



Fish habitats in regulated rivers

Relevance for hydropower development

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The 6th mass extinction

REVIEW

doi:10.1038/nature09678

Has the Earth's sixth mass extinction already arrived?

Anthony D. Barnosky^{1,2,3}, Nicholas Matzke³, Susumu Tomiya^{1,2,3}, Guinevere O. U. Wogan^{1,3}, Brian Swartz^{1,2}, Tiago B. Quental^{1,2†}, Charles Marshall^{1,2}, Jenny L. McGuire^{1,2,3*}, Emily L. Lindsey^{1,2}, Kaitlin C. Maguire^{1,2}, Ben Mersey^{1,4} & Elizabeth A. Ferrer^{1,2}

RESEARCH ARTICLE

ENVIRONMENTAL SCIENCES

Accelerated modern human-induced species losses: Entering the sixth mass extinction

Gerardo Ceballos,^{1*} Paul R. Ehrlich,² Anthony D. Barnosky,³ Andrés García,⁴ Robert M. Pringle,⁵ Todd M. Palmer⁶

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Endangered species

Humans creating sixth great extinction of animal species, say scientists

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Earth 'entering new extinction phase' - US study

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Strategic Plan for
Biodiversity 2011-2020



Intergovernmental Platform on
Biodiversity & Ecosystem Services



The EU Biodiversity
Strategy to 2020



EU Water Framework Directive



NATURA 2000

Governments committed to CBD, RAMSAR, EU, Convention on migratory species, and others, to conserve and sustainable use biodiversity and ecosystems.

In Europe, most threatened species are freshwater species (507 vs. 442)

European Red List of Non-marine Molluscs

Annabelle Cuttelod, Mary Seddon and Eike Neubert



European Red List of Freshwater Fishes

Jörg Freyhof and Emma Brooks



Hydropower Development

- Is a major threat to biodiversity
- **At the wrong place**, lead to extinction of species and other massive impacts
- Is often contradicting the CBD and other UN goals + EU biodiversity strategy, PAs and Natura 2000 sites





Neue Homepage zum ZSK

Eine neue Website bringt nun eine übersichtliche Zusammenfassung. Sie informiert über ein besseres Niederschlagsmanagement und verfügbare Informationen zum ZSK. [mehr](#)

Mur-Demo

Wieder demonstrieren am 25. März tausende Menschen in der Grazer Innenstadt. Die Mur wollen sie als frei fließenden Fluss bewahren und fordern daher einen sofortigen Baustopp für Murkraftwerk und Kanal, eine Nachdenkpause und die Volksbefragung für Graz... [mehr](#)

Stromwechsel - Jetzt!

Wer sein Geld nicht in ein unwirtschaftliches Projekt stecken will, kann den Stromanbieter wechseln. So kann jeder Stromkonsument ein Zeichen setzen... [mehr](#)

Murstaustufe in Graz ist ökonomisches Desaster

Erstmals legen WWF und Rettet die Mur eine Detailstudie zur Wirtschaftlichkeit der Murstaustufe Graz vor. Das Ergebnis ist eindeutig...

[mehr](#)

Meinungen zur Staustufe

Prominente, WissenschaftlerInnen und Grazer BürgerInnen erzählen, warum ihnen der Erhalt der Mur am Herzen liegt...

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Unterstützer der Plattform

Die Plattform Rettet die Mur wird von mehreren NGOs und Initiativen unterstützt. Auch Privatpersonen erklären, warum sie die Mur schützen wollen...

[mehr](#)



Impact on freshwater biodiversity

- 1) Upstream migration**
- 2) Downstream migration**
- 3) Hydropeaking**
- 4) Downstream sediment flow**

