Longitudinal continuity for international watercourses

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Increasing water demands of human society

Drivers

Social development

- Population growth
- Urbanization

Economic activity

- Agriculture
- Industry
- Energy production
- Transport/navigation

Benefits for society

- **Mitigation of flood damage** (protect people, urban areas)
- **Explotation hydroelectric power** (renewable)
- **Improvement of navigability** (enable larger ships, etc.)

Pressures

River engineering (flow regulation)

Dam constructions

State of environment

- Biological elements and processes
- Hydrologic and hydro-morphological elements, processes
- Physical and chemical elements, processes

Impacts

Decline of ecological integrity

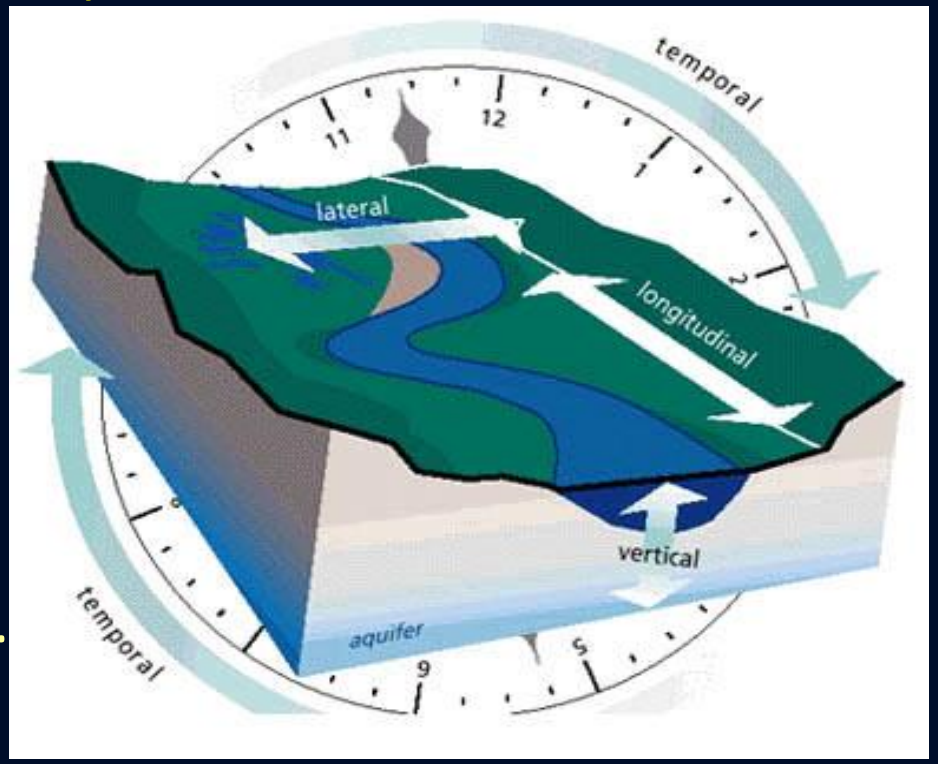
- Fragment. of longitud. connectivity
- River bed incision (bed-load transp.)
- Sinking of ground-water level
- Biodiversity and habitat loss
- Eutrophication, etc.

Connectivity of rivers

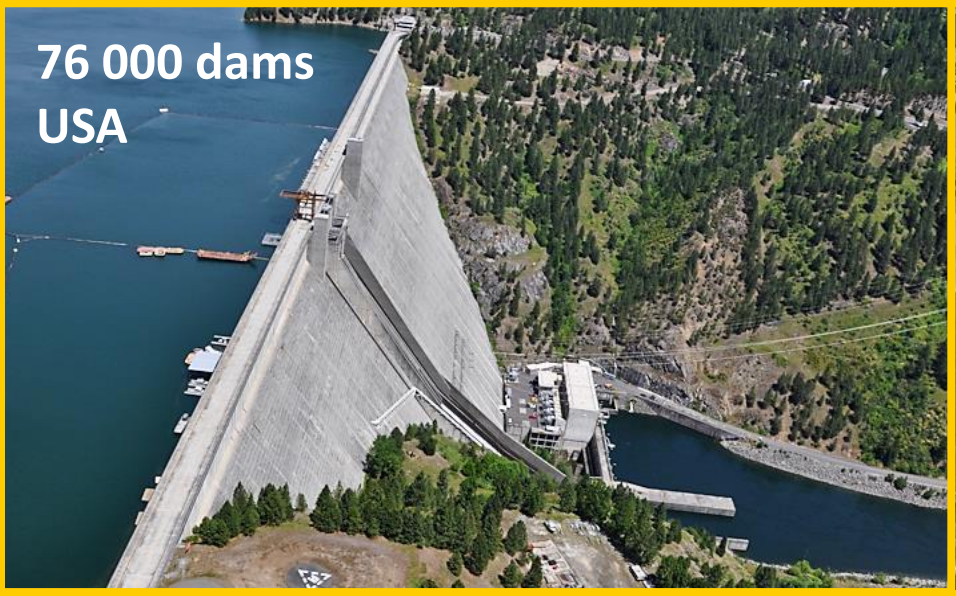
Spatial arrangement and quality of landscape elements → Movement of organisms among habitat patches

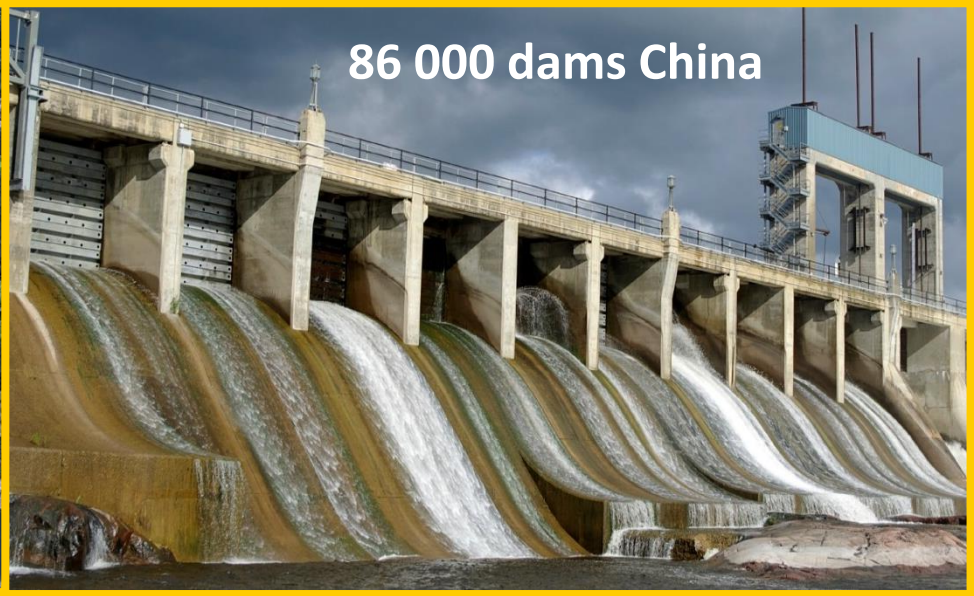
Connectivity of river ecosystem can be described in four dimensions:

- longitudinal
  downstream – upstream continuity
- lateral
  river – floodplain
- vertical
  river – hyporheic zone
  (below river bed)
- temporal
  diurnal, seasonal, interannual, .



