THE IMPACT OF RUN-OF-RIVER SMALL HYDROPOWER PLANTS ON BIODIVERSITY IN THE BALKANS

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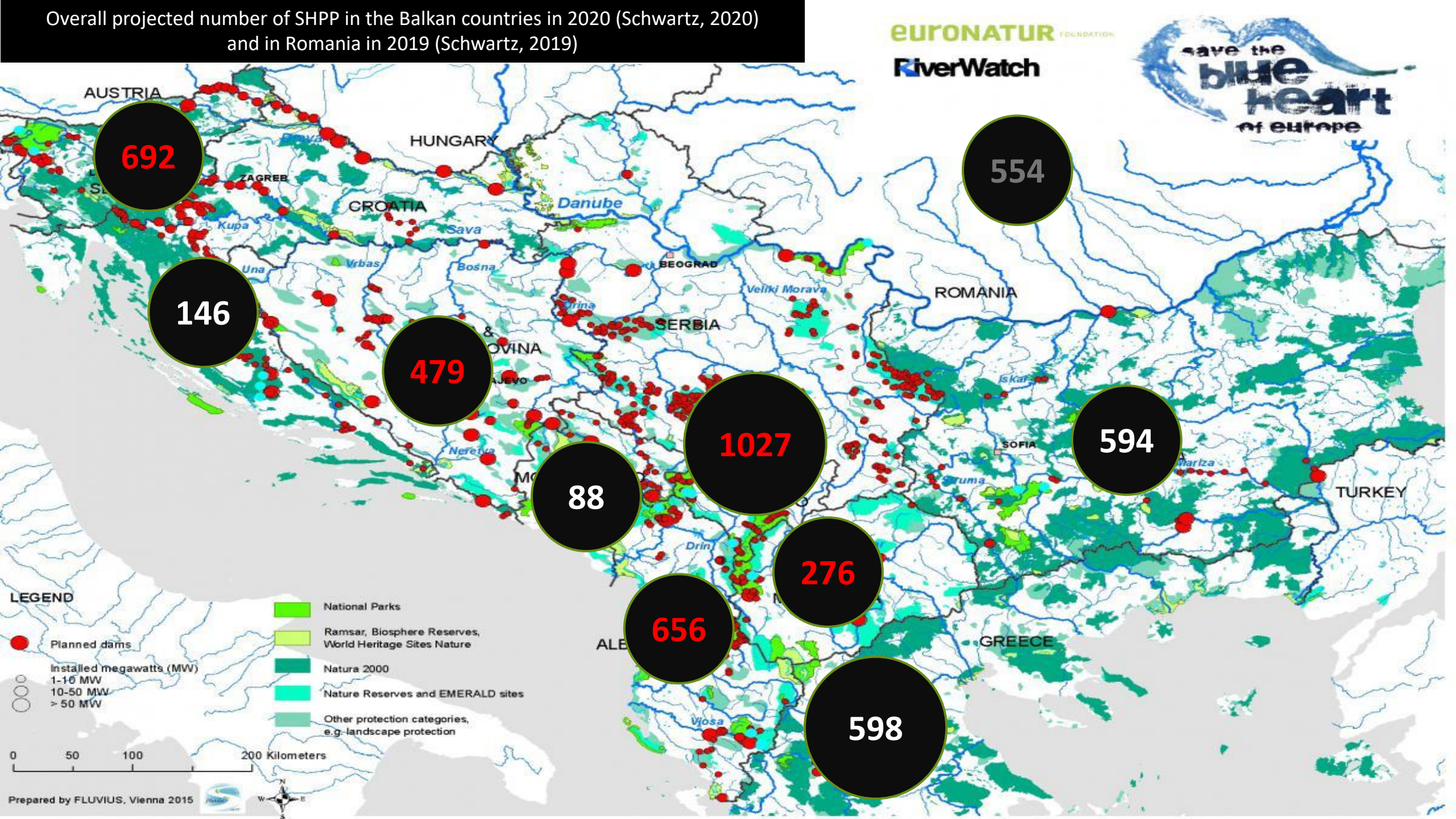
