IHG
Institute of Hydrobiology and Aquatic Ecosystem Management

# Conservation Requirements of European Eel (*Anquilla anquilla*) in a Balkan Catchment

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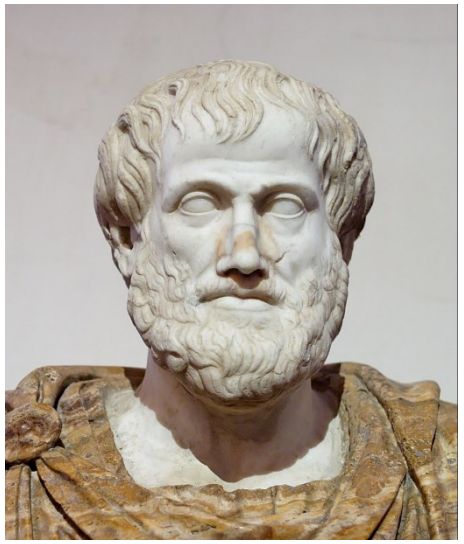
# Where do Eels come from?

“eels emerge spontaneously from mud and rainwater” (Aristoteles)



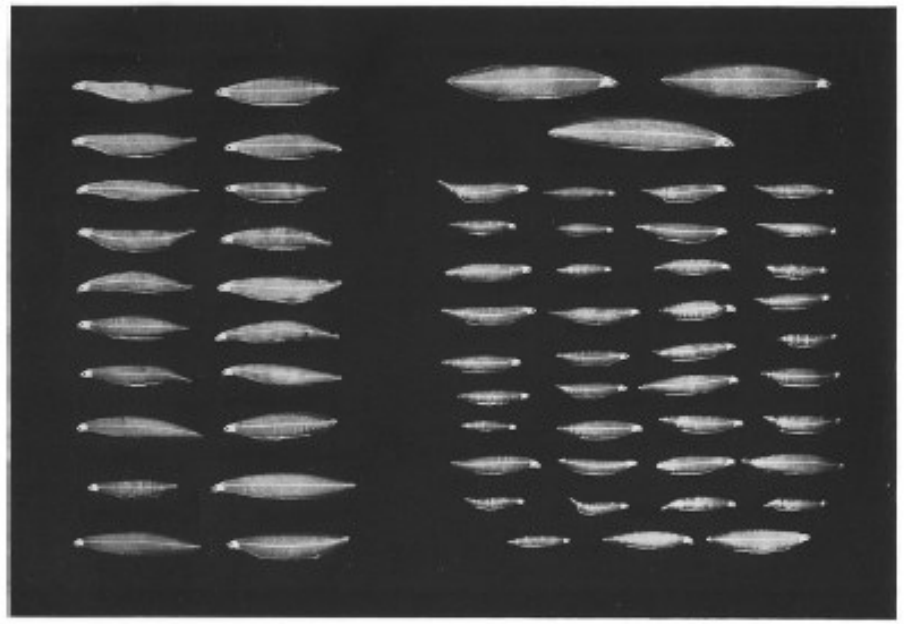
“Eels are produced by the sun warming the Nile” (ancient Egyptians)

“New eels developed when old eels rubbed away parts of their bodies on rocks.” (Pliny the Elder)

“Eels begin their lives as beetles” (old Scottish belief)

