Hyla arborea</i>	LC	II	IV	SP	-	SP	SP	SP	P
<i>Pelobates fuscus</i>	LC	II	IV	SP	SP/-			SP	
<i>Pelobates balcanicus</i> ⁴	NA	II	IV				SP	SP	P
<i>Pelophylax epeiroticus</i>	NT	III	-	*			P		
<i>Pelophylax kl. esculentus</i>	LC	III	V	-	-			P	
<i>Pelophylax kurtmuelleri</i>	LC	-	-	-	-	SP	P		
<i>Pelophylax lessonae</i>	LC	III	IV	SP	-			P	
<i>Pelophylax shqipericus</i>	VU	III	-			SP	P		
<i>Pelophylax ridibundus</i>	LC	III	V	-	-	SP		P	-
<i>Rana arvalis</i>	LC	II	IV	SP					
<i>Rana dalmatina</i>	LC	II	IV	SP	-	-	SP	SP	P
<i>Rana graeca</i>	LC	III	IV		SP/-	SP	SP	SP	P
<i>Rana latastei</i>	VU	II	II, IV	SP					
<i>Rana temporaria</i>	LC	III	V	-	-	-	P	SP	-

IUCN – International Union for Conservation of Nature (VU-Vulnerable; NT-Near Threatened; LC-Least Concerned; NA-Not Assessed); BERN – Bern Convention on conservation of European wild flora, fauna, and natural habitats (Appendix II – strictly protected animal species, Appendix III – protected animal species); HABITATS – Habitats Directive or European directive on conservation of natural habitats and of wild flora and fauna (Annex II – vulnerable/sensitive species which could become endangered in the near future if the factors of threat continue to act, Annex IV – species that require strict protection, Annex V – species which breeding in the wild and exploitation could be a matter of management); NCS-National Conservation Status (SP – Strictly Protected; P – Protected); Croatia - OG (144/13) and OG (73/16); Bosnia and Herzegovina -

Habitat degradation and destruction

Loss of small lentic water bodies as a threat

- A case study:
- Conservation of SWB in the Western Balkans is, in many cases, related to the socio-economic status of the people i.e. to the stimulation of local stakeholders to continue with traditional practices of agriculture and animal husbandry, including maintenance of SWB, and to their continuous education on the importance of SWB for the preservation of high values of local biodiversity.
- It seems that decision makers in the Balkan countries have not been educated or, what could be more efficient, trained by implementation of adequate legal acts to take care of these important habitats.



Habitat degradation and destruction

Degradation of the mountain rivers as a threat

Although hydropower has been considered as a “renewable” and “green” source of electricity (see, for example Altinbilek, 2004; Flamos et al, 2011), it seems that hydropower plants have a strong environmental impact on freshwater wetlands (Bunn and Arthington, 2002; Collen et al, 2014; Wu et al., 2019), additionally strengthened by climate change (Wu et al, 2021). Small hydropower plants (SHPPs) with 0.1 to 10 MW of installed power, at the beginning were presented as a very “green” and sustainable source of electricity: the general impression was that they had a much less negative environmental impact than the large HPPs (see short overview in Couto and Olden, 2018). However, in reality the situation is quite the opposite (Konak and Sungu-Eryilmaz, 2016; Kelly-Richards et al., 2017).

Habitat degradation and destruction

Degradation of the mountain rivers as a threat

- “(1) confusion in small hydropower definitions is convoluting scholarship and policy-making;
- (2) there is a lack of knowledge and acknowledgement of small hydropower’s social, environmental, and cumulative impacts;
- (3) small hydropower’s promotion as a climate mitigation strategy can negatively affect local communities, posing contradictions for climate change policy;
- (4) institutional analysis is needed to facilitate renewable energy integration with existing environmental laws to ensure sustainable energy development.”