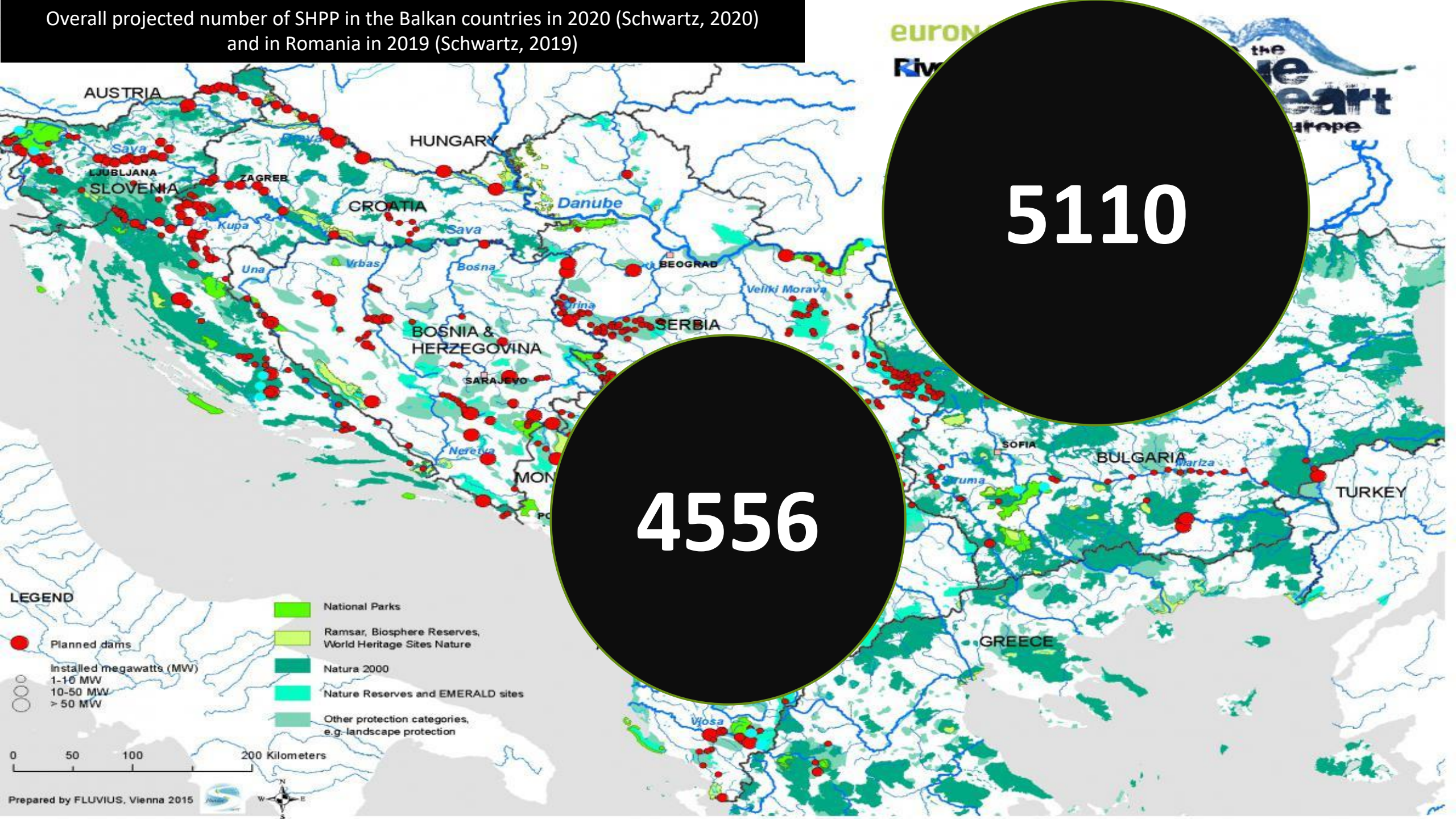
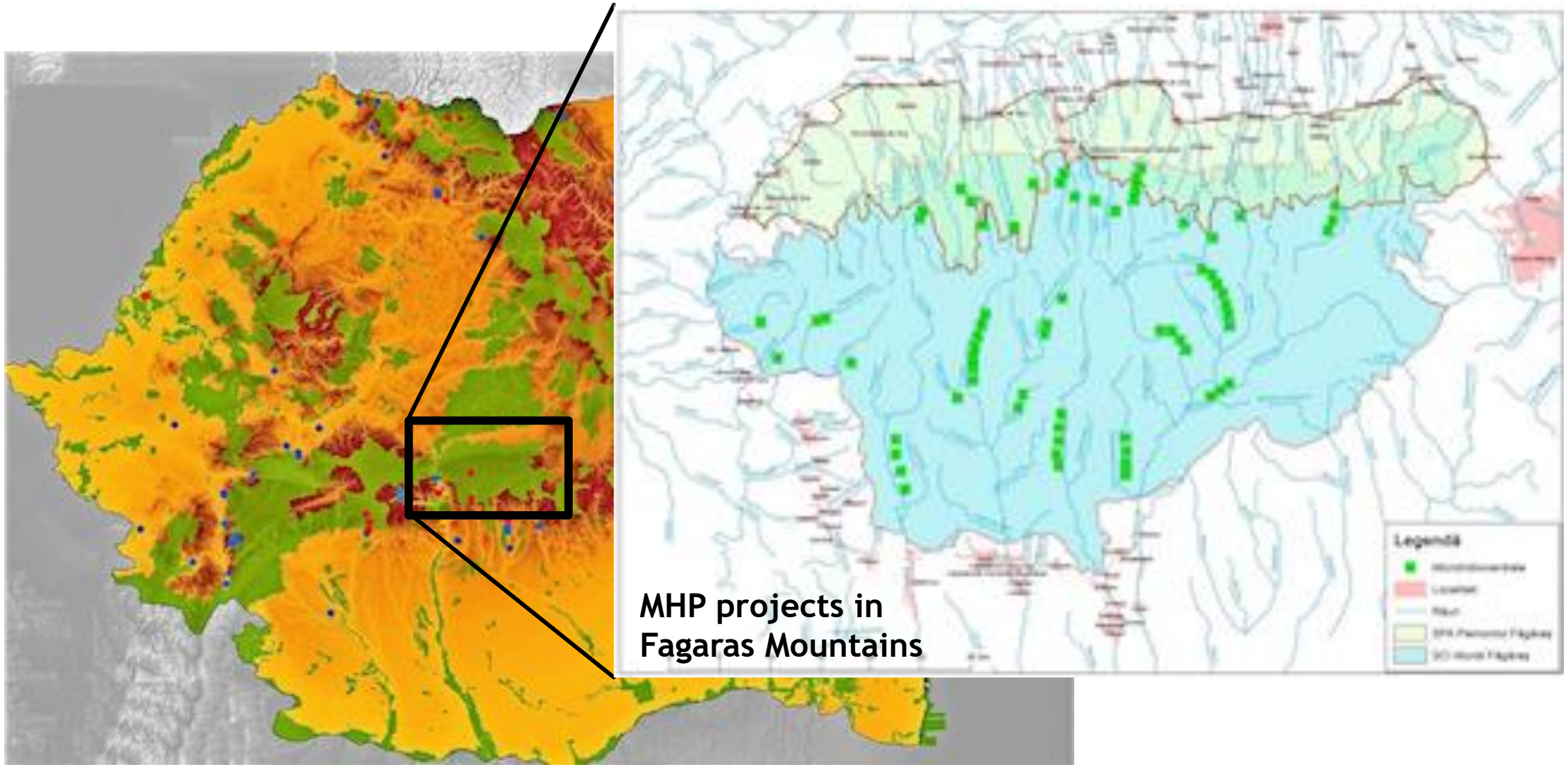
Overall projected number of SHPP in the Balkan countries in 2020 (Schwartz, 2020) and in Romania in 2019 (Schwartz, 2019)