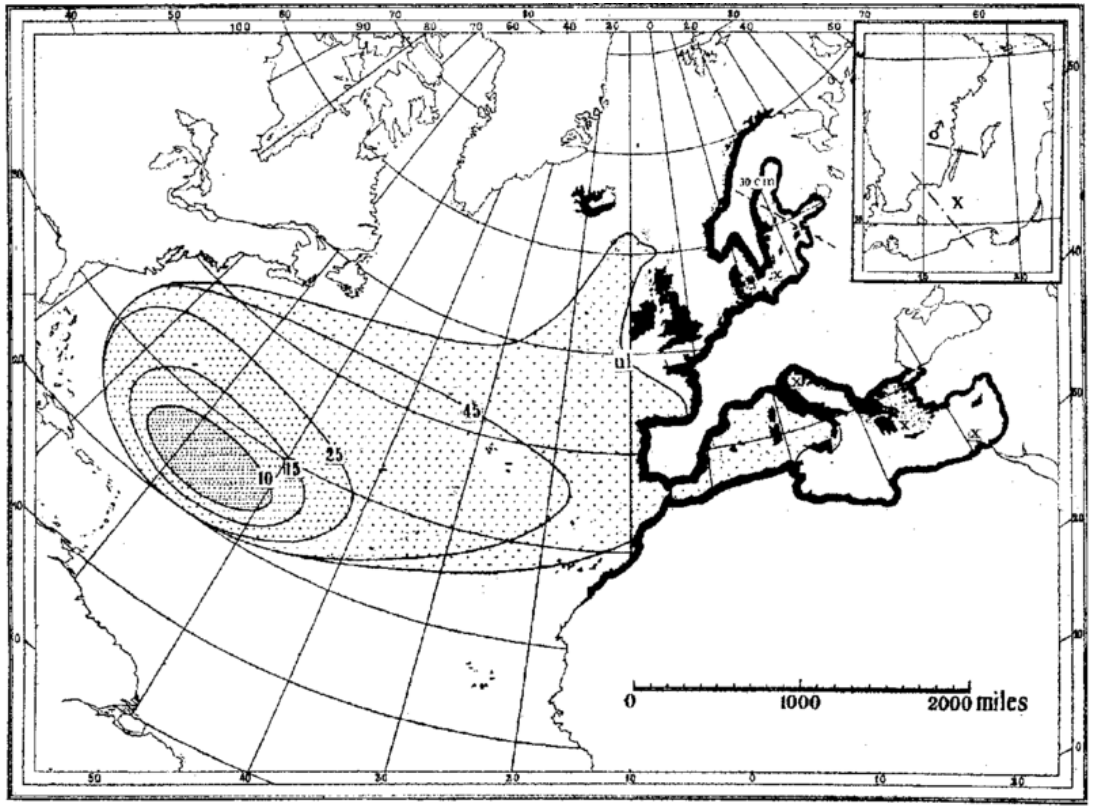
“all the important questions . . . had now been settled…
**except the eel question.”**
(Max Schultze, lying on his deathbed)

Schmidt J (1923) Breeding places and migration of the eel. Nature 111:51–54



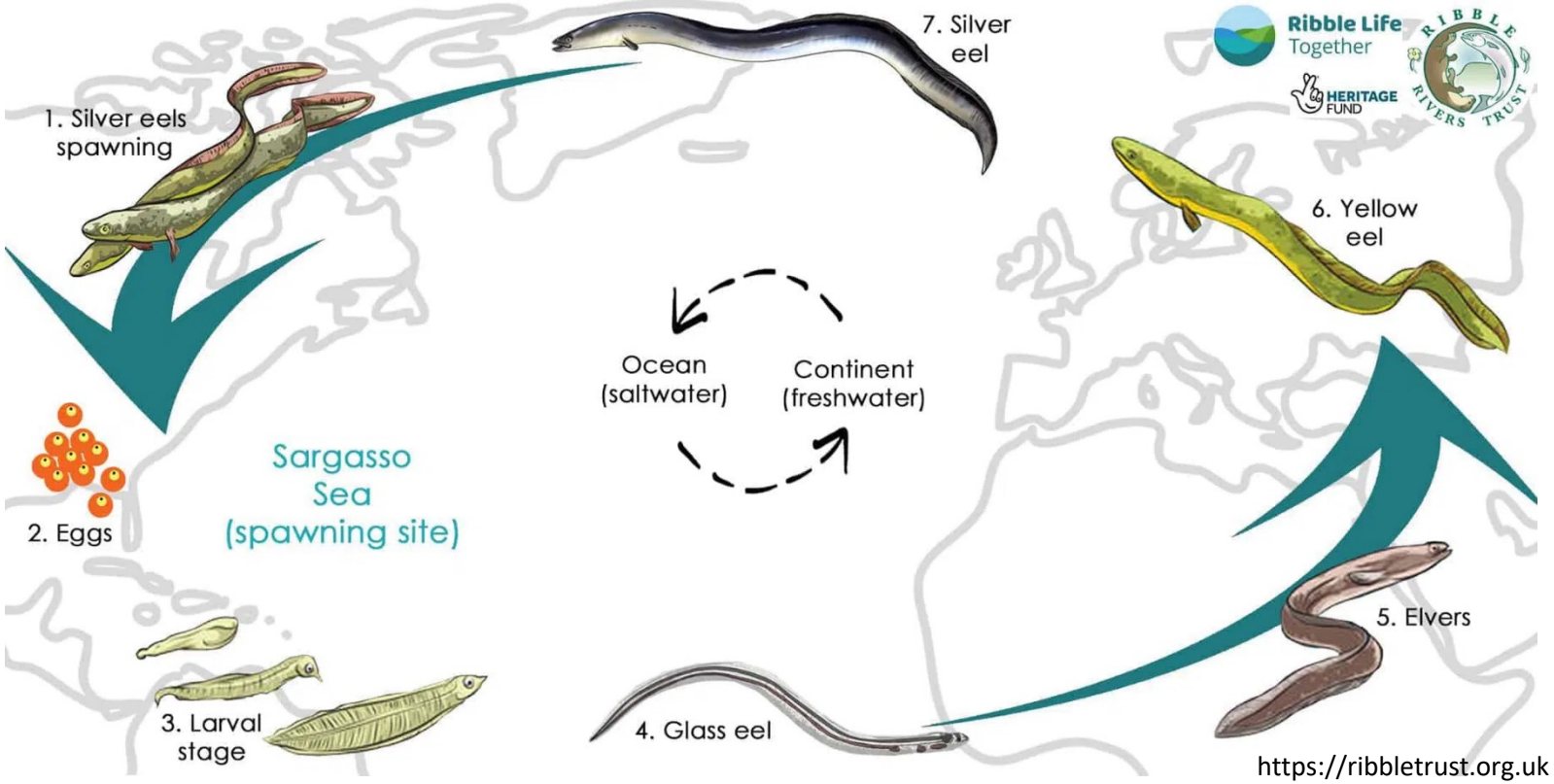
Anguilla rostrata. Anguilla vulgaris.