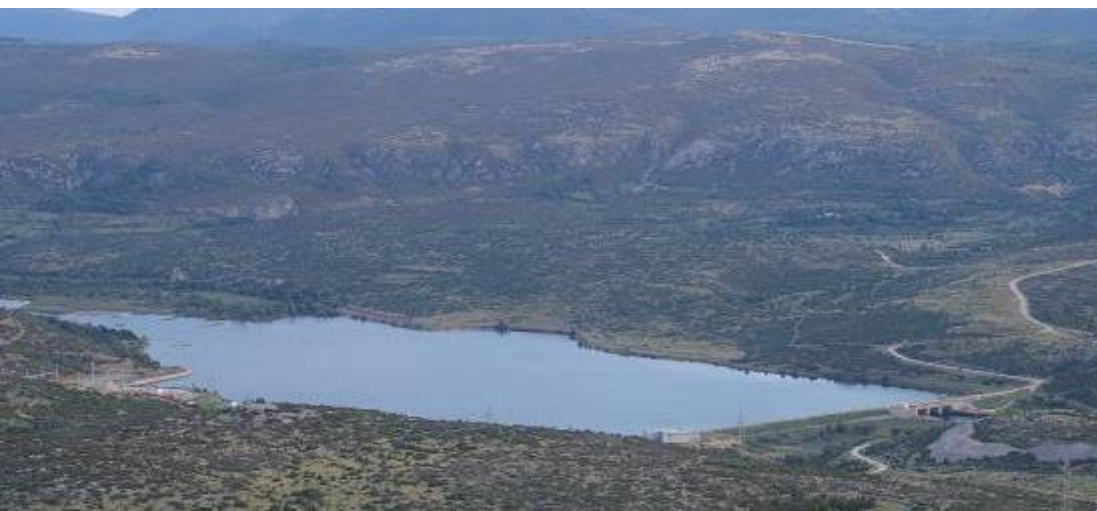




Impact on freshwater biodiversity

5) Habitat alterations

The dam transfers the **river into a reservoir**. This results in a strong shift in freshwater biodiversity. **Habitat alterations can be mitigated by offsets.**

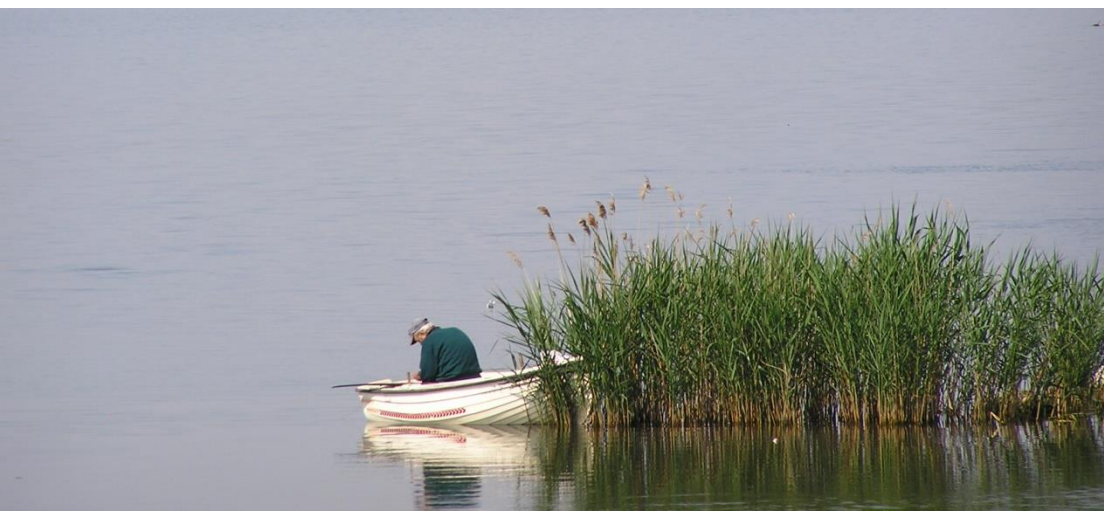




Impact on freshwater biodiversity

6) Alien species invasion

Reservoirs unavoidably encourages the stocking of alien species. **Alien species introduction can be avoided by a strict, controlled fencing of the whole reservoir area.**