Overall projected number of SHPP in the Balkan countries in 2020 (Schwartz, 2020) and in Romania in 2019 (Schwartz, 2019)





Bocutiu & Plesa
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Map of micro-hydropower projects in Romania (overlapping on protected areas)

Ristić et al. (2018):

“During low water periods, due to lack of surveillance,
ROR SHPP owners direct almost all water to diversion pipelines to produce more energy and achieve higher profits, causing complete destruction of streambed communities for several kilometers.”

FISHES

Simonović et al. (2021):

“In addition to water pollution, extracting water for crop irrigation, mining, timber utilization, deforestation and erosion, and introduction of nonnative strains, RRHPs are the latest impact on native brown trout (*Salmo trutta*)…

› Two highly distinct morphs detected in the Aegean drainage. Left from the River Lisina, and right from the River Tripušnica.

Installing of ROR SHPP in Serbia started in 2015. ROR SHPP were constructed exclusively in steep-sloped montane streams that host fish communities including brown trout.
Downstream of the water intake structures, diversion pipelines 1–3 km, sometimes up to 5 km in length, were installed, often in the mere streambed,
to transport water to turbine buildings,
from where water returns to the watercourse.”

Simonović et al. (2021):

“Construction required heavy machinery, affecting remarkably the streambed and riparian area, and most likely the organisms of both aquatic and adjacent terrestrial ecosystems. That changed the stream sections along the derivation pipes to uniform runs that resemble the shallow (up to 50 cm deep) channels, without any diversity of natural montane stream habitats (e.g., pools, riffles, glides, and cascades) featuring the sections upstream of the ROR SHPP dams.”

Simonović et al. (2021):