Schmidt. Phil. Trans. B, vol. 211, pl. 18.



# Highly unique catadromous life history cycle

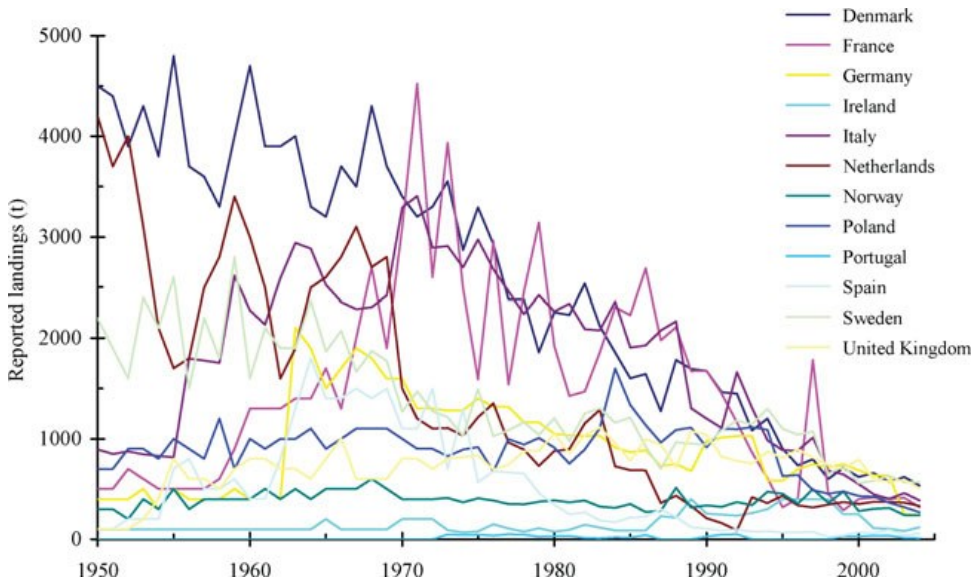
Reproduction in the Sargasso Sea



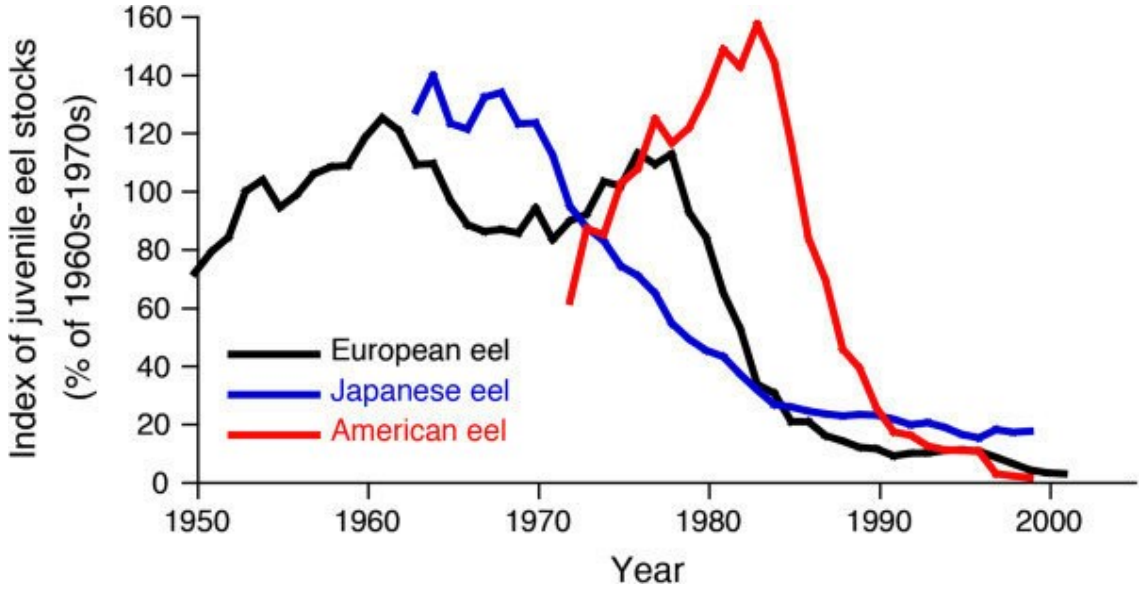

migrate upstream into rivers wherein they mature for 3 (males) to 20 (females) years.

after 2–3 years of oceanic migration,
covering a distance between 5000 and 10,000 km [1–3]

# DECLINE of European Eel populations




Dekker, W., et al. (2007)




Arai, T. (2014)

The European Inland Fisheries Advisory Commission (EIFAC) and the International Council for the Exploration of the Sea (ICES) estimates that **only 10% of the historical European eel population are left** [13].

**Several hypotheses have been suggested for this decline** (reviewed by 6–9):

- shifts in the Gulf Stream,
- overfishing,
- loss of habitat,
- water quality,
- …
- obstructions to upstream and downstream migration,

**Migration barriers** as a **major threat** to the European eel population [10].
Several studies have reported **large-scale extinctions** of inland stocks from rivers **upstream of dams** [e.g. 11,12].


VJOSA
WILD RIVER NATIONAL PARK

## Balkan Rivers and European Eel

- European eel could access all rivers along the Adriatic and Aegean coasts [10,31].
- Population densities in these systems have decreased dramatically over the last few decades [20,21].
- A “high number” of Balkan rivers are still in an excellent hydromorphological state with longitudinal connectivity [18,30].

