

RIVEAL PROJECT

RIPARIAN FOREST VALUES AND ECOSYSTEM SERVICES – RIVER REGULATION



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FLOW REGULATION

Is the human alteration of river flow regimes, interfering with the natural patterns of the river basin's hydrological variability. This human alteration is one of the most endangering processes to river ecosystems and one of the major causes for river degradation.

FLOW REGIME MODIFIERS

- Dam, weirs and groynes
- Channelization
- Embankments, levees and dikes
- Water diversion & groundwater pumping
- Land drainage, sealing

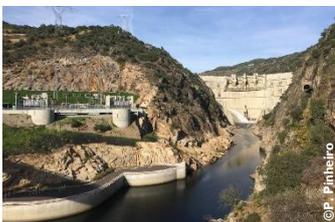
DAM FLOW REGULATION

► Storage reservoir:

- Most common type;
- Mainly to stock water during rainy seasons for later use during dry seasons and hydropower generation;
- Large impoundment of water;
- Base flows usually eliminated while high floods result only from dam outflows through the spillways when reservoir is full;
- Greater environmental footprint.

► Run-of-river:

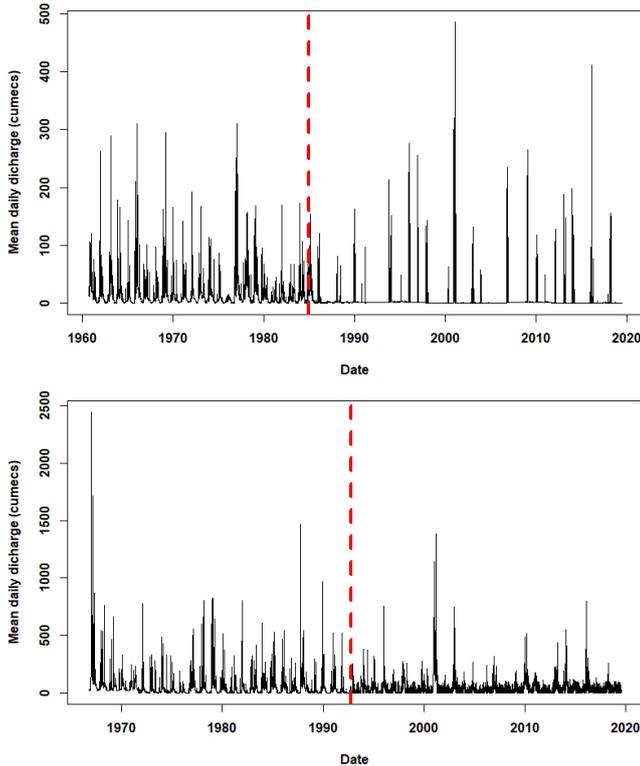
- Usually of smaller dimension;
- Mainly for hydropower production, but also flood protection;
- Little storage capacity (pondage) and more discrete river flow variations;
- Exclusion of high flood discharges and magnification of base flows due to the constant and stabilized release of river flows;
- Considered less environmentally damaging.



Damming, channelization, embankments and, land drainage and sealing (clockwise).



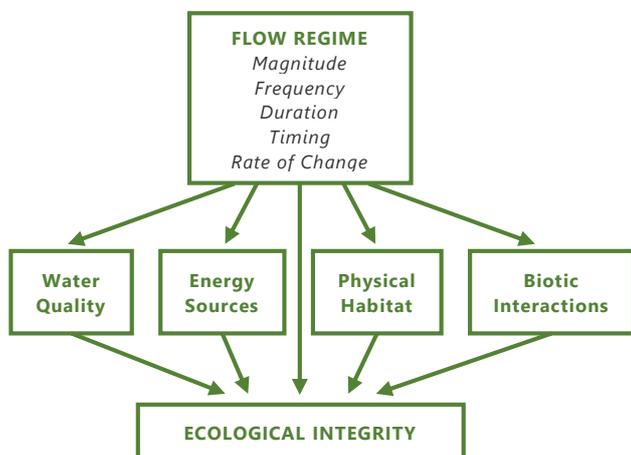
Pracana storage reservoir in Ocreza River, Portugal (left) and Runserau run-of-river dam in Inn River, Austria (right).