(Kelly-Richardson et al., 2017)

Habitat degradation and destruction

Degradation of the mountain rivers as a threat

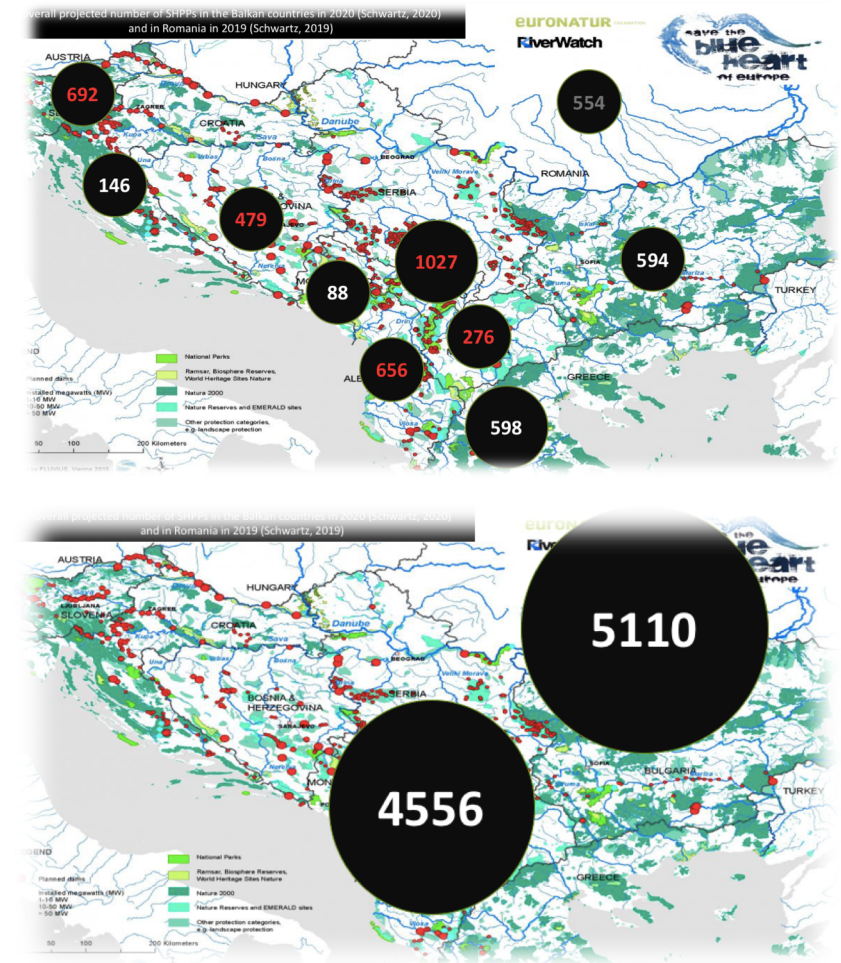
- A case study:
- Some years ago, out of river small hydropower plants (SHPP) start to proliferate throughout the Balkans, revealing questionable capacity of national governments to fight ecological crisis.
- Recent mini-review about impact of SHPP on Balkan herpetofauna reminded that there are amphibian species in the hilly/mountain parts which rely on small lotic aquatic systems (Crnobrnja-Isailović et al, 2021).
- Even these are just 28% of overall amphibian species number in the region, respectively, some of them are very widespread.