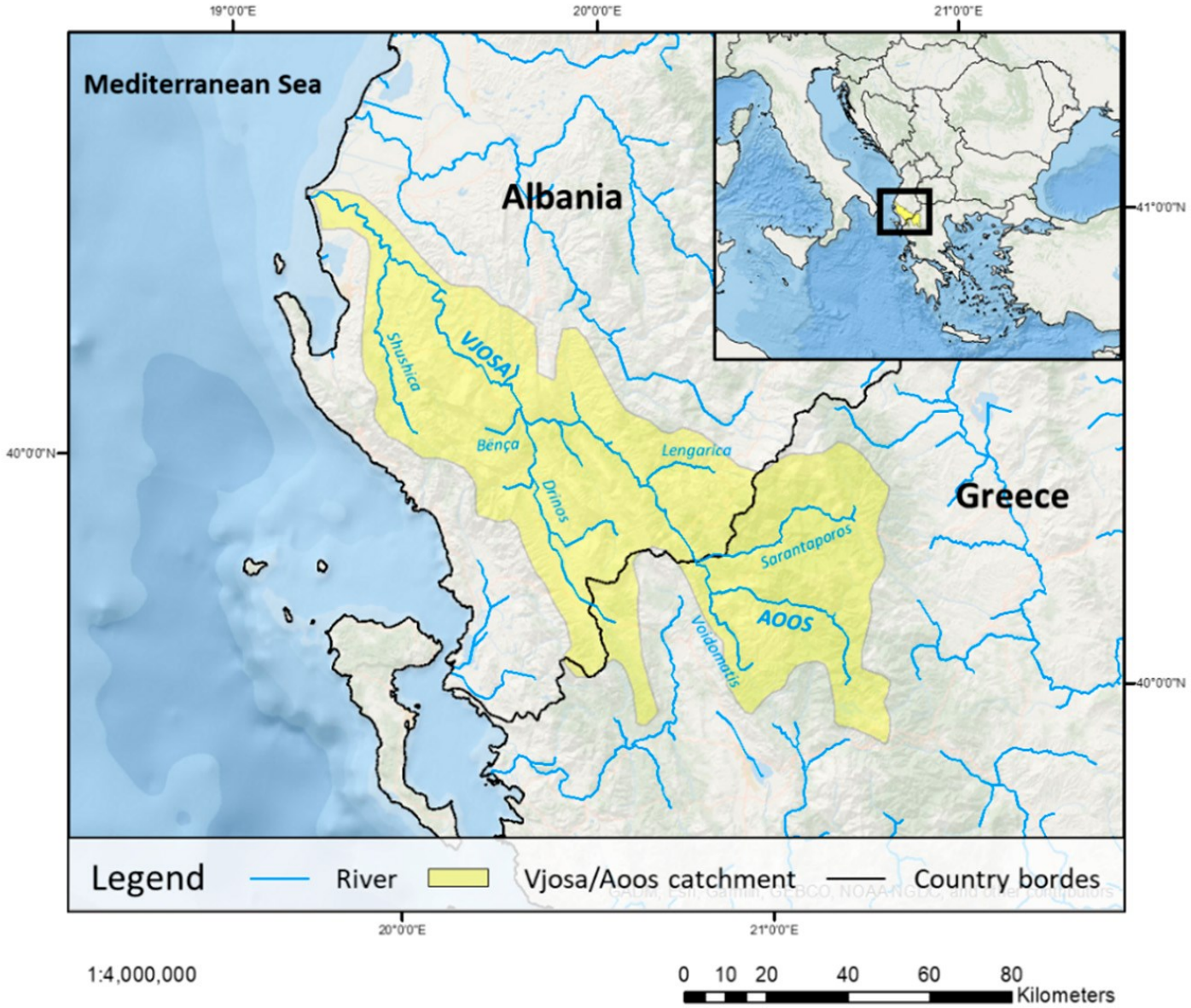
## Data deficit

Important Balkan rivers for the European eel:

- Neretva in Croatia and Bosnia–Herzegovina,
- the rivers Strymon and Evros in Greece,
- and the river Moraˇca in Montenegro [18].
- Further records are available from the rivers Jadro, Žrnovnica, Sutorina, Bojana [32], Crna [33] Cetina and Ljuta [34]…

Limited quantifiable data are available.

# Case study River Vjosa in Albania




Literature and data review

eDNA survey of the entire catchment

Boat electrofishing surey in the lower section

# Selected results

- European Eel is present in the entire catchment
- Eel densities for all 3 morphological river types and mesohabitats
- Overall, an average of **376 ind./ha** (or ~2 eels/m)

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nd./ha
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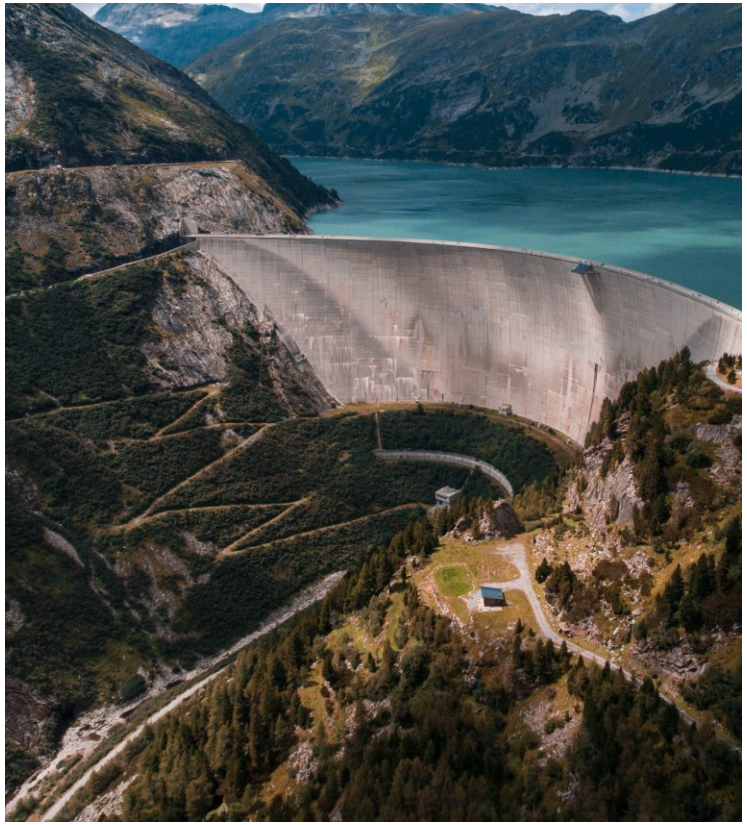
Rio Esva in Spain: 400–2000 ind./ha [41];
small tributaries e: 430–20,800 [42];
Danish streams: 43]).