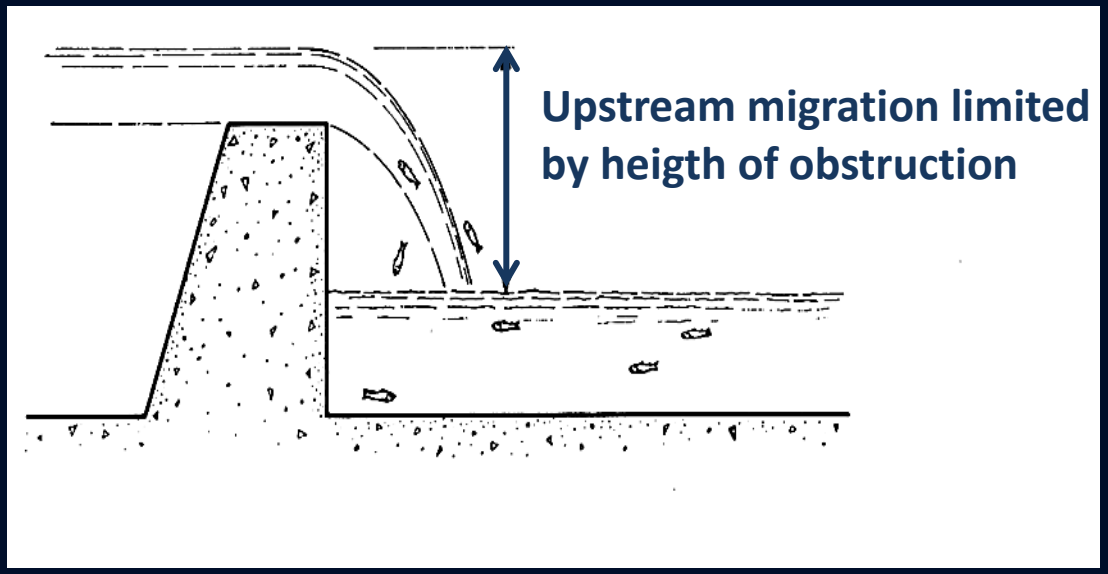
Dam constructions – attractive investments for governments

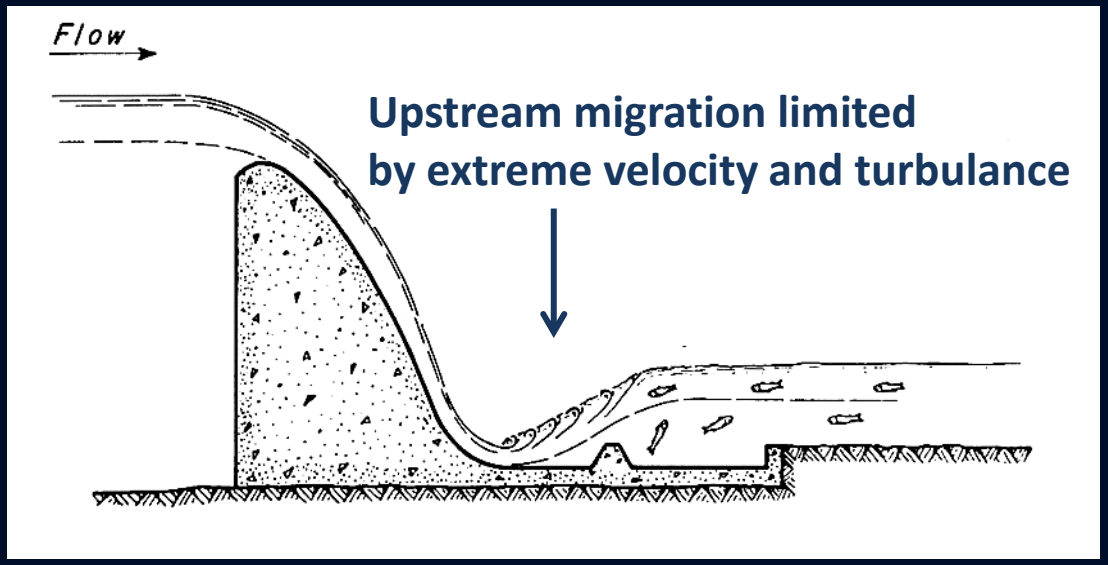




66% of world's total river flow was controlled by dams in 2000 (FAO)