Habitat degradation and destruction

Degradation of the mountain rivers as a threat

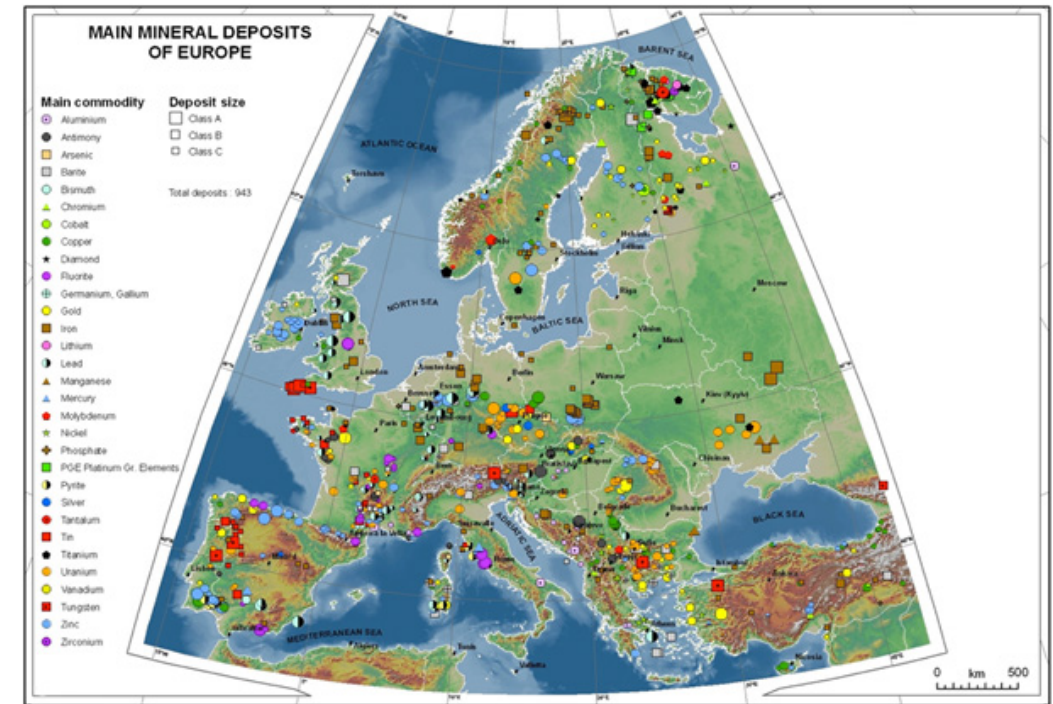
- A case study:
- The fact that almost 5000 Balkan rivers would be devastated, suggested that many of those species would be regionally threatened.
- This revealed deep conflict between scientific knowledge and profit (see also Dogmus and Nielsen, 2020),
- and a paradox of ignoring biodiversity conservation while applying theoretically sustainable practices.
- Even hydroenergy in EU is now not recognized as „sustainable“ source, there are still investors in the Balkans, at least in Serbia, whose gain profit by establishing SHPP which apparently disturb local environmental values and local biodiversity. Appeals of local communities and even national experts are still ignored.



Habitat degradation and destruction

Establishment of new mining areas

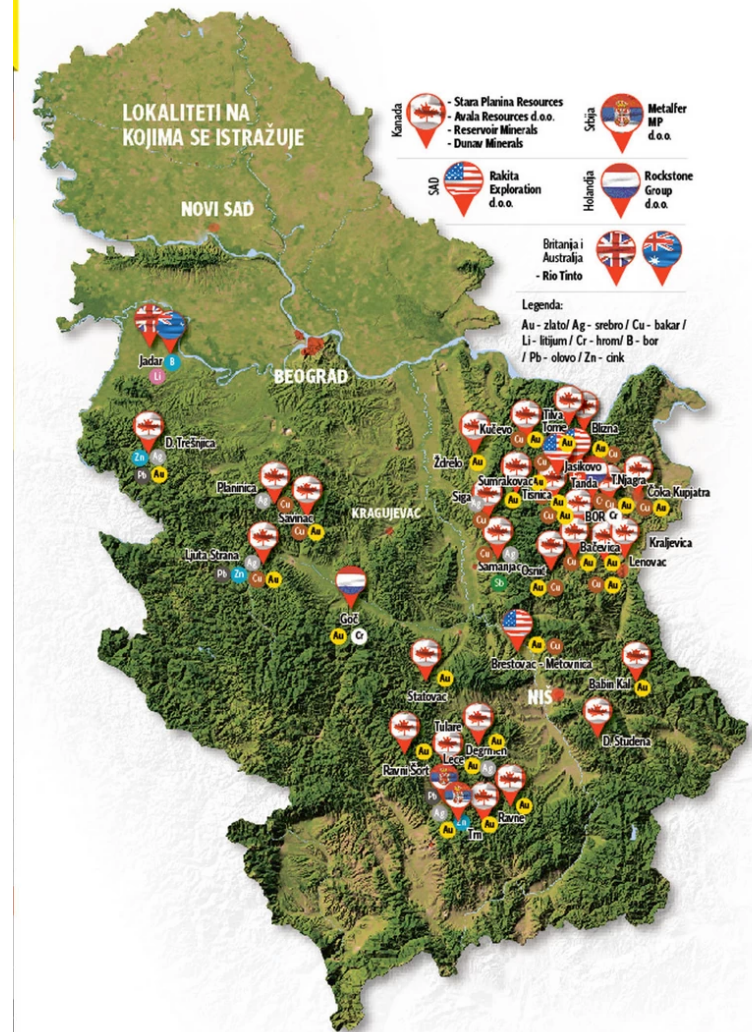
“Europe is rich in natural resources and the extraction and supply of minerals continue to play a crucial role in the European economy and society as it has done for thousands of years. Minerals are used in everyday life, as construction materials (crushed rock, sand and gravel) for infrastructure, buildings, and roads, and for industrial purposes (e.g. metals, lime, kaolin, silica sand, talc) in the production of steel, cars, computers, medicines, human and animal foodstuffs and fertilizers, to name just a few key applications.”
(<https://www.euromines.org/mining-Europe>)