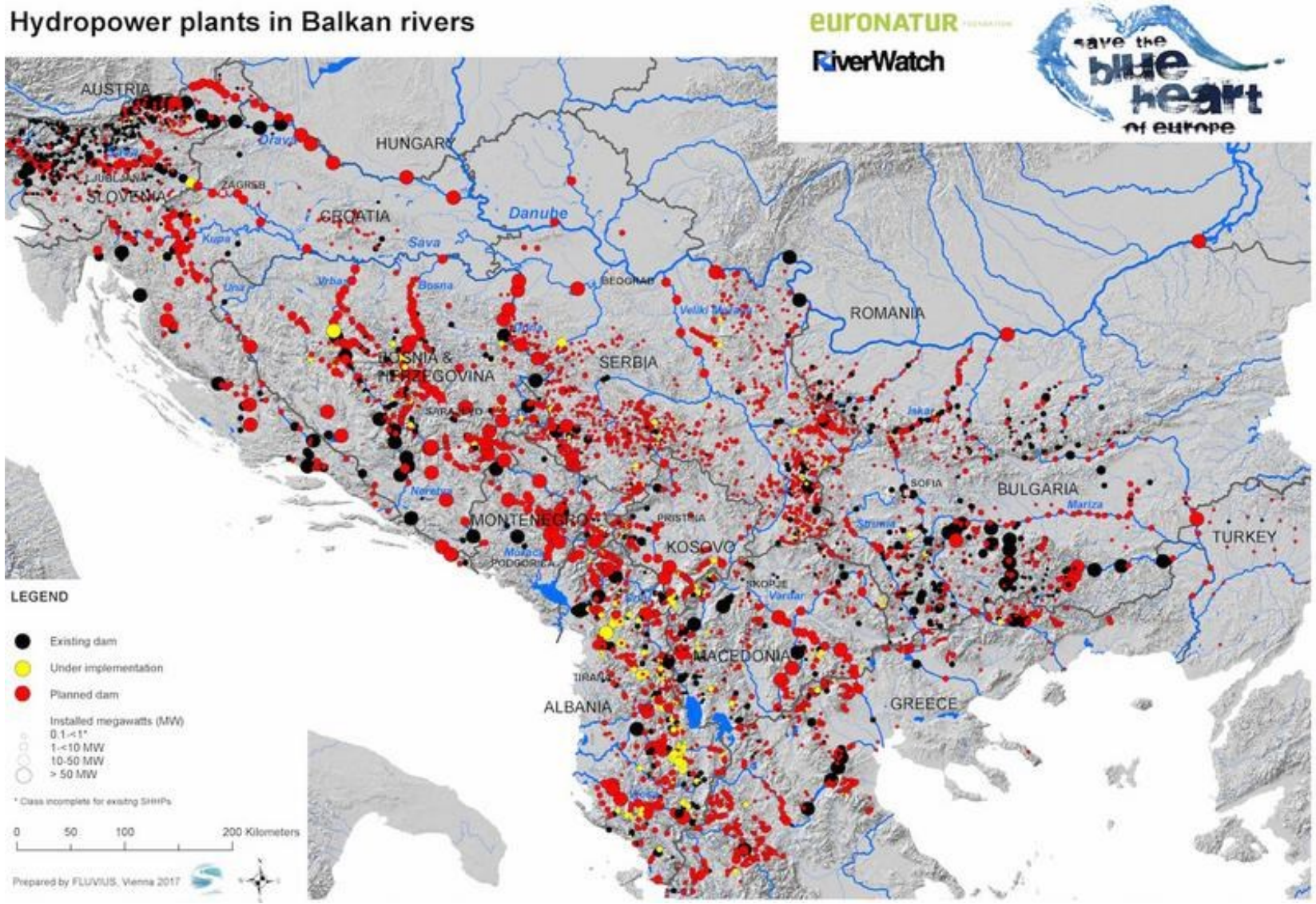
**Table 1.** Meso-habitat distribution (in %) for all three morphological river sections and mean eel densities for each meso-habitat type in 2018.