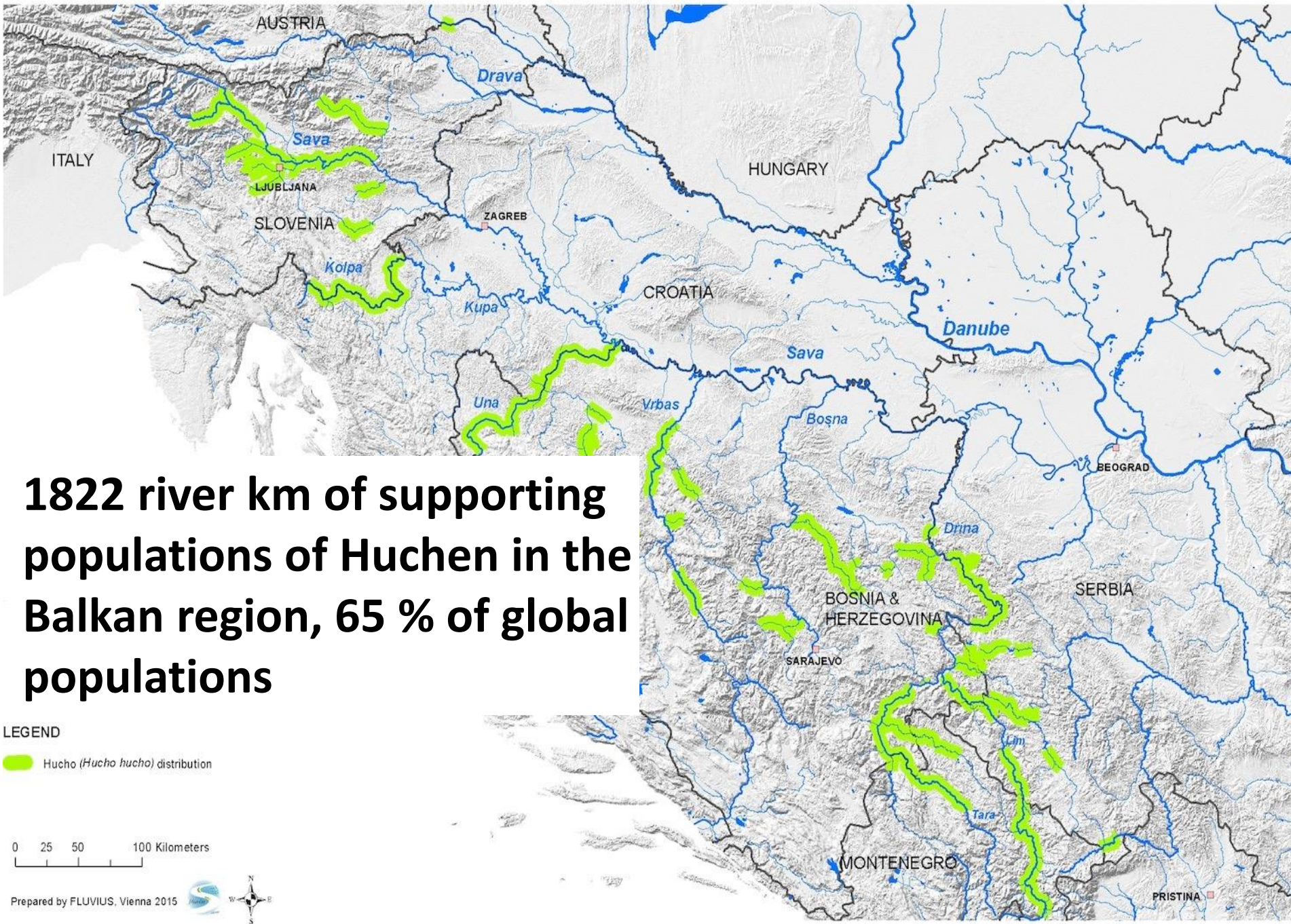
Croatian Pijor - *Telestes croaticus*

- **Endemic to Croatia**
- **Lives in small streams and lakes**
- **Very sensitive to alien species invasion**
- **Has gone from EN to CR**

The Huchen

- The largest salmon of the world, endemic to the Danube drainage
- Very sensitive to hydropower
- Major target species for angling tourists
- Well protected and listed all over (IUCN, national Red Lists, Natura 2000)