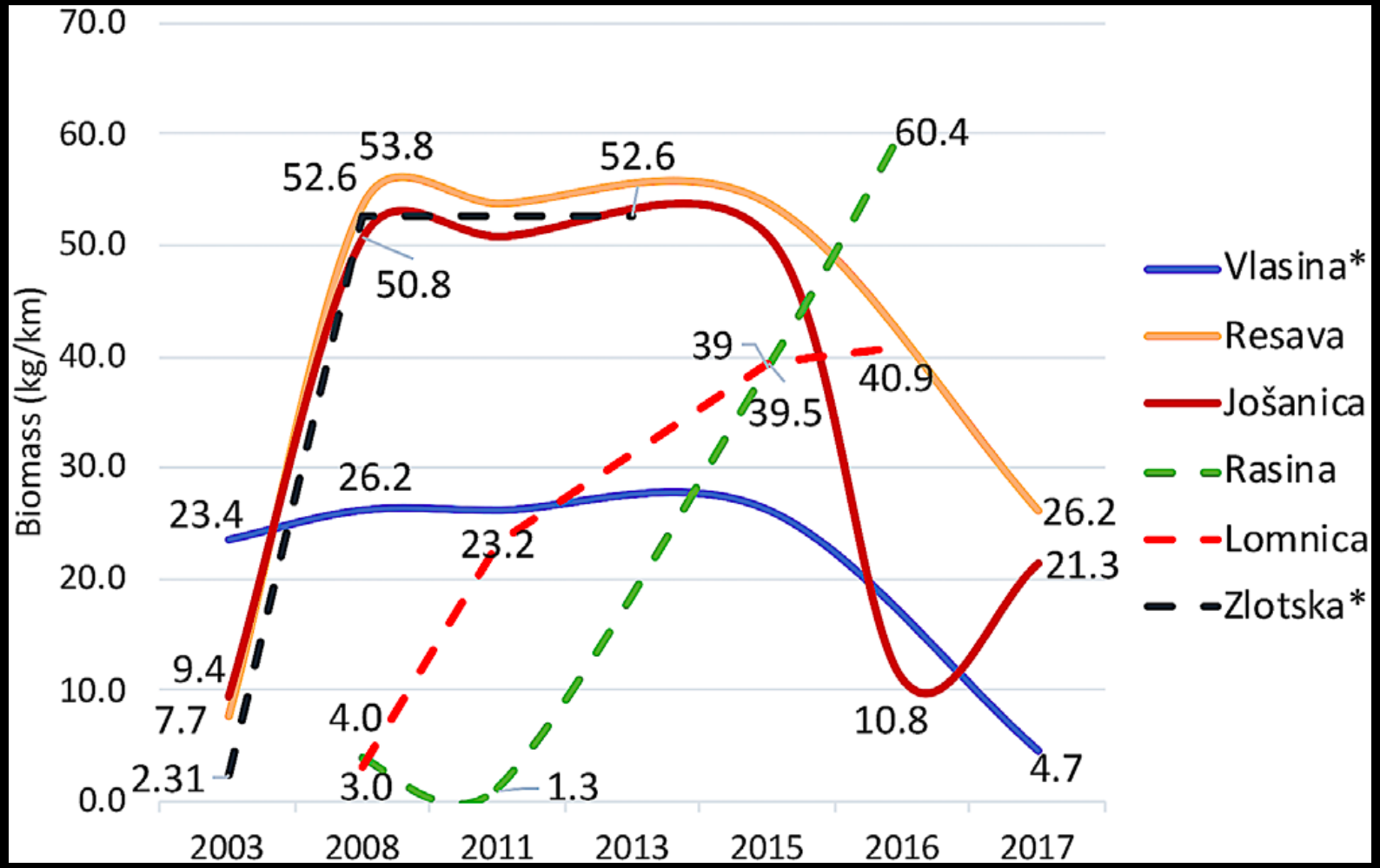
“Having in mind that environmental requirements, especially the habitat preferences of various species

(e.g., brown trout *Salmo trutta*,
Danube barbel *Barbus balcanicus*,
minnow *Phoxinus phoxinus*,
bullhead *Cottus gobio*,
and
stone loach *Barbatula barbatula*)

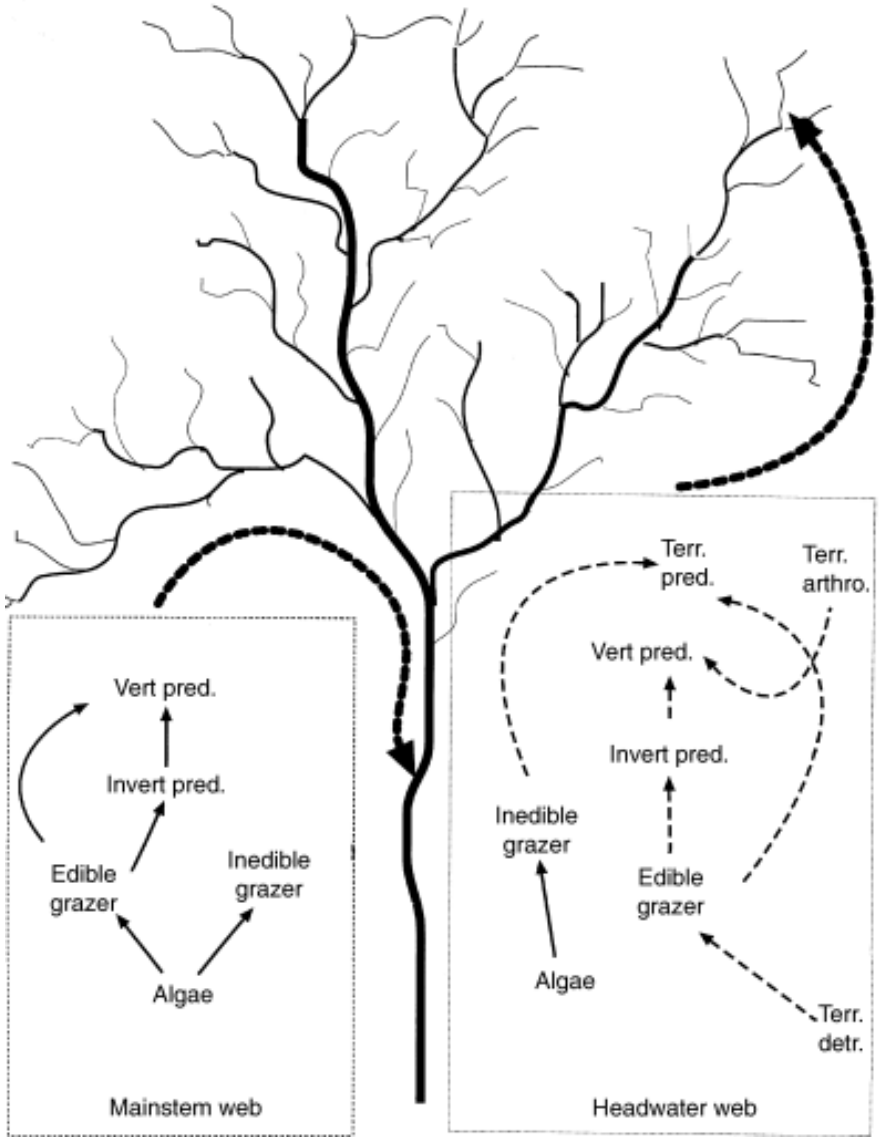
common in montane streams' fish communities are diverse, this change likely affects them.”