| Morphological River Section | Meso-Habitat | Areal Share of Meso-Habitats | No of Stretches | Total Fished Length | Mean ind./ha | Standard Deviation | Confidence Interval ($\alpha = 0.1$) |
|---|---|---|---|---|---|---|---|
| Braided | Main arm | 25.58 | 3 | 160 | 0.0 | 0.0 | 0.0 |
| | Cut bank | 1.93 | 1 | 60 | 222.2 | 0.0 | 0.0 |
| | Riffle | 1.91 | 3 | 195 | 624.3 | 596.9 | 566.9 |
| | Sand bank | 1.36 | 3 | 175 | 74.1 | 104.8 | 99.5 |
| | Gravel bank | 33.16 | 8 | 505 | 332.9 | 295.0 | 171.6 |
| | Sidearm flowing | 33.91 | 2 | 100 | 0.0 | 0.0 | 0.0 |
| | Sidearm standing | 1.59 | 2 | 110 | 117.0 | 117.0 | 136.0 |
| | Tributary | 0.56 | 4 | 240 | 249.4 | 280.5 | 230.7 |
| | *Total* | 100 | 26 | 1545 | 202.5 | | |
| Constrained | Groyne | 0.33 | 1 | 60 | 444.4 | 0.0 | 0.0 |
| | Rock shore | 2.32 | 3 | 230 | 133.0 | 113.6 | 107.9 |
| | Main arm | 65.3 | 4 | 200 | 0.0 | 0.0 | 0.0 |
| | Cut bank | 4.57 | 5 | 360 | 525.0 | 609.9 | 448.6 |
| | Riffle | 0.74 | 2 | 80 | 1010.1 | 1010.1 | 1174.8 |
| | Sand bank | 0.21 | 2 | 110 | 392.2 | 392.2 | 456.1 |
| | Gravel bank | 20.15 | 14 | 2109 | 1303.6 | 2522.0 | 1108.7 |
| | Sidearm standing | 2.3 | 1 | 20 | 1233.3 | 0.0 | 0.0 |
| | Tributary | 4.07 | 1 | 150 | 55.6 | 0.0 | 0.0 |
| | *Total* | 100 | 33 | 3319 | 566.4 | | |
| Meandering | Groyne | 2.11 | 3 | 200 | 777.8 | 742.6 | 705.2 |
| | Main arm | 81.18 | 3 | 150 | 0.0 | 0.0 | 0.0 |
| | Cutbank | 6.69 | 2 | 155 | 344.0 | 66.2 | 77.0 |
| | Sand bank | 1.56 | 5 | 370 | 380.5 | 346.3 | 254.8 |
| | Vegetated shore | 8.45 | 4 | 305 | 285.9 | 75.0 | 61.7 |
| | *Total* | 100 | 17 | 1180 | 357.6 | | |

# Conservation issues regarding the European Eel and proposed development of HPPs in the Balkan

1. **Ecological degradation of large, unique river systems and consequent habitat and connectivity losses,**