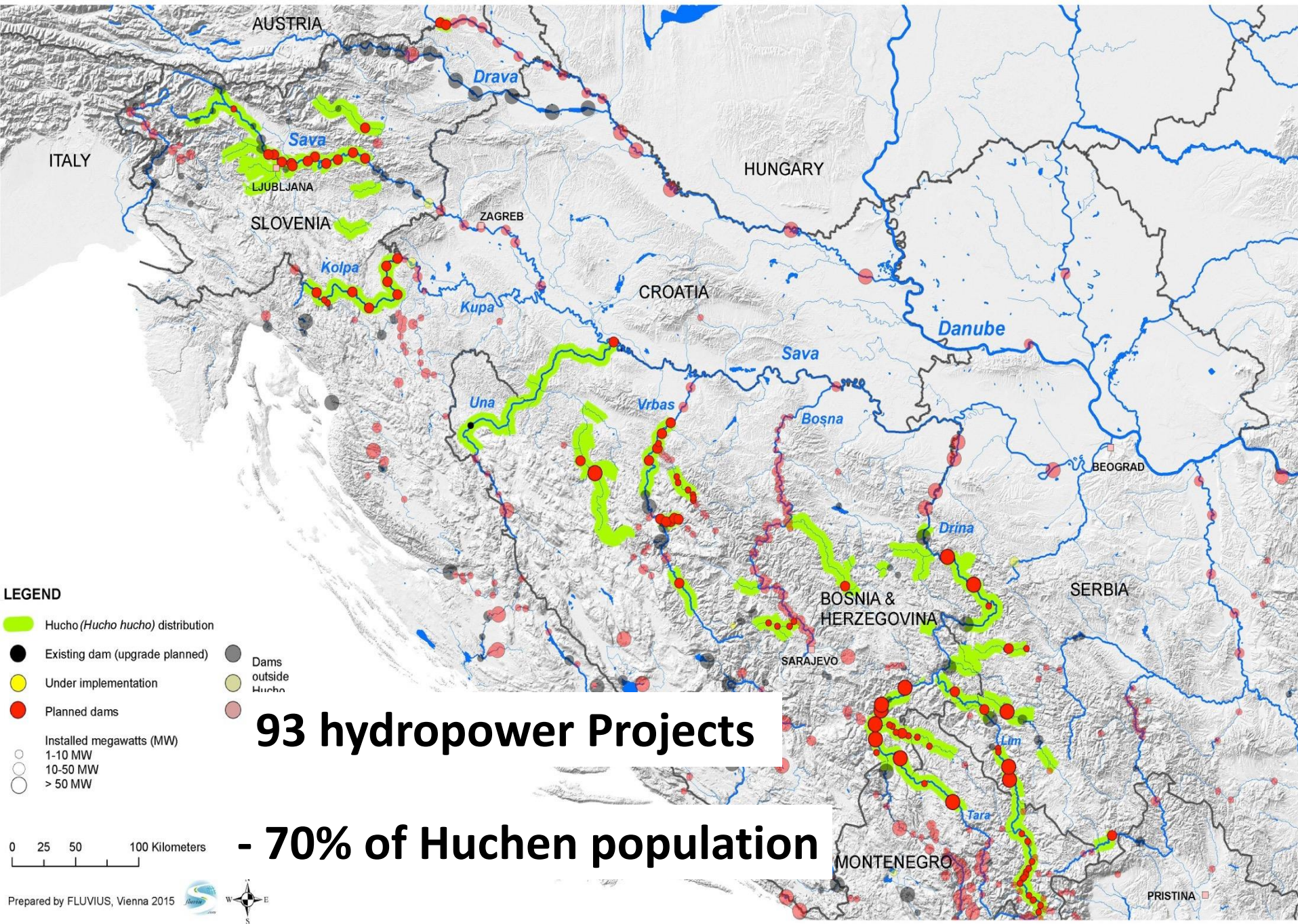


1822 river km of supporting populations of Huchen in the Balkan region, 65 % of global populations

LEGEND
Hucho (*Hucho hucho*) distribution

0 25 50 100 Kilometers

Prepared by FLUVIUS, Vienna 2015



93 hydropower Projects

- 70% of Huchen population



LEGEND

- Hucho (*Hucho hucho*) distribution
- Existing dam (upgrade planned)
- Under implementation
- Planned dams
- Dams outside Hucho
- Installed megawatts (MW)
 - 1-10 MW
 - 10-50 MW
 - > 50 MW

0 25 50 100 Kilometers



Where are we today?

- Restore rivers and mitigate effects of existing HPP and areas already impacted 
- Wildly build new HPPs in countries with high HP potential and high biodiversity uniqueness 



Hydropower Development

- **We need to build the EU energy sector for the future**
- **We need to be world leader in innovation**
- **Which biodiversity knowledge do we need?**
- **Which mitigation works for alien species and habitat loss?**
- **How do citizens perceive the action?**

Can biodiversity impacts be predicted?