Dams are physical barrier for migratory fish



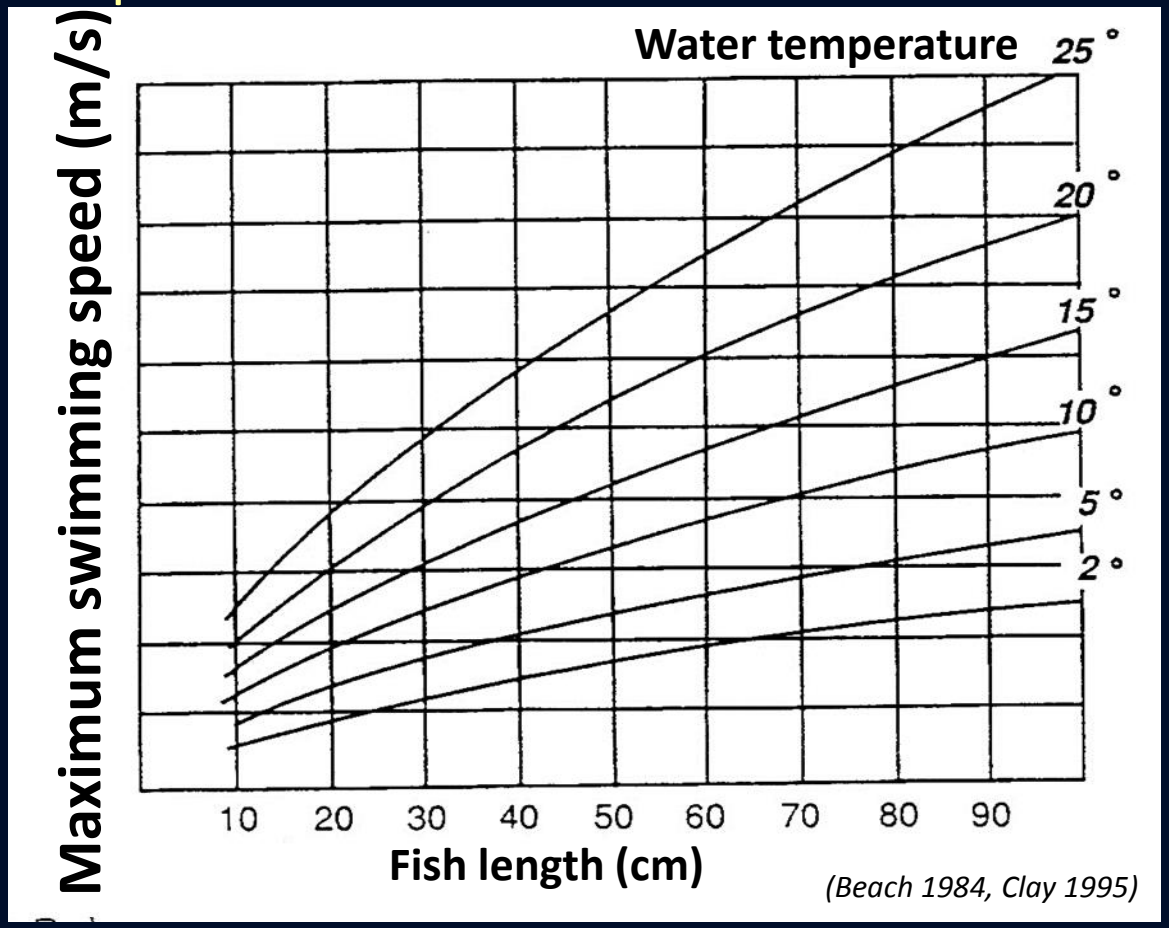


Fragmentation of longitudinal connectivity can be mitigated

Fish-pass = rehabilitation of upstream migratory route for fish

Important design criterion – swimming capacity of target fishes

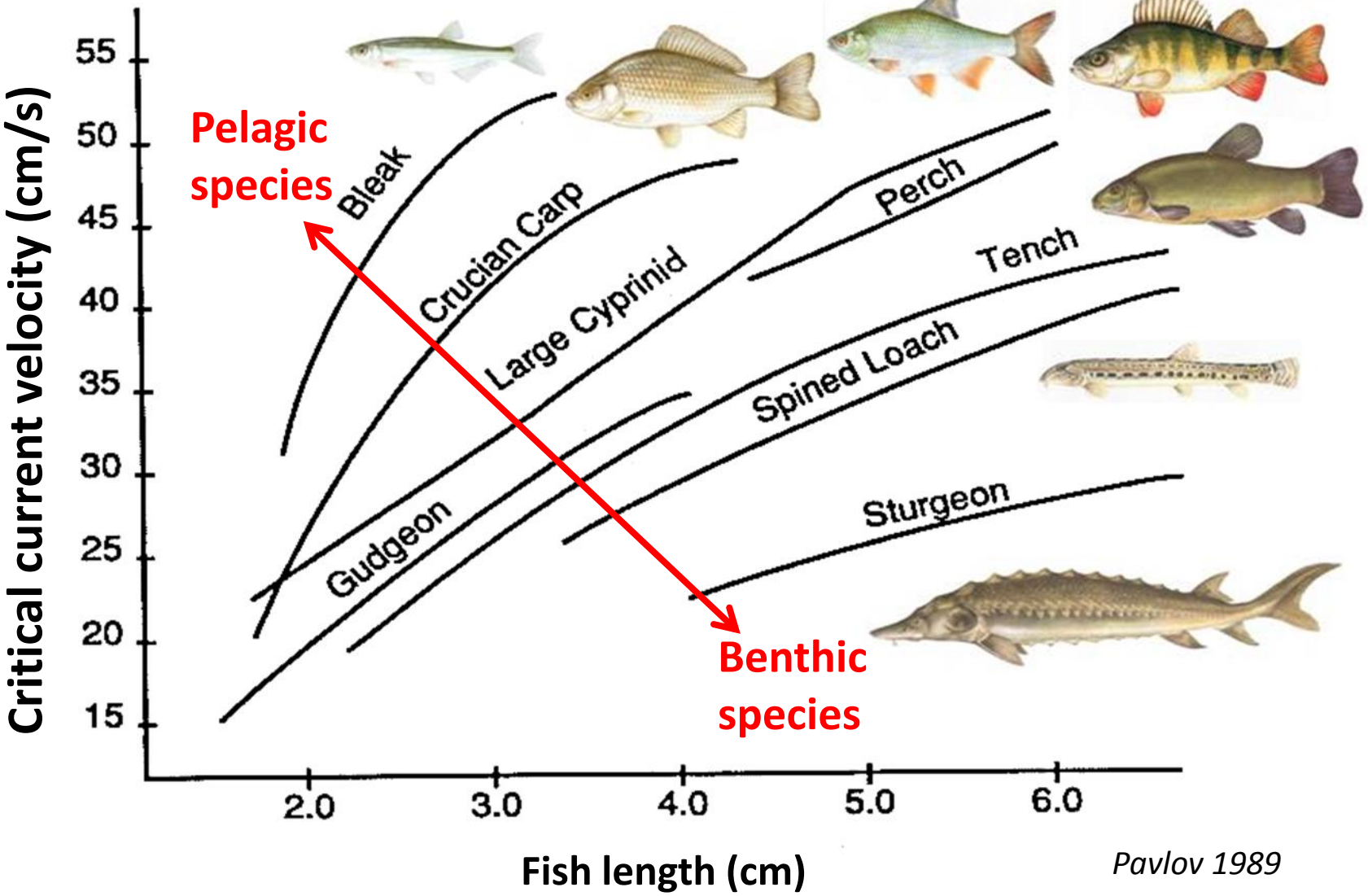
Flow velocity over fishway must be less than the max. swimming speed – dependence on the size of fish and the water temperature



(Beach 1984, Clay 1995)

Swimming capacity of fish

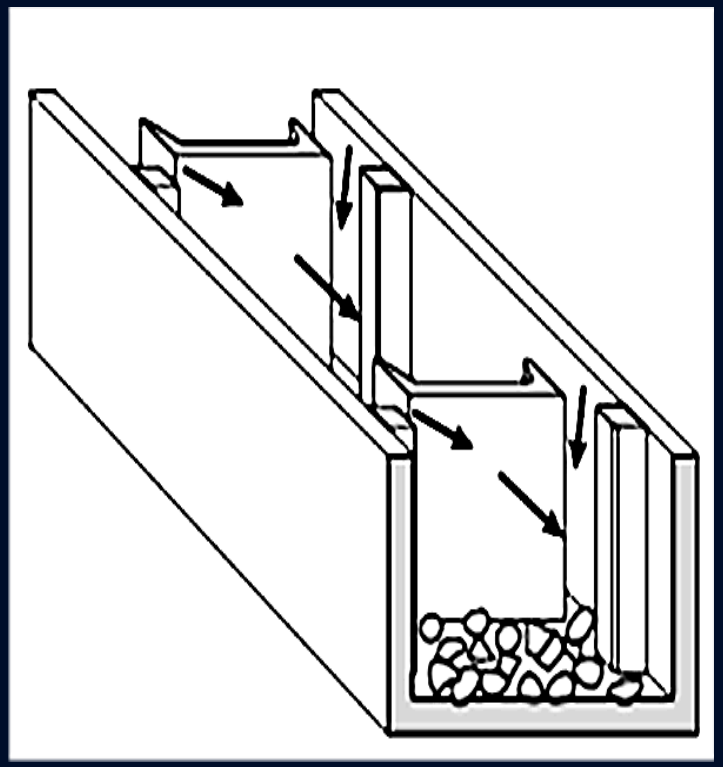
considerable variation between species of the similar length