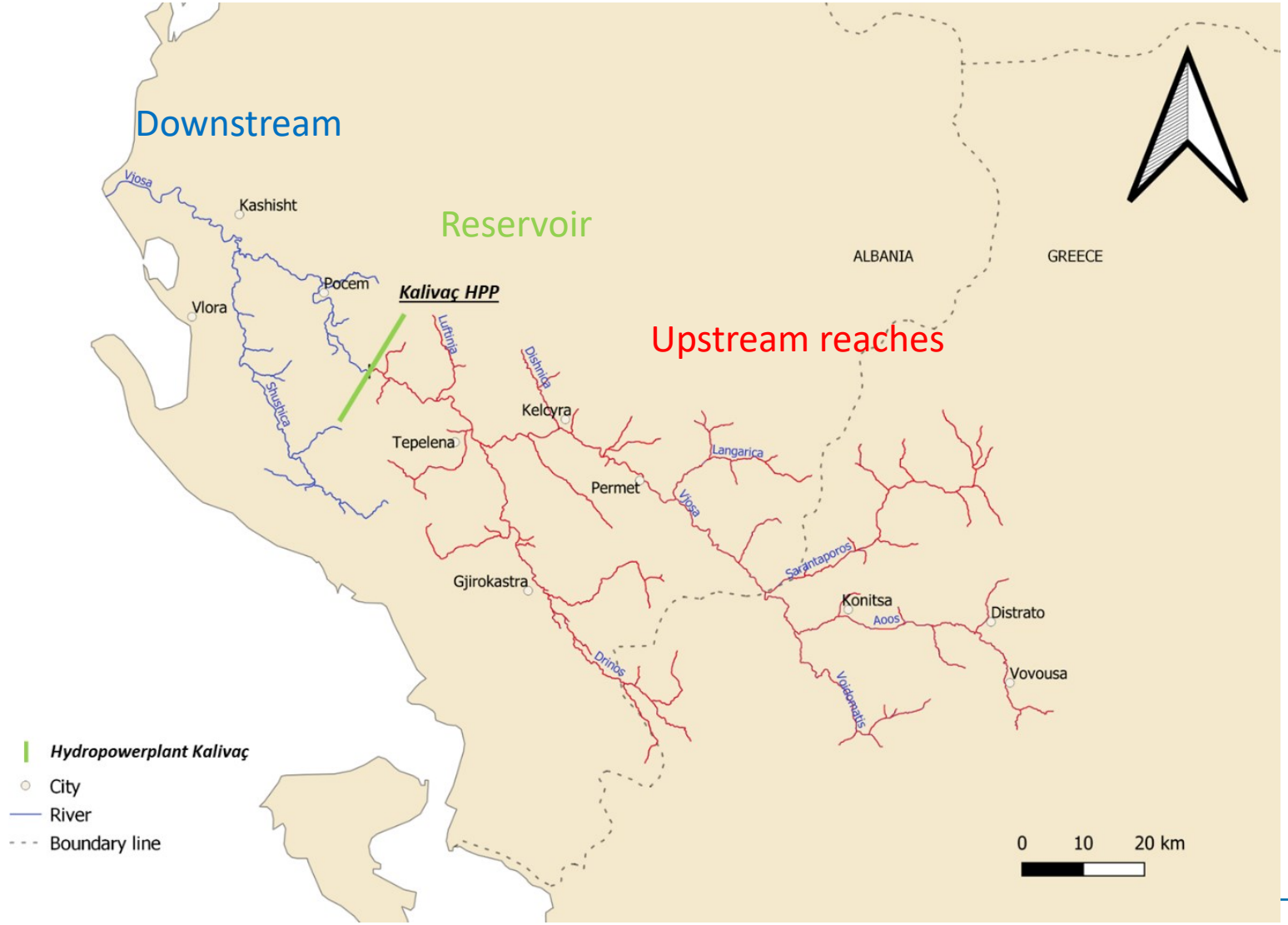





[22]

Longitudinal connectivity is of paramount importance for long-distance migratory species [50,51].

# Impacts of Hydropower plants



# Impacts in the reservoir

Slide provided by Thomas Frank

# Downstream impacts

- hydrological dynamics are altered
- Sediment retention in reservoir -> incision of the riverbed linked to a total change in river morphology
- Deficit of sediment in the lagoon
- Changes in water temperature
- Reservoir flushing
- Hydro-peaking
- Drying up of the river!!!

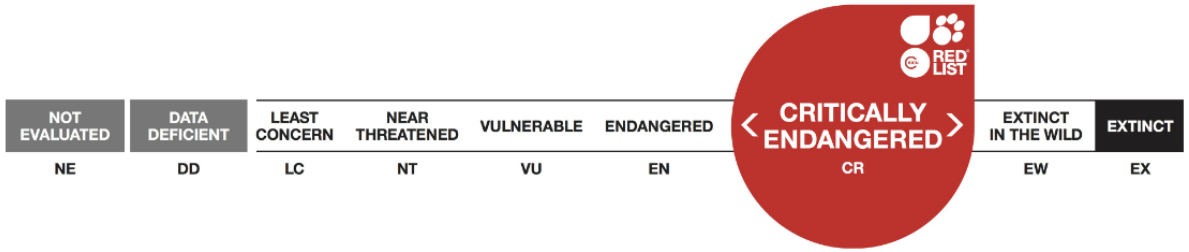
# Conservation issues regarding the European Eel and proposed development of HPPs in the Balkan

1. Ecological degradation of large, unique river systems and consequent habitat and connectivity losses,

2. Insufficient mitigation measures

3. Violation of signed laws and conventions (national and international)

# Laws and Directives




**EU Accession countries** are obliged to approximate its national legislation to the legislation of the EU.

Water Framework Directive [64],
Environmental Impact Assessment Directive [65],
and European Habitats Directive [66].