Habitat degradation and destruction

Establishment of new mining areas

- Case study:
- In Serbia, about 20 new mining areas is planned, mostly for lithium extraction.
- One of them is going to be established on appr. 1.200 ha of very fertile agricultural land.
- Ecological activists and local municipalities claim that this mine would produce more than 1,2 million thousands kilograms of toxic and carcinogenic tailings per year.




Habitat degradation and destruction

- These few examples provide clear message:
- There is urgent need for prompt actions focused on protection of European amphibians from the negative anthropogenic effects leading to habitat loss.
- It is important to act before the destruction happens.
- HOW?



Possible solutions for early warning on amphibian threats



Our idea was to remind you on one not brand new, but, by the author's experience, useful intellectual tool which would help in establishing and maintaining early warning on amphibian threats, including this one we were just talking about today:

Possible solutions for early warning on amphibian threats

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Application of an expert-based threat analysis (Salafsky approach) involving local herpetologists to quantify extent, intensity and magnitude of any threats could help seems suitable in each crisis context where human-induced threats act on amphibian assemblages.

Possible solutions for early warning on amphibian threats

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Application of an expert-based threat analysis (Salafsky approach) involving local herpetologists to quantify extent, intensity and magnitude of any threats could help seems suitable in each crisis context where human-induced threats act on amphibian assemblages.

This approach allows to build a conceptual framework expliciting the complex causal chains among targets, threats and driving forces, therefore selecting the priority threats where focus the main conservation effort.

Possible solutions for early warning on amphibian threats using a strategic system thinking

The site-based threat analysis (Salafsky et al., 2008 and IUCN), is a building of a logical framework unifying threats and driving forces acting on amphibian targets.

The site-based threat analysis

By applying this approach it is possible to change the focus - from a target quantification to a local expert-based threat assessment.

1. Any local threat (acting on our targets) should be named (see IUCN nomenclature).
2. Local threats and targets will be linked along a cause-effect chain (conceptual framework).
3. A group of experts will assess the magnitude of each threat using scores for a set of regime attributes (extent, intensity, duration, frequency).
4. Upon this analysis, the experts will obtain a ranking of the local threats and recognize the priority ones.
5. Based on this ranking, a project teams will be able to start with a conservation projects focused on the more urgent threats.

1. THE THREAT NOMENCLATURE

IUCN and EU developed a systematic and nomenclature of human-induced threats.

Any threat may be classified in a standardized way.

EXAMPLE:

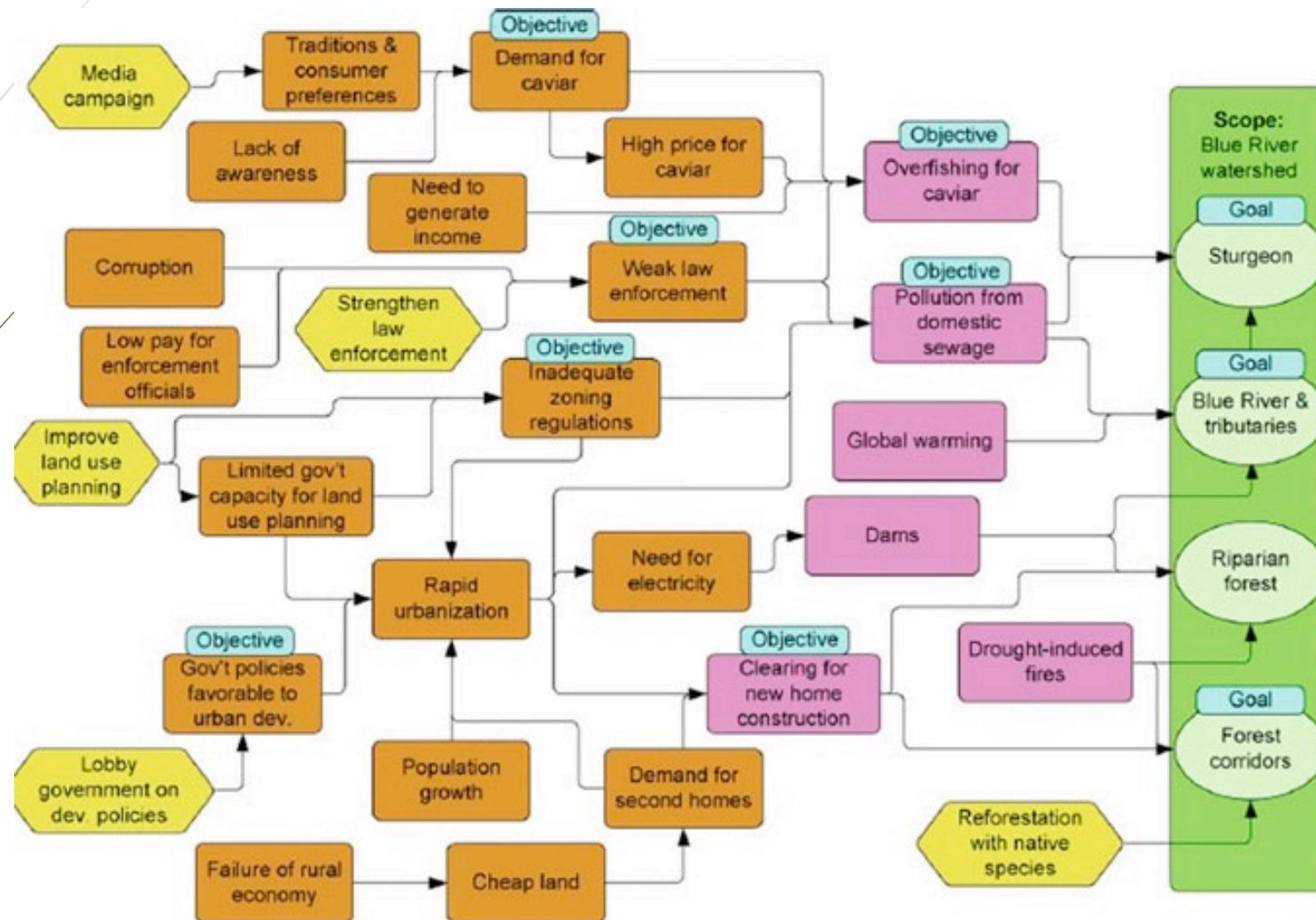
CATEGORY. 2. Agriculture and aquaculture

2.1 Annual and perennial non-timber crops

2.2 Wood and pulp plantations....

2. THE CAUSE-EFFECT CHAIN

Linking targets (GREEN), threats (PINK) and driving forces (ORANGE) in a causal chain...therefore, suggesting strategies (YELLOW)



3. THREAT EVALUATION (using expert-based approaches with scores)

(A procedure similar to the matrices of Environmental Impact Assessment)

- Regime attributes: threat extent, intensity (severity), duration, frequency and others.
- Each attribute will be assessed using scores (1- low to 4 - high)
- Sum of attributes will provide a Magnitude index
(TOTAL IMPACT OF THREAT)
- Having scores in Magnitude for each threat will allow....