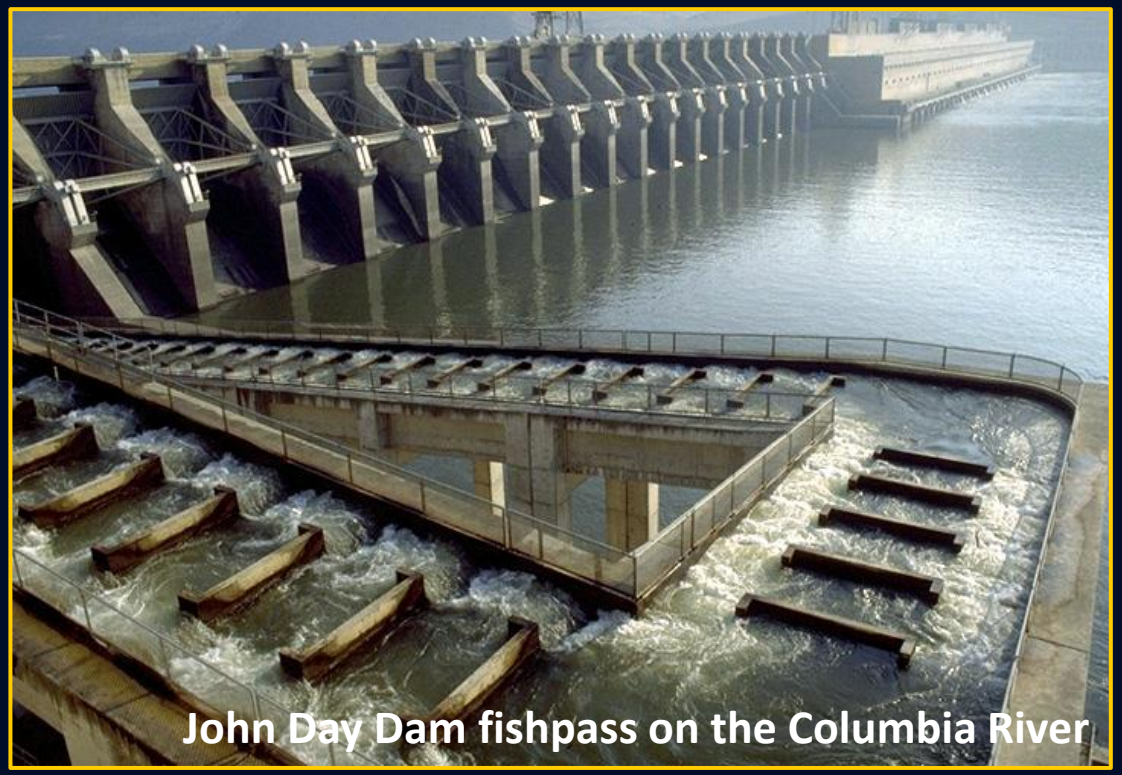


Pavlov 1989

Upstream fish passage facilities - **Pool and weir type fishpass**

- **One of the oldest and widely used concept**
- **Energy of falling water is dissipated by a series of pools**
  (dissipated power 100-200 W/m^3 - The drop between the pools is less than 30 cm)
- **Allows passage for several riverine fish species**



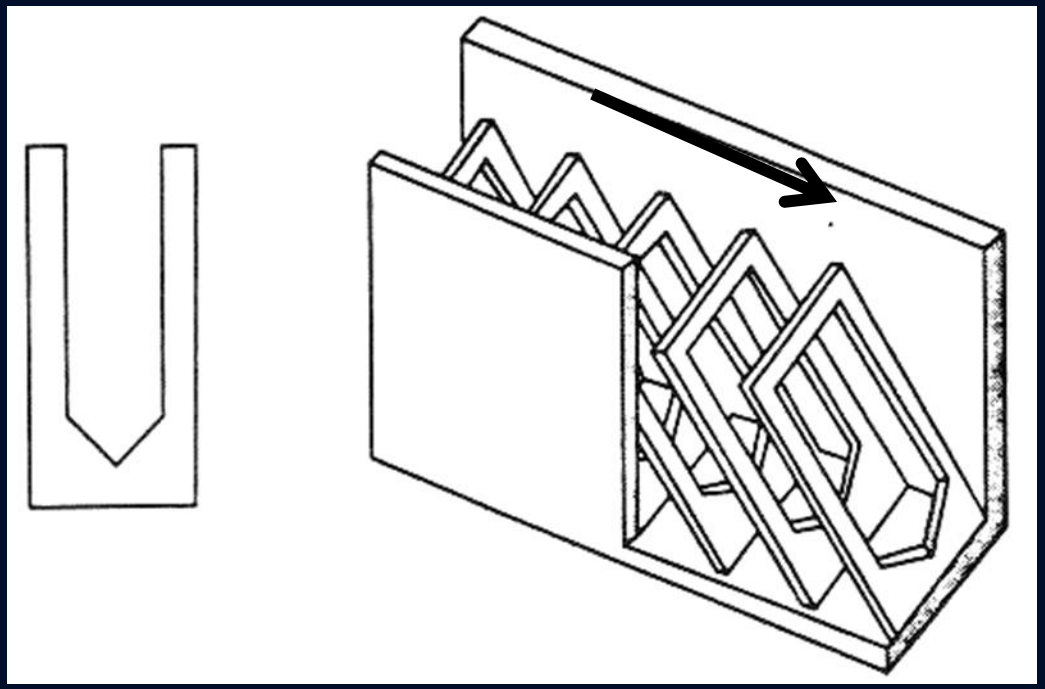


John Day Dam fishpass on the Columbia River

Upstream fish passage facilities - **Denil fish pass**

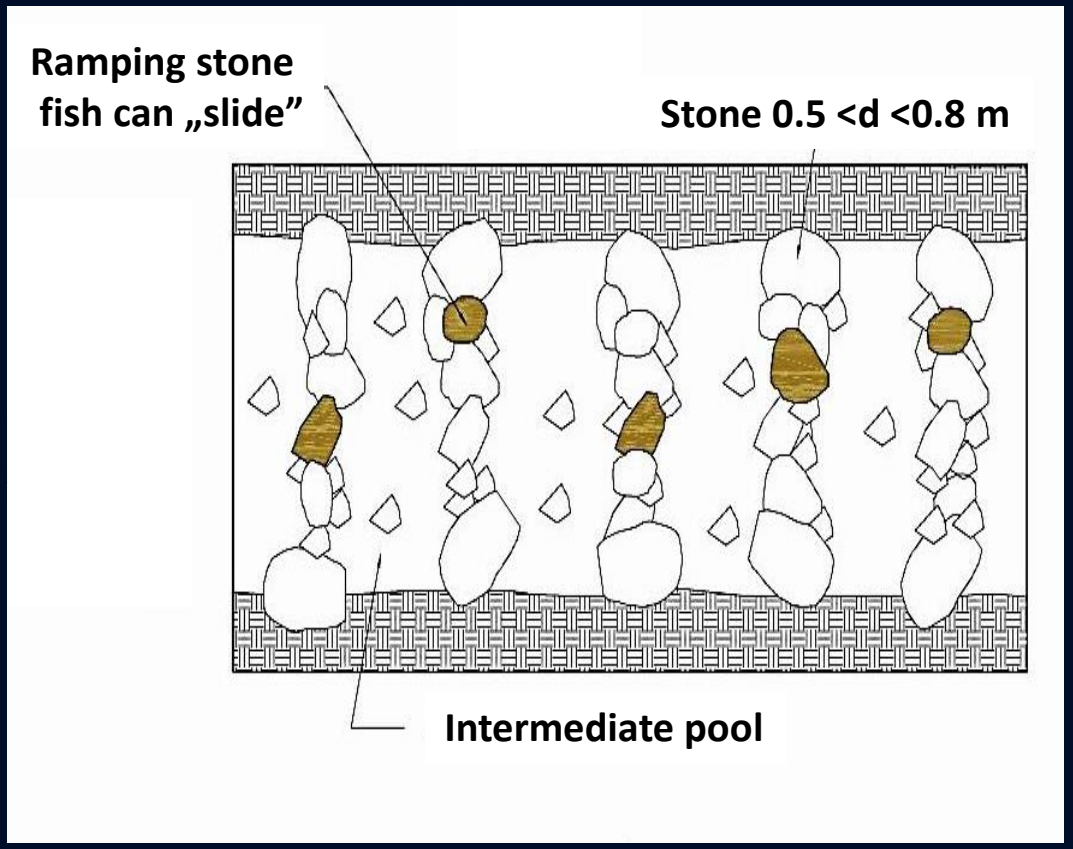
(developed by Denil in 1908)

- **Relatively steep slope (10-25 %)**
- **Helical currents dissipate the energy of flowing water**
  Discharge < 1 m^3/s
- **Cheaper than the other types of fish-pass**
- **Selective for larger (>30 cm) fish**
  (mainly for salmonid fish – mountain r.)



