

The effects of flow alteration on ecology and water quality

Prof. Michael McClain
IHE Delft

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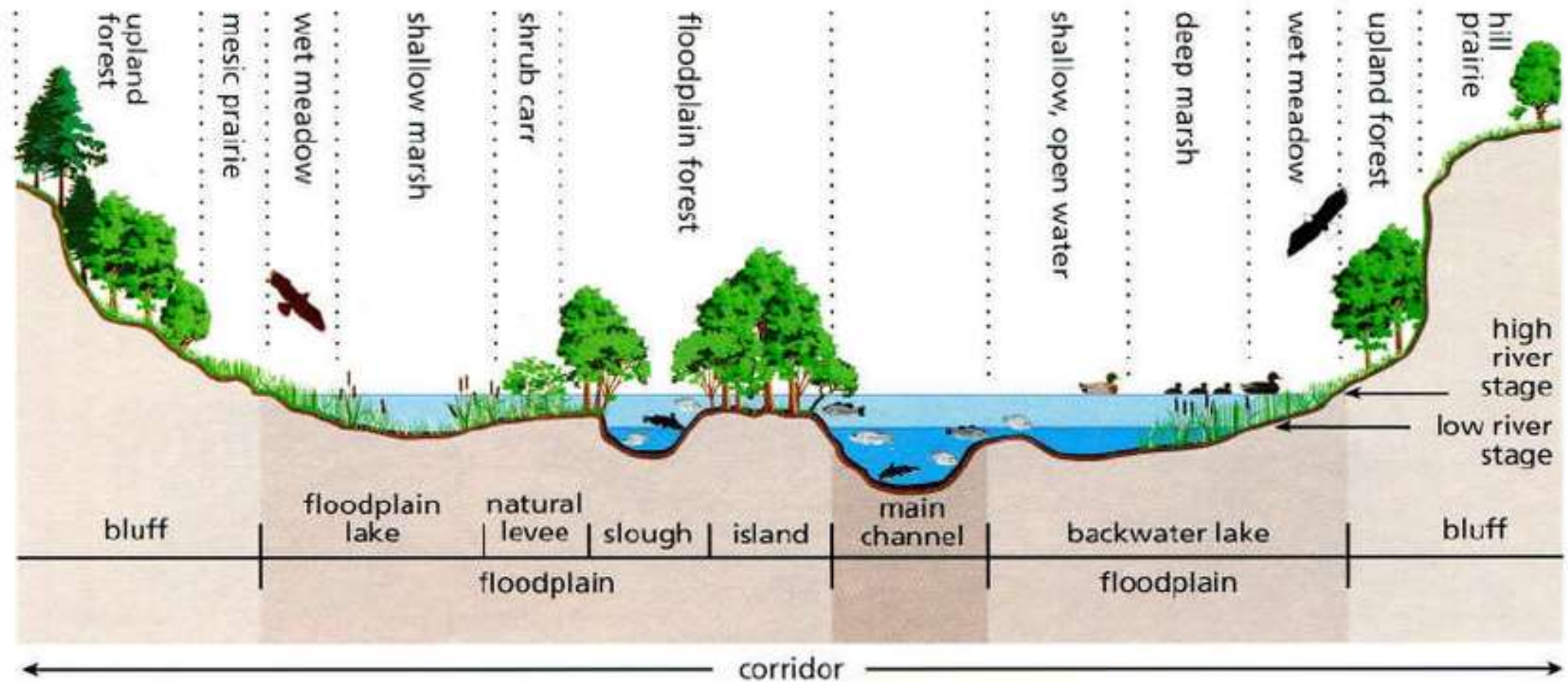
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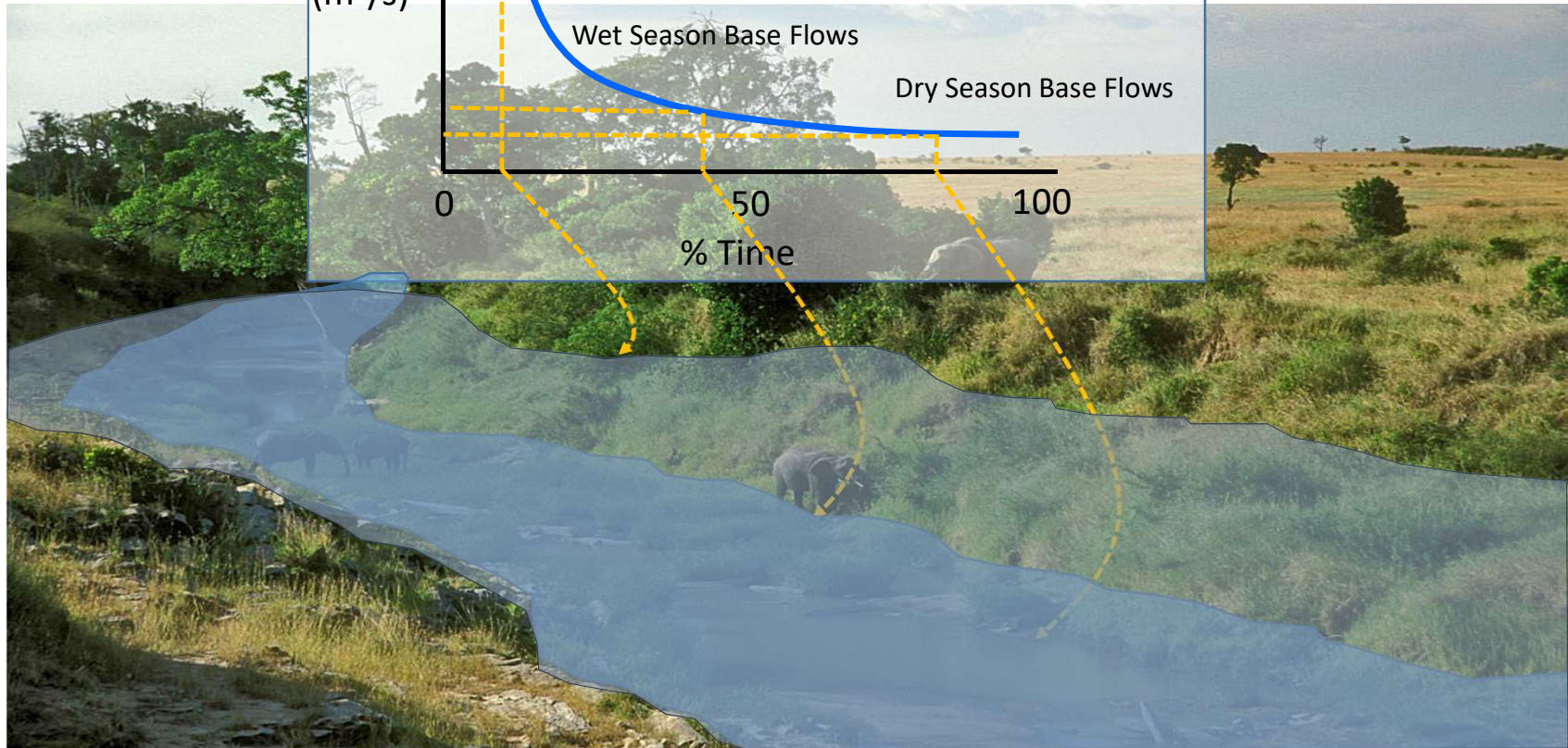