Simonović et al. (2021):

“Relative biomass of brown trout (*, populations important for conservation) in streams with (solid line) and without (dashed line) ROR SHPP in Serbia since 2003 (the construction of ROR SHPP started in 2015).”



"Run-Of-River" SHPP (ROR SHPP) with 0.1-10 MW of installed power, redirect water from small mountainous rivers into several-kilometer-long tubes, disrupting complex dynamics of local aquatic food webs and their interactions with neighbor terrestrial food webs.
It certainly affects local aquatic communities, but it is often neglected that two highly threatened vertebrate groups - amphibians and reptiles - which live in and around these wetlands, could be affected as well.



Complexity of aquatic food webs. From: Power and Dietrich (2002)

AMPHIBIANS

Amphibians of temperate climate region have a biphasic life history (aquatic and terrestrial environment) and they require freshwater for reproduction

Amphibian larval stages are characterized by complex spatial-temporal feeding dynamics

The impact of reduced water availability is particularly important in areas that are already under hydrological stress

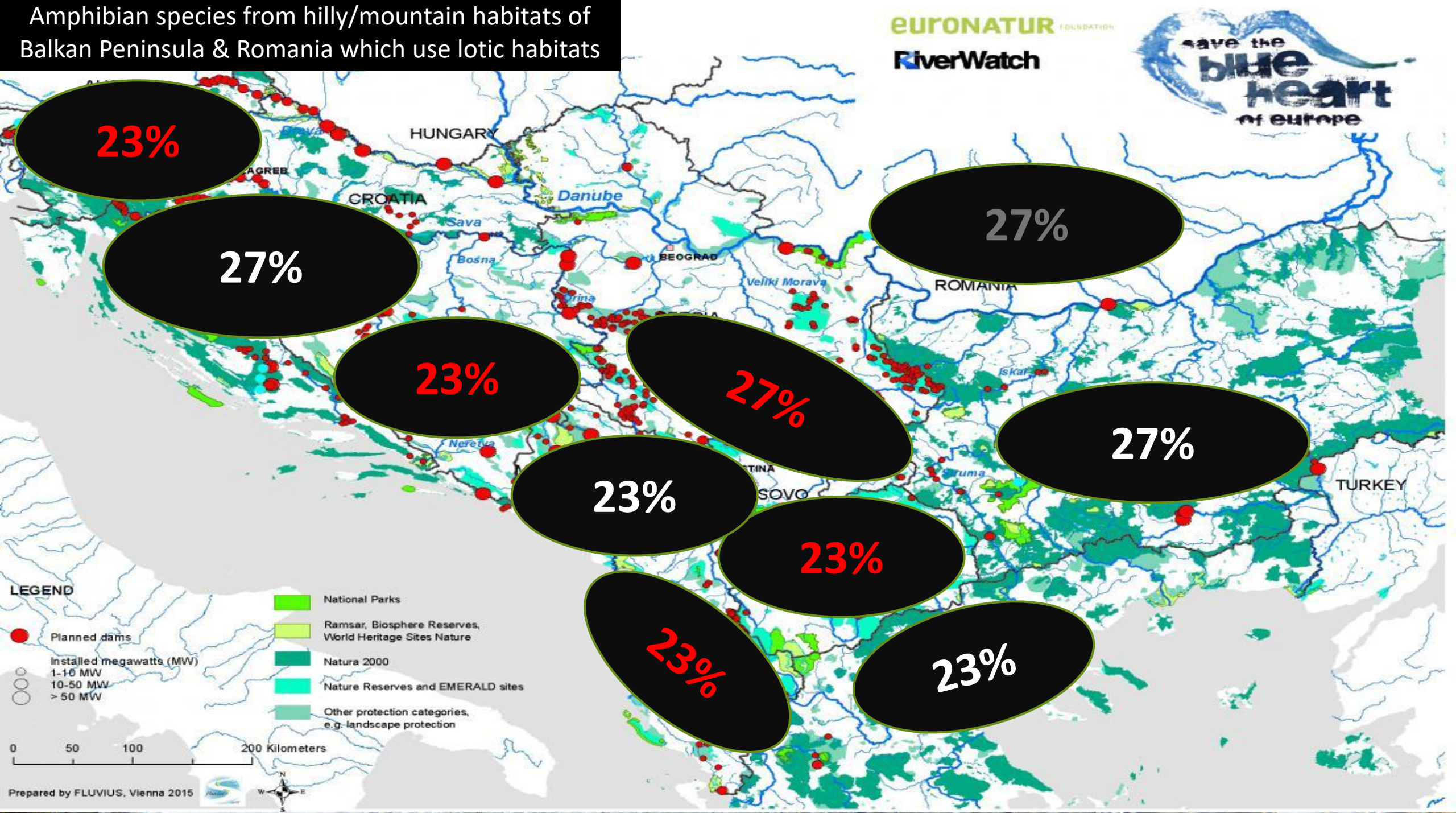
According to the literature data, approximately 30% of amphibian species in the hilly/mountain area of Balkan Peninsula & Romania also use small rivers and streams as breeding and nursery habitats
(Arnold and Ovenden, 2002; Crnobrnja-Isailović, 2020).

List of amphibian species inhabiting hilly/mountain areas of the Balkan Peninsula & Romania. IUCN -International Union for Conservation of Nature; LC – Least Concern; VU – Vulnerable; EN – Endangered; NA – Not Assessed. Red colored are species known for inhabiting lotic or lentic & lotic aquatic ecosystems.

	Genus	Species	Common name	IUCN Global Red List status/Natura 2000 species	Recorded in lentic habitats	Recorded in lotic habitats
1	*Proteus*	*anguinus*	Olm	VU/+	Subterranean	Subterranean
2	***Ichthyosaura***	***alpestris***	**Alpine newt**	**LC/-**	**Y**	**Y**
3	***Lyciasalamandra***	***helverseni***	The Karpathos Lycian salamander	VU/+	N	N
4	***Lyciasalamandra***	***luschani***	Lycian salamander	EN/+	N	N
5	***Lissotriton***	***vulgaris***	Smooth newt	LC/-	Y	N
6	***Lissotriton***	***montandoni***	Montandon's newt	LC/+	Y	N
7	***Salamandra***	***atra***	Alpine salamander	LC/+	N	N
8	***Salamandra***	***salamandra***	**Fire salamander**	**LC/+**	**Y**	**Y**
9	***Triturus***	***carnifex***	Italian crested newt	LC/+	Y	N
10	***Triturus***	***cristatus***	**Northern crested newt**	**LC/+**	**Y**	**Y**
11	***Triturus***	***ivanbureschi***	Buresch's crested newt	NA/+	Y	N
12	***Triturus***	***macedonicus***	Macedonian crested newt	NA/+	Y	N
13	***Bombina***	***variegata***	**Fire-bellied toad**	**LC/+**	**Y**	**Y**
14	***Bufo***	***bufo***	**Common toad**	**LC/-**	**Y**	**Y**
15	***Bufotes***	***variabilis***	Variable green toad	NA/+	Y	N
16	***Bufotes***	***viridis***	Green toad	LC/+	Y	N
17	***Hyla***	***arborea***	Common tree frog	LC/+	Y	N
18	***Hyla***	***orientalis***	Oriental tree frog	NA/+	Y	N
19	***Phelophylax***	***bedriagae***	Levant water frog	LC/+	Y	N
20	***Phelophylax***	***cerigensis***	Carpathos frog	EN/+	Y	N
21	***Phelophylax***	***cretensis***	Cretan frog	EN/+	Y	N
22	***Phelophylax***	***epeiroticus***	Epirus water frog	VU/+	Y	N
23	***Phelophylax***	***kl.esculentus***	Edible frog	LC/+	Y	N
24	***Phelophylax***	***kurtmuelleri***	Balkan water frog	LC/+	Y	N
25	***Phelophylax***	***shqipericus***	Albanian water frog	EN/+	Y	N
26	***Phelophylax***	***ridibundus***	Marsh frog	LC/+	Y	N
27	***Rana***	***dalmatina***	**Agile frog**	**LC/+**	**Y**	**Y**
28	***Rana***	***graeca***	**Greek stream frog**	**LC/+**	**N**	**Y**
29	***Rana***	***latastei***	**Italian agile frog**	**VU/+**	**Y**	**Y**
30	***Rana***	***temporaria***	**European common frog**	**LC/+**	**Y**	**Y**

Species list made following: Adrović (2015), Cogălniceanu and Rozylowicz (2015), Crnobrnja-Isailović and Paunović (2015), Crnobrnja-Isailović et al. (2018), Ćirović (2015), Haxhiu (2015), Jovanović and Jelić (2015), Sotiropoulos and Lymberakis (2015), Stanković et al. (2015), Sterijovski (2015), Tzankov and Popgeorgiev (2015). Information on use of lentic or/and lotic habitats followed Arnold and Ovenden (2002) and Crnobrnja-Isailović (2020).

Amphibian species from hilly/mountain habitats of Balkan Peninsula & Romania which use lotic habitats



REPTILES

Reptiles often are indirect and direct consumers of species that are a part of the freshwater ecosystems

Humidity apparently influences different aspects of reptile biology and ecology such as reproductive output, population growth and survival

Decline in reptile species' richness in SE Europe in the future is expected if precipitation decrease and the air temperature significantly increase

Additionally, 12.5% of the European reptiles strictly need humid habitats in the hilly/mountainous areas of Balkan Peninsula & Romania (Arnold and Ovenden, 2002; Speybroeck et al., 2016).



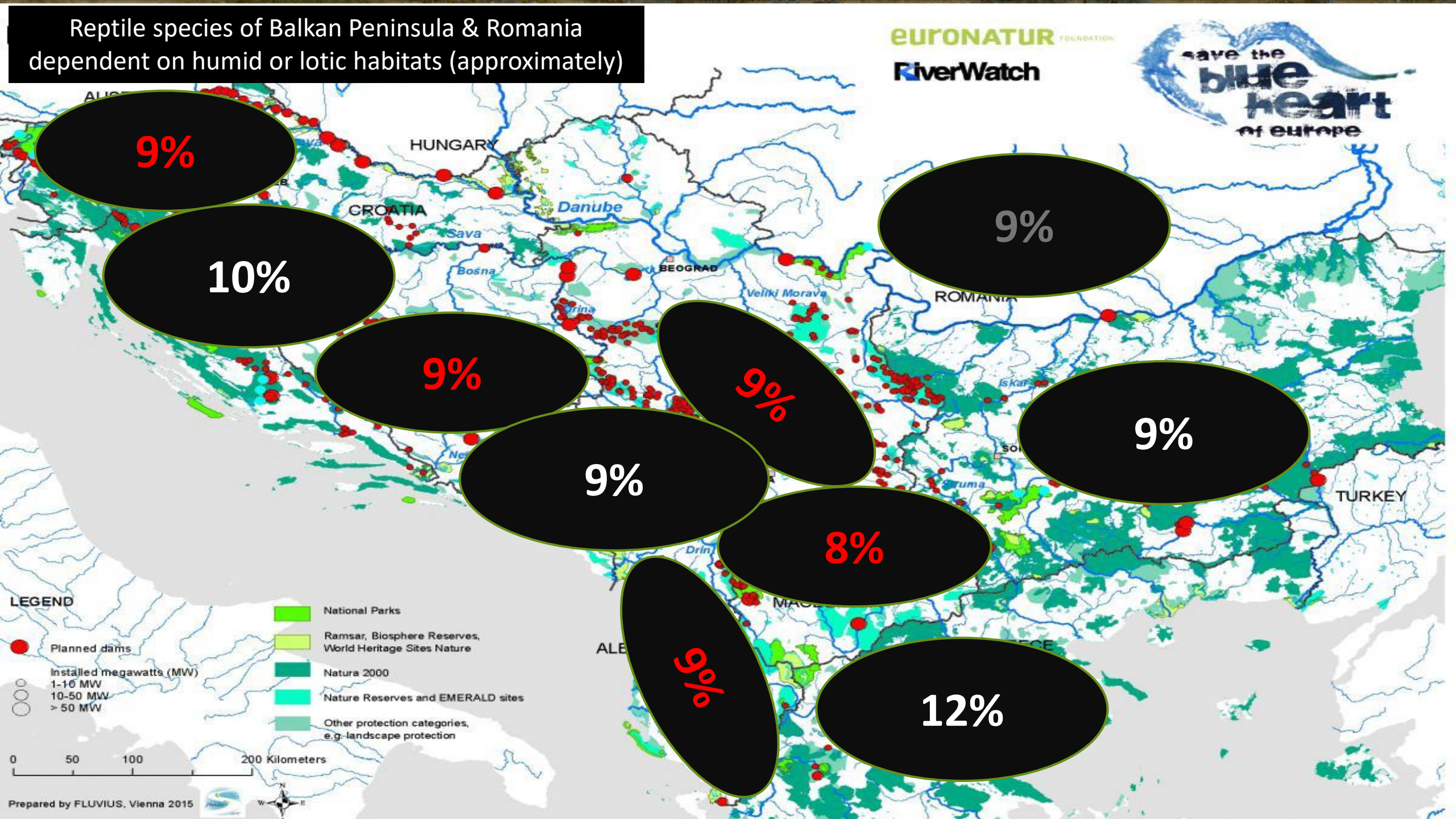



List of reptile species dependent on humid hilly/mountain areas of Balkan Peninsula & Romania.
IUCN -International Union for Conservation of Nature;
LC – Least Concern; VU – Vulnerable; EN – Endangered; NA – Not Assessed.

	Genus	Species	Common name	IUCN Global Red List status/Natura 2000 species	Need humid habitats	Inhabit lotic habitats
I	*Anguis*	*fragilis*	Slow worm	LC/-	Y	N
II	*Algyroides*	*moreoticus*	Greek Algyroides	NT/+	Y	N
III	*Darevskia*	*praticola*	Meadow lizard	NT/+	Y	N
IV	*Dinarolacerta*	*mosorensis*	Mosor rock lizard	VU/+	Y	N
V	*Hellenolacerta*	*graeca*	Greek rock lizard	NT/+	Y	N
VI	*Iberolacerta*	*horvathi*	Horvath's rock lizard	NT/+	Y	N
VII	*Zootoca*	*vivipara*	Viviparous lizard	LC/-	Y	N
VIII	*Elaphe*	*quatuorlineata*	Four-lined snake	NT/+	Y	N
IX	*Natrix*	*natrix*	Grass snake	LC/-	N	Y
X	*Natrix*	*tessellata*	Dice snake	LC/+	N	Y
XI	*Vipera*	*berus*	Adder	LC/-	Y	N

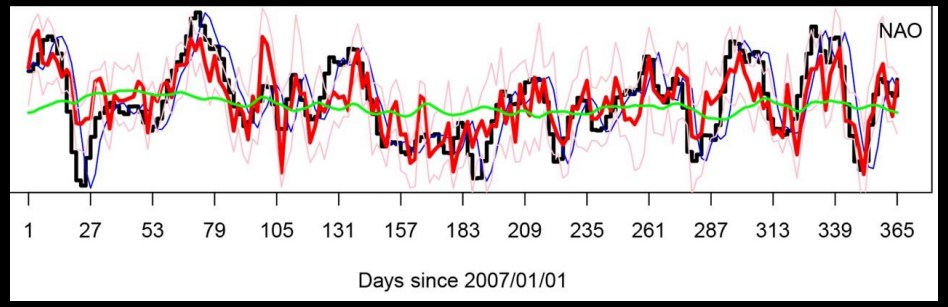
Species list made following Arnold and Ovenden (2002) and Speybroeck et al. (2016)

Reptile species of Balkan Peninsula & Romania dependent on humid or lotic habitats (approximately)

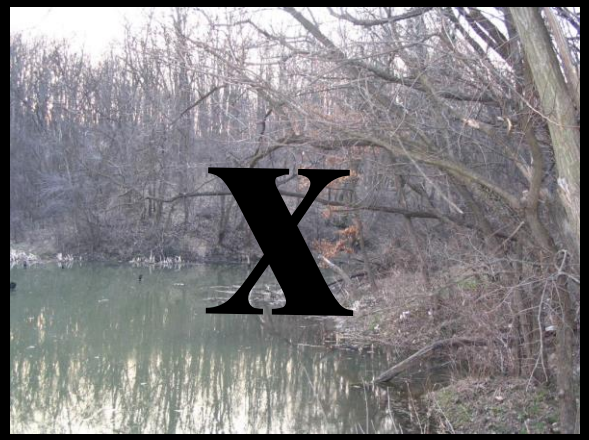


Additional issue is the ongoing climate change and expected natural drying up of a number of amphibian reproductive centers in the region,

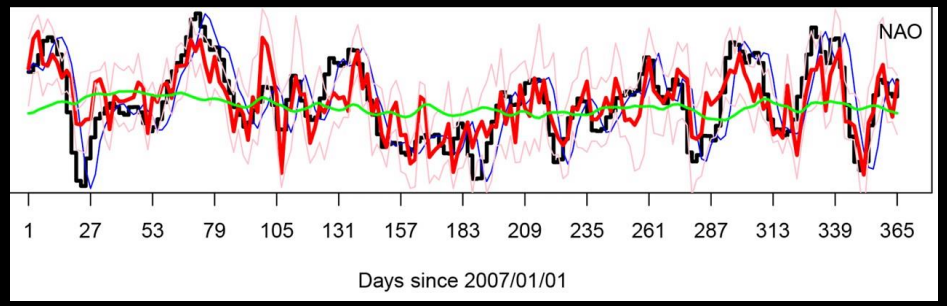
as well as aridization of some humid terrestrial habitats suitable for certain reptile species



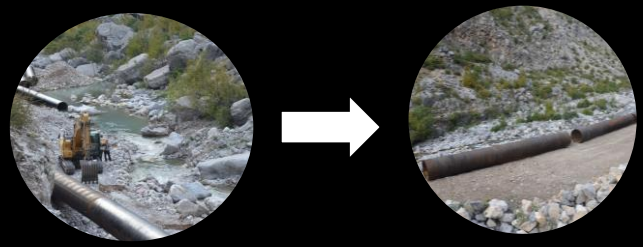
SUPPOSED CUMULATIVE NEGATIVE EFFECT OF CLIMATIC AND ANTHROPOGENIC IMPACTS ON AMPHIBIANS AND REPTILES IN HILLY/MOUNTAIN PARTS OF THE REGION



LOSS OF SMALL WATER BODIES



INCREASED ENVIRONMENTAL STOCHASTICITY



PROLIFERATION OF ROR SHPP

In conclusion,

our statement is that further proliferation of ROR SHPP all over the Balkan Peninsula & Romania would negatively impact local biodiversity, among the others ichthyofauna and herpetofauna, particularly those species which are directly or indirectly dependent on the lotic ecosystems in the hilly/mountainous areas.

Existing policies and regulations generally appear to underestimate these impacts but scientific interest on issue of non-sustainability of (ROR) SHPP increases.

Almost half of possibly affected amphibian and reptile species are widespread in the region, so proliferation of ROR SHPP would negatively affect many of their local populations, while the amount of electric energy they produce is negligible.

Thank you!