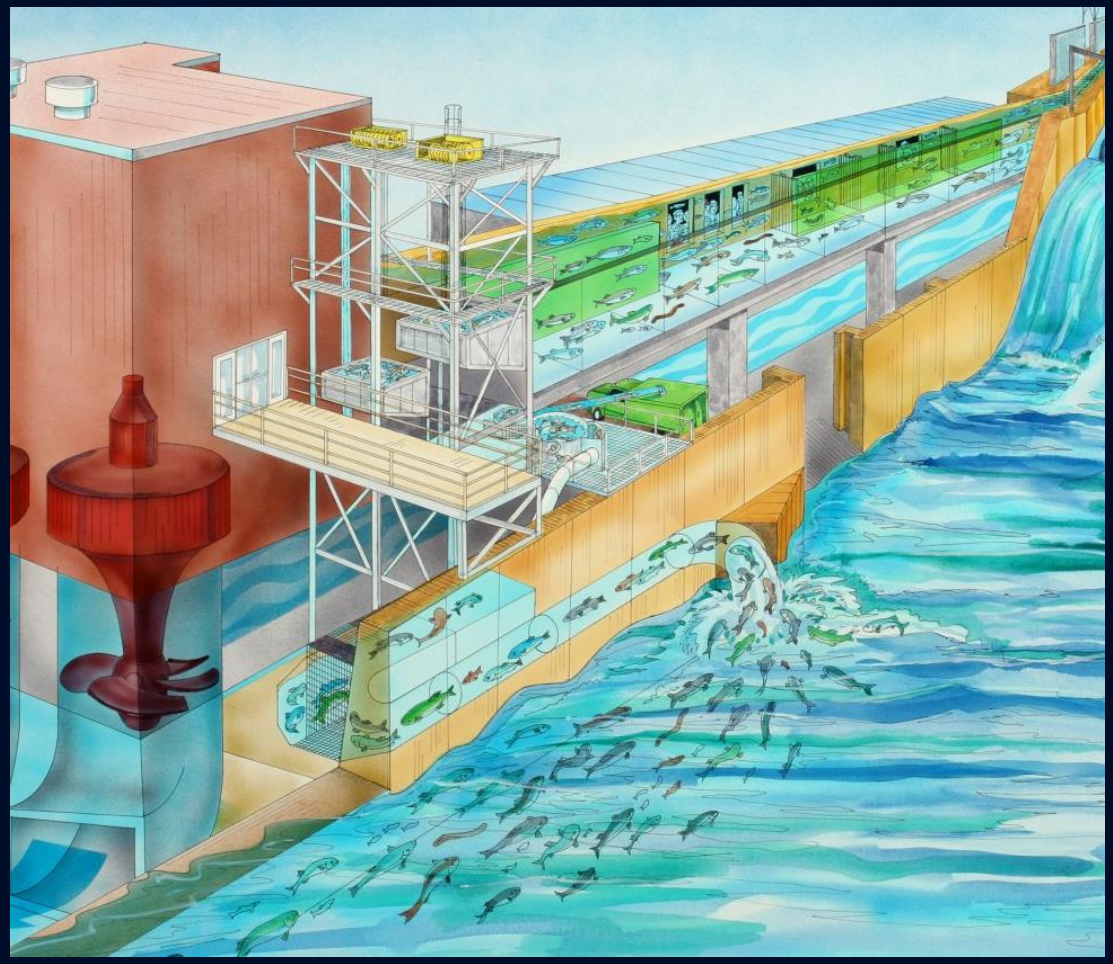
Upstream fish passage facilities - **Nature-like fishpass**

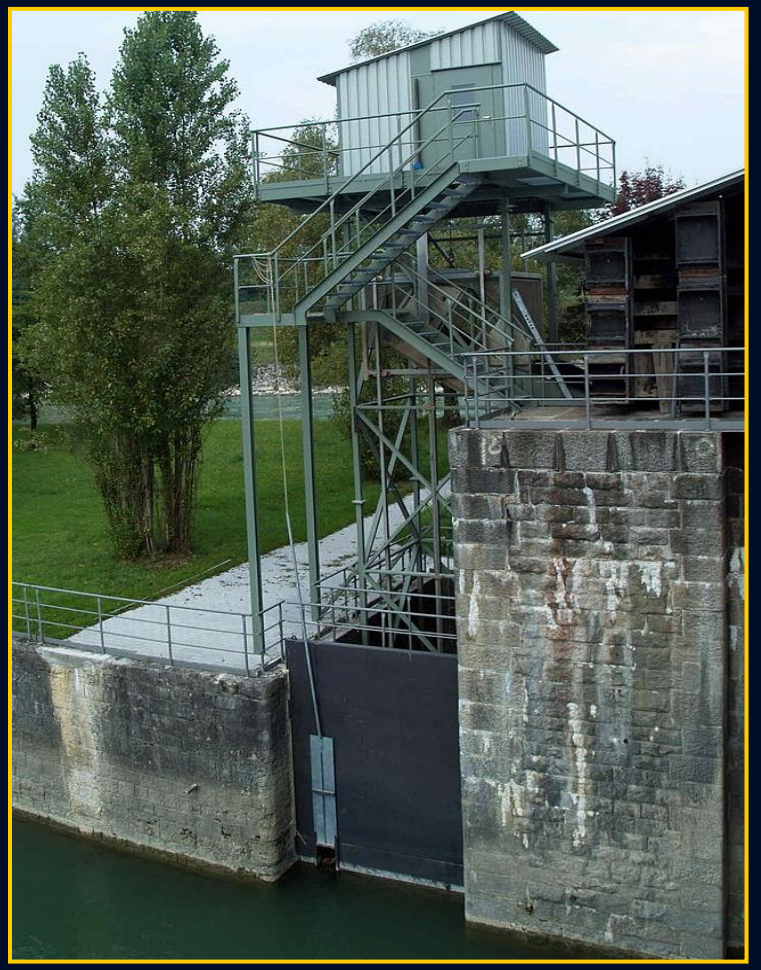
- **Bypass channel similar to natural stream beds**
- **Energy is dissipated by rock stairs and cascades**
- **Particularly effective for smaller fish and fish of low gradient rivers** (cyprinid species)