“Eel directive” (Regulation EC 1100/2007) [14], requiring member states to reduce anthropogenic mortalities, by permitting the escape of at least 40% of the silver eel biomass to the sea.

**Convention on the Environmental Impact Assessment in a Transboundary Context** [67]

Assessment of the environmental impacts of a project on a neighboring state - > panmictic species???

**Environmental legislation in many Balkan countries** [68,69].**:**

- Long-standing top-down planning traditions,
- inadequate planning of national environmental policies,
- poor administrative capacities,
- heavy investment requirements
- combined with a lack of environmental awareness

# Extensive financial resources have been invested

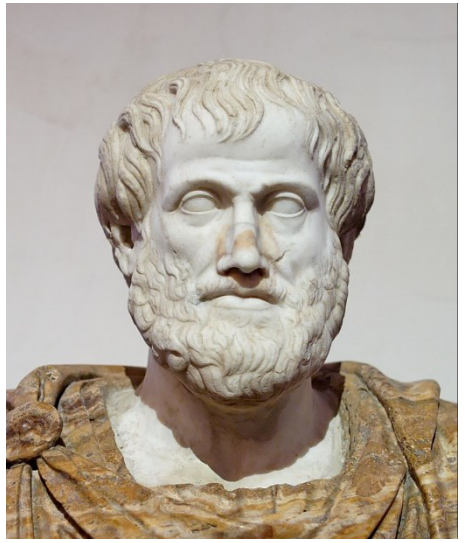
- by installing eel ladders,
- increasing the evacuation of glass eels from fisheries,
- habitat restoration,
- restocking activities [8]

**The stock is in decline, despite all efforts.**

**Protecting natural freshwater areas** with functioning habitat conditions might be a cost-effective measure [71,72].

**Dam removal or Eel removal**

“Eels may have possibly come out from *earthworms*.”



Thank you