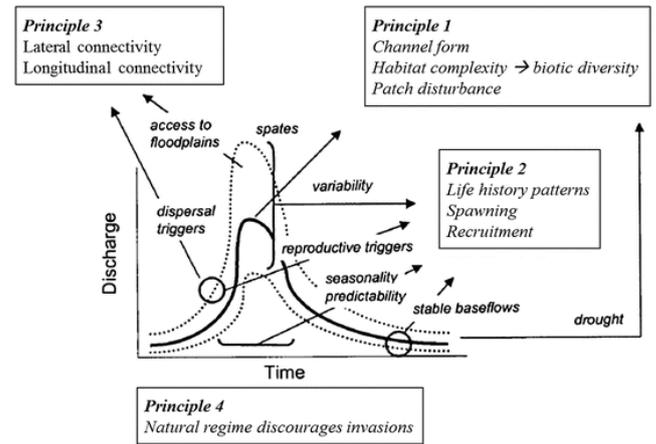
Hydrographs of the storage Fronhas dam, Alva River, Portugal (upper), and run-of-river Touvedo dam, Lima River, Portugal (bottom), before and after dams went into operation (red line).

NATURAL FLOW REGIME ECOFUNCTIONS

- Regulates ecological processes and preserve the naturalness of freshwater ecosystems;
- Promotes sediment transport, rejuvenates the physical habitat and exports organic resources;
- Source of energy, revitalizing communities, maintaining ecosystem productivity, biodiversity and water quality;
- Links channel and floodplain, presenting increased opportunities for biotic interactions.



Ecological integrity of lotic systems uphold by the natural flow regime (from Poff et al., 1997; doi: 10.2307/1313099).



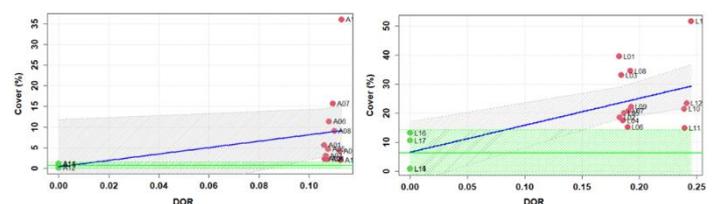
The influence of the natural flow regime on aquatic biodiversity over different spatial and temporal scales (from Bunn & Arthington 2002; doi: 10.1007/s00267-002-2737-0).

FLOW CONTROL OF HABITAT AND BIOTA

- Flow regime molds the habitat;
- Habitat influences greatly biodiversity;
- Large flow occurrences determine channel form;
- Seasonality, predictability and timing of flow regime controls species life history events, triggers life cycle events, promotes lateral and longitudinal river connectivity;
- The natural flow regime meta-stability rules species persistence and coexistence.

ECOLOGICAL RESPONSES TO RIVER REGULATION

- Affected species growth, dispersal, reproduction and survival;
- High mortality from physiological stress;
- Altered water quality and thermal regimes;
- Native species replacement by more tolerant generalist species, including alien invasive species;
- Changes in food webs and ecological invasion;
- Biodiversity impoverishment and commercially valuable stocks threatening;
- Terrestrial habitat degradation by habitat change in the medium- to long-term.



Cover response of aquatic macrophyte vegetation as a function of the Degree-of-Regulation (DOR) in unregulated (green dots; green shade for unregulated 95% confidence interval) and regulated sites (red dots). Sampling sites: A – Alva river; L – Lima river (from Lozanovska et al., 2020; doi:10.1016/j.scitotenv.2020.141616).