Fish lift – alternative device to conventional fish-passes

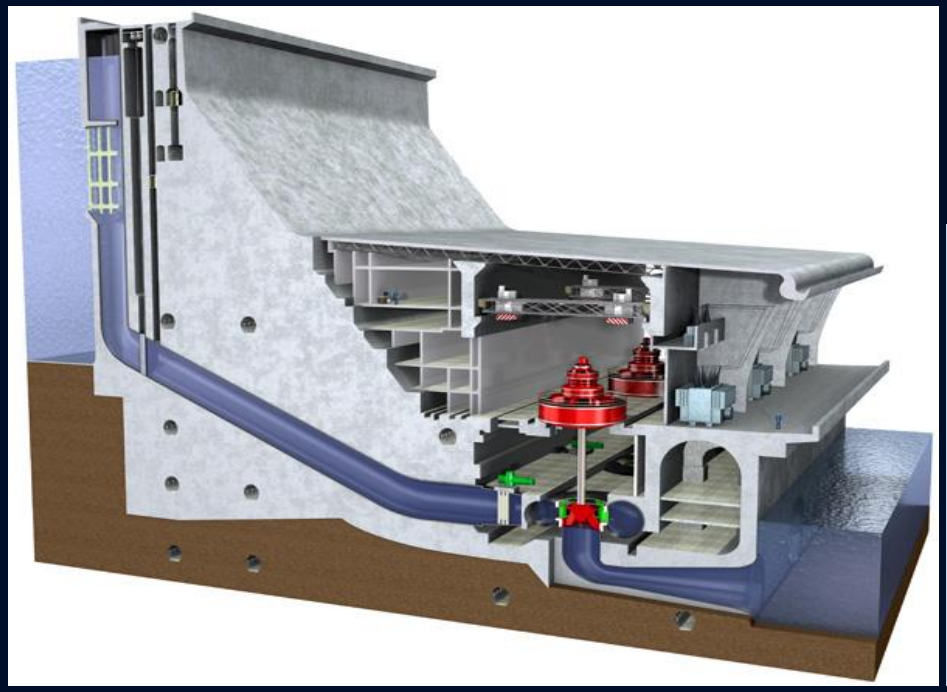
- **Fish are trapped and lifted up by mechanical means**
  – content of trap empties into upstream
- **Cost of installation is low – cost of operation is high**
- **Effective facility at higher (>8m) dams –** passage for several species



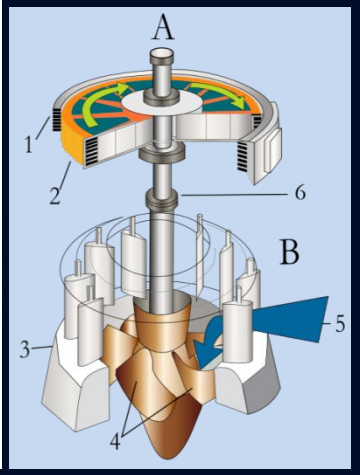


Problems of downstream migration must be considered

Mortality of hydroelectric turbine-passed fish is varied from 1 to 99 %



Main reasons of mortality:



- Mechanical damage
- Shearing action damage
- Cavitation damage

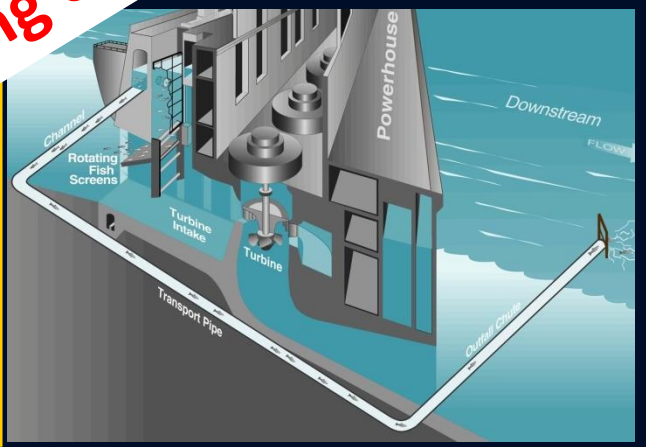
Downstream fish passage facilities

many attempts to solve the problem of mortality of turbin-passed fish:

1) **Fish-diversion devices**

Submerged screens to guide fish to a bypass canal to do[illegible]n

- **Behavioral barriers** (electrical screen, water jet [illegible], light, …)
- **Physical barriers** (trashracks, … high cleanin[illegible]due to clogging)



None of these facilities are very promising on large rivers!

2) **Fish-co[illegible]n devices**

tra[illegible]s and transporting fish downstream

Summary of technical aspects of restoration of longitudinal connectivity

- River fragmentation can be mitigated by fish passage facilities
- Important requirement in development of fishpass technology: multi-disciplinary approach by cooperation of engineers and biologists
- The progress in fishpass technology depends on the in situ experiments and assessment of existing fishpass structures
- Dams have a significant negative impact on migratory species, even with efficient fish passage.
- The best way to restore the longitudinal connectivity: removing of dams, where it is possible

Why connectivity restoration is needed?

River ecosystems form a continuum with gradual changes from upper to lower reaches

-Habitat change (e.g. slope, surrounding landscape, substrate, temperature, oxygen, sediment transport, water flow, discharge)

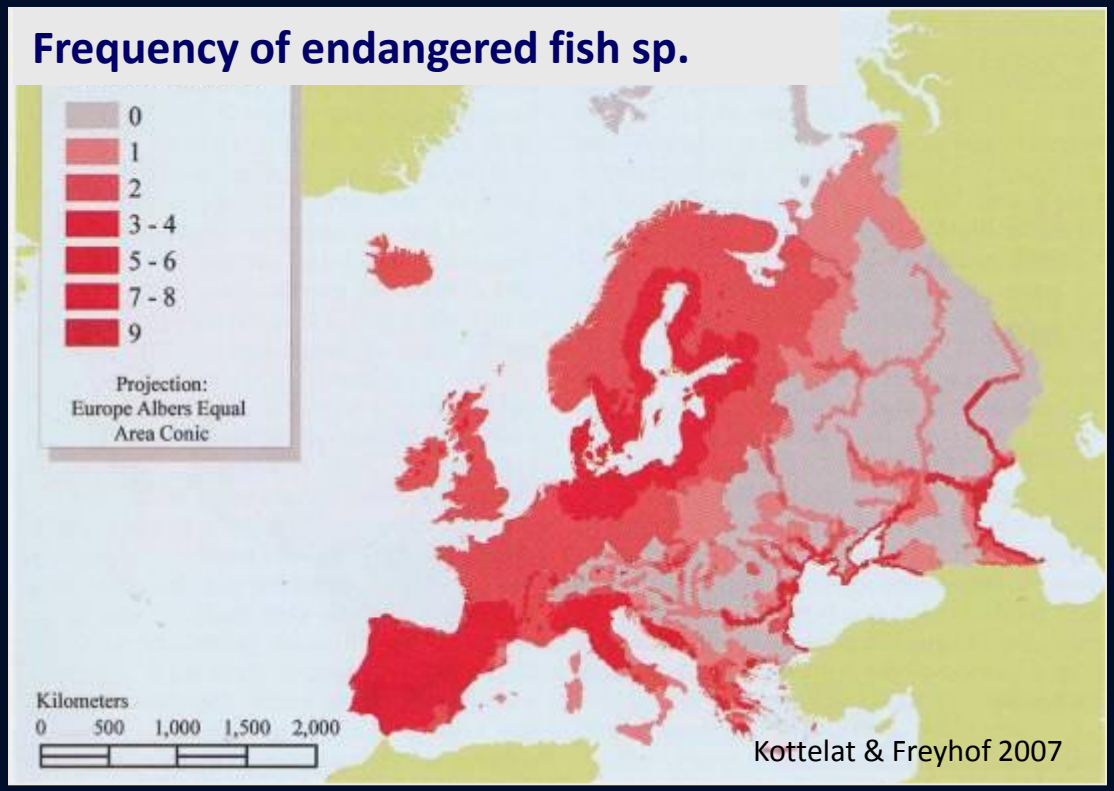
-Structure of the aquatic communities change