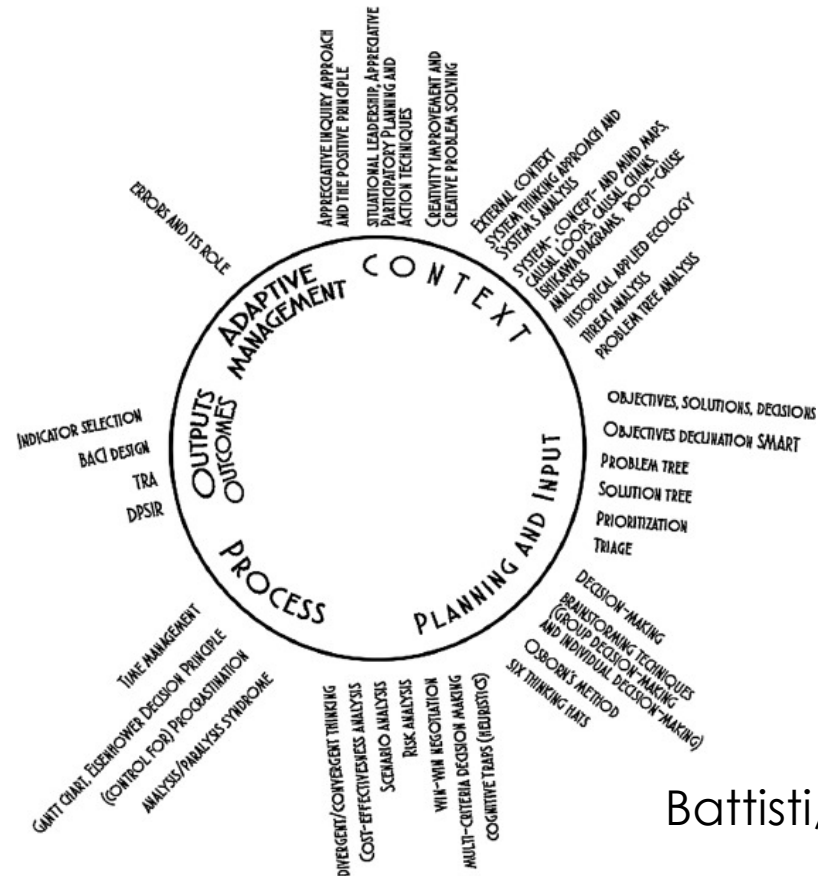
4. THE THREAT RANKING (ORDER OF PRIORITY)

Threat (IUCN)	Target:			Total	Ranking
	Scope	Severity	...		
.....	4	4	4	12	Very High
.....	1	2	1	4	Low
.....	4	4	4	12	Very High
.....	2	3	4	9	High

- **Delphi** and **Focus group** methods are appropriate in order to evaluate those threats that are empirically very little known, have different metrics, are comparable with difficulty and thus the potential degree of uncertainty is very high (Linstone and Turoff, 1975; Hess and King 2002).

And last...

Thanks to a local order of priority we may start with a **local conservation project** (see the IUCN project cycle) focused on the priority threats



Battisti, 2018, J. Nat. Cons.

SUMMARY

- Amphibians are **globally very threatened** animal group (Anthony et al 2008).
- Europe is small area but **under strong pressure of industrially quite developed human population** and with a lot of challenges to biodiversity conservation.
- Europe has well developed set of legislatives for biodiversity conservation, but the question is **are these legislatives fully implemented everywhere?**

SUMMARY

- Freshwaters and forests are important habitats for amphibians; however, In Europe they are threatened by the growing appetites of modern and spoiled human population. In some parts of Europe, these habitats are treated by main stakeholders as a free capital which must be easily converted into their own economic benefit.

SUMMARY

- Process of democratisation of Europe have not been inevitably coupled with increase of ecological awareness; the **citizens** of certain number of countries so far **did not show interest/knowledge/capacity** to **choose/elect** political option which understands importance of biodiversity conservation.

SUMMARY

- This suggests that, maybe, the **biodiversity issues** in some parts of Europe, therefore the loss of essential habitats for local amphibians, **should not be exclusively a national issue.**

SUMMARY

- Intensification of consultations/interviews with the entire community of local experts in the process of recognizing major threats for local amphibians and in decision making on the urgent conservation actions could lead to elimination or, at least, minimisation, of both national and regional (continent-wide) threats which jeopardize survival of this fragile vertebrates.

Grazie a tutti per l'attenzione!



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