We have no agreed tools to predict the impacts of HPP at a given site

- Perfect distribution data (600 fish species)
- Numbers of **threatened - rheophilic - migratory** species
- % of local compared to national/global populations
- **Species sensitivity scores** (e.g. alien species invasion)
- Indicator for the **uniqueness of the particular site**



Freshwater Biodiversity Data Portal

The gateway to freshwater biodiversity data



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Global Freshwater Biodiversity Atlas

The gateway to freshwater biodiversity maps



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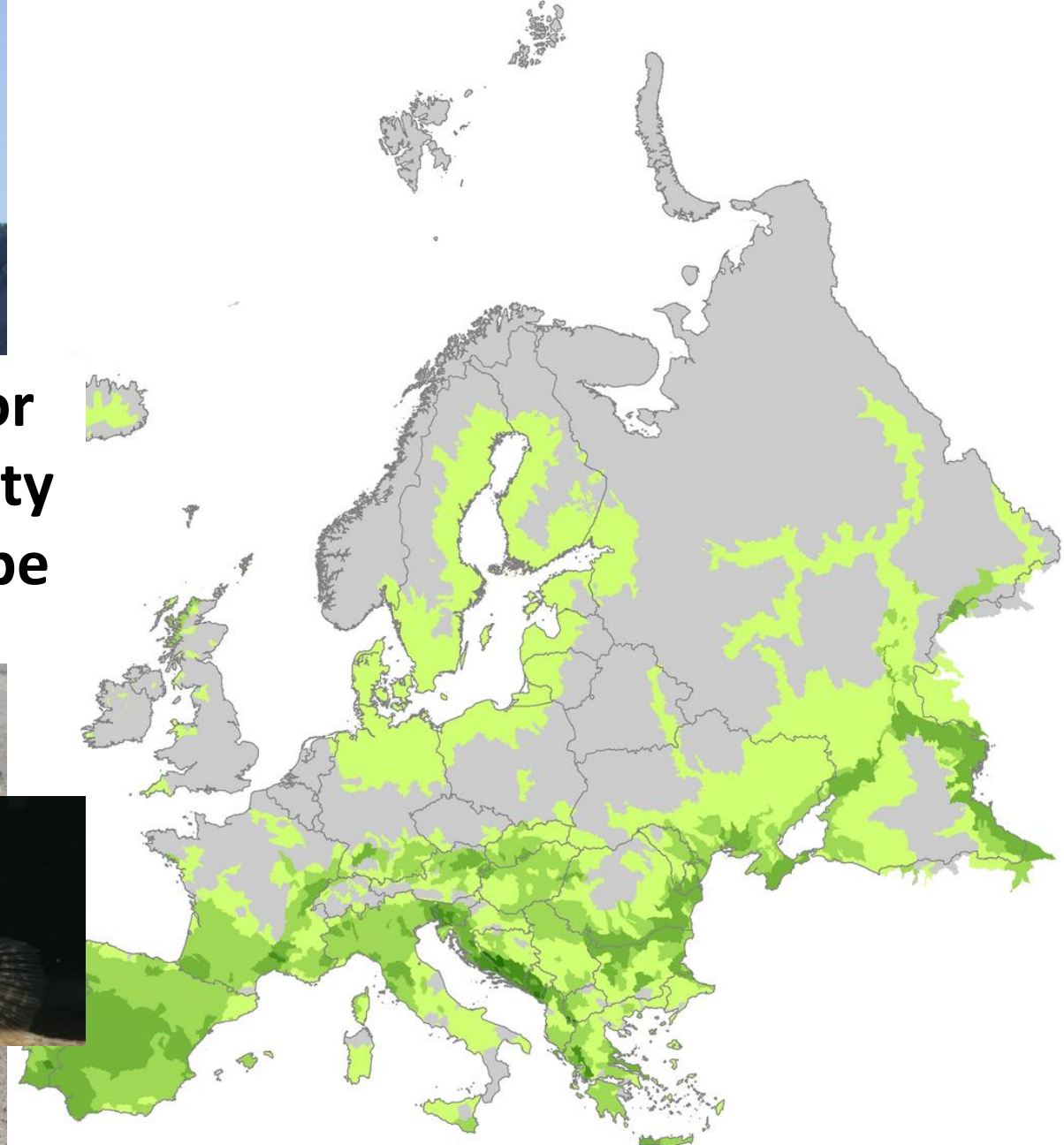
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Data density is not high enough to be always usefull



Critical catchments for freshwater biodiversity conservation in Europe



No. trigger species



Journal of Applied Ecology
9 JAN 2017



Limits of Acceptable Change