The connectivity – vital for river functionality and biodiversity

Change of fish fauna – indicator of ecological integrity of rivers

200 out of 522 of Europe's freshwater fish species are at risk for extinction

60% of riverine species are endagered



Frequency of endangered fish species is positively related to <u>indicators of "human activity"</u>

- **GDP,**
- **population density,**
- **percentage of urban area**

New trends required for the economic development

Connectivity restoration – increase biodiversity (Schmutz, 2013)

Increased biodiversity provide multiple benefits for human society , including business environment (MEA, 2005; TEEB, 2009)

Organisation for Economic Cooperation and Development: The protection of biodiversity and ecosystems must be a priority in our quest to build a stronger, fairer and cleaner world economy (Living Planet Report, 2010)

Political support towards integrative environmental friendly solutions

- Water Framework Directive – river basin approach

- International Commission for the Protection of Danube River (ICPDR)

Danube River Basin Management Plan - Joint Program of Measures – river continuity restoration

Dialogue with major stakeholders – mitigation of impact

- EU Strategy for the Danube Region – integrates socio-economic development with environmental protection

EUSDR actions requiring river connectivity

Pillar B – Protecting the environment in the Danube Region

PA4

To implement fully the Danube River Basin Management Plan

To reduce existing water continuity interruption for fish migration in the Danube river basin

PA5

To support wetland and floodplain restoration as an effective mean of enhancing flood protection, and more generally to analyze and identify the best response to flood risk (including "green infrastructure")

PA6

To contribute to the 2050 EU vision and 2020 EU target for biodiversity

To protect and restore most valuable ecosystems and endangered animal species

To develop green infrastructure in order to connect different bio-geographic regions and habitats

Program Sturgeon 2020

Supported by EUSDR Pillar II – Environment


EUROPEAN COMMISSION

Brussels, 8.4.2013
COM(2013) 181 final

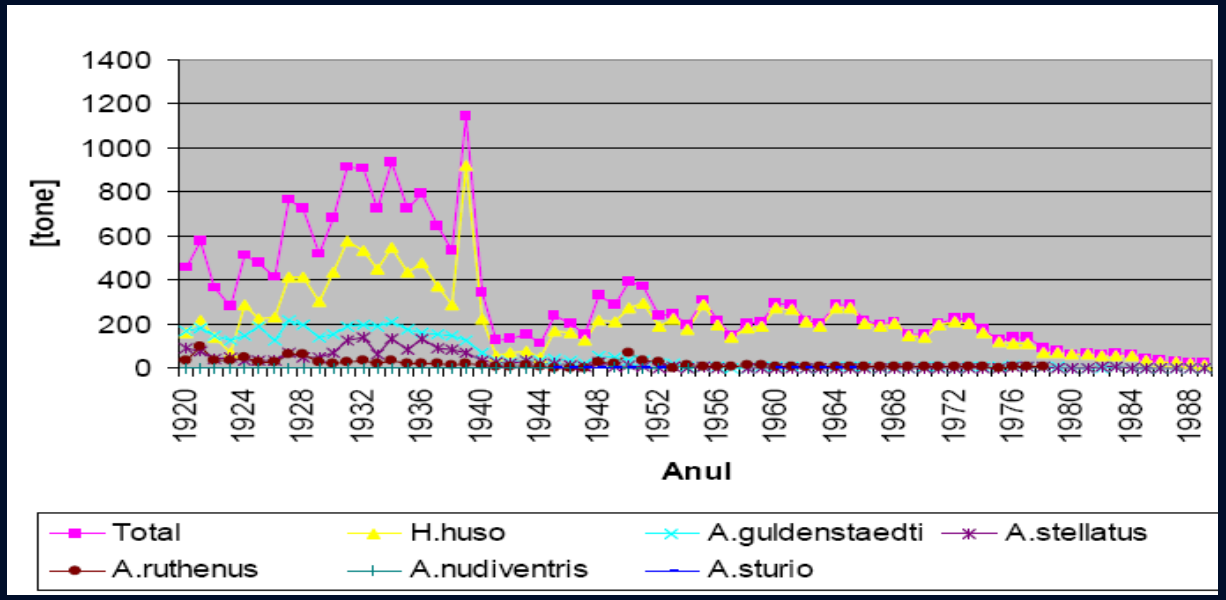
REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

concerning the European Union Strategy for the Danube Region

Sturgeons dramatic decline

Major causes:

- Overfishing
- Habitat loss (pollution, constructions in the river bed)
- Continuity interruption – migration disruption



Source: Stoica, G., PhD thesis, 2011 - compilation of data provided by the Danube Delta National Institute, Tulcea

3. In situ conservation

- Identification/restoration key habitats
- Evaluation of health status of habitats and biota
- Population analysis
- Stock & by-catch assessment

- Develop identification system for sturgeon products origin
- Estimate impact of climate change and invasive species – consider preventive measures
- Guidelines for population management – use research results

3. In situ conservation

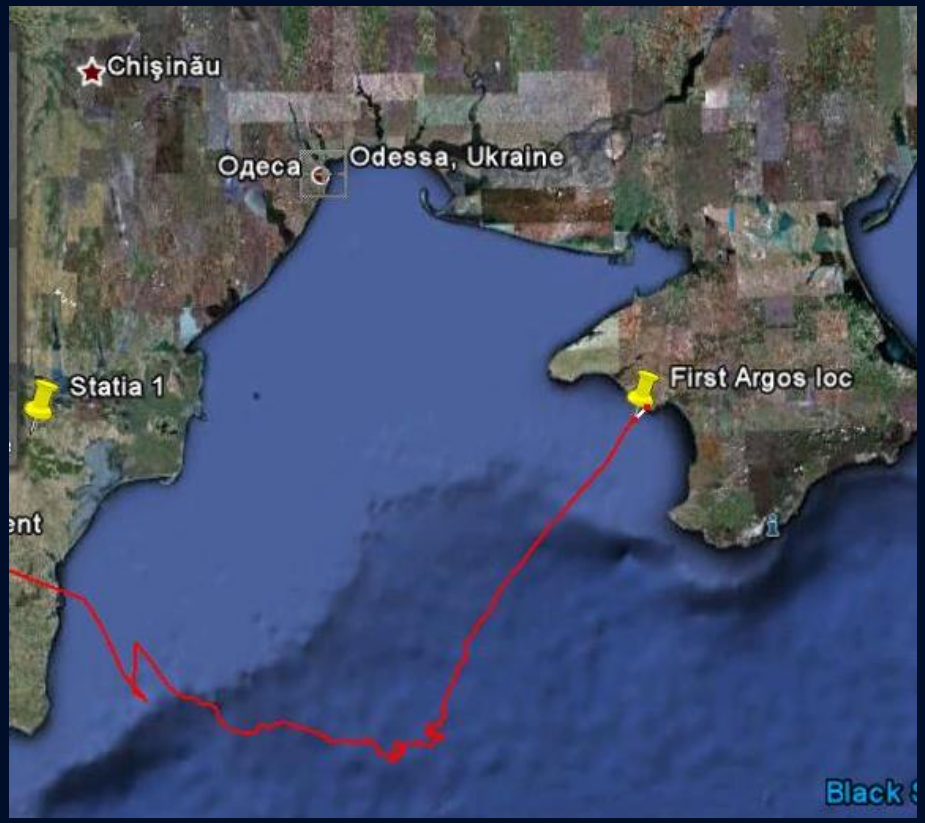
Key measure: Restoration of spawning migration routes and former habitats

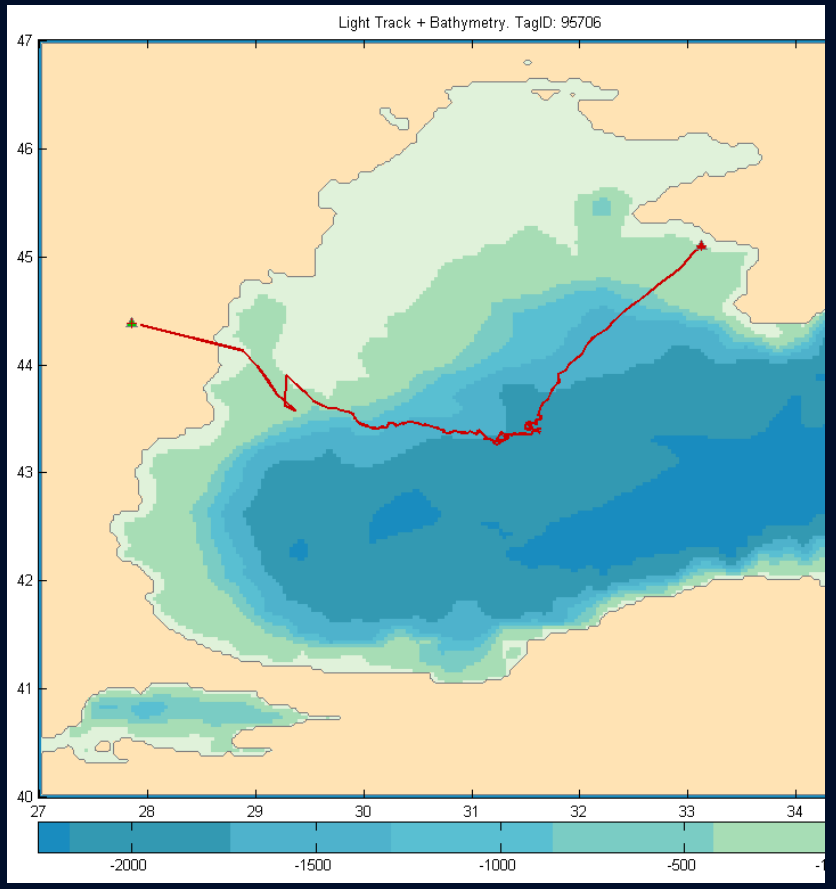
Map source: www.icpdr.org, modified by Ralf Reinartz

Joint conservation measures required in the Danube River Basin & Black Sea

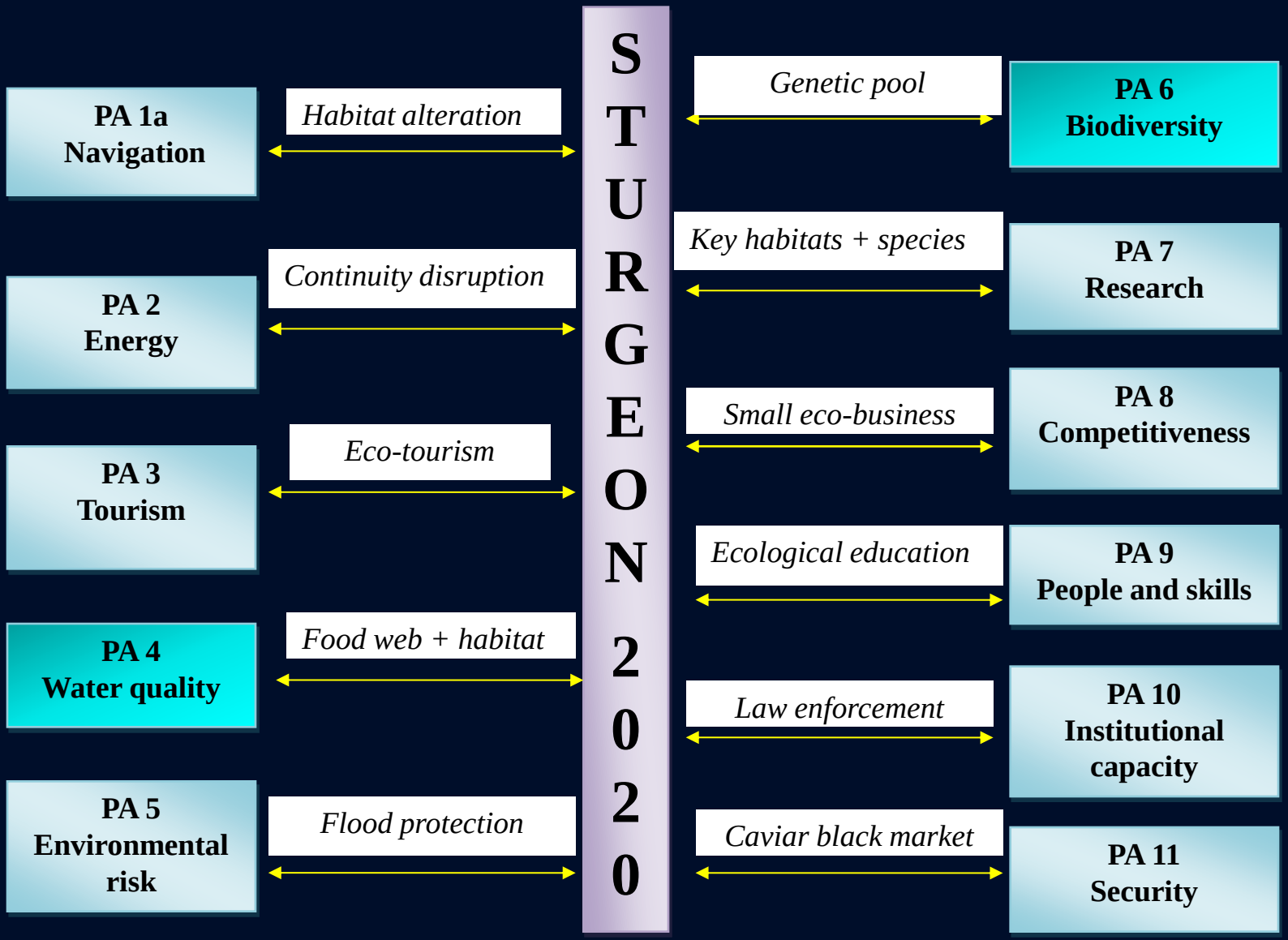
Satellite telemetry proves the long distance migration of sturgeons
Beluga male - 164 days - 11Km of the coast of Crimea

Info provided by DDNI Tulcea – Danube Sturgeon Group





Sturgeon 2020 & EU SDR



New type of funding programs needed for EUSDR projects

- Transboundary (EU and non EU MS)
- Financial support for project planning phases
- Full funding of the proposal
- Simplified project templates
- Shorten terms/chains for funding allocation
- Long term governmental commitment towards implementation

TAKE HOME MESSAGE

EUSDR offers the opportunity to make the Danube River Basin a worldwide example of truly sustainable economy

Are we willing to learn from our previous mistakes and try to improve our future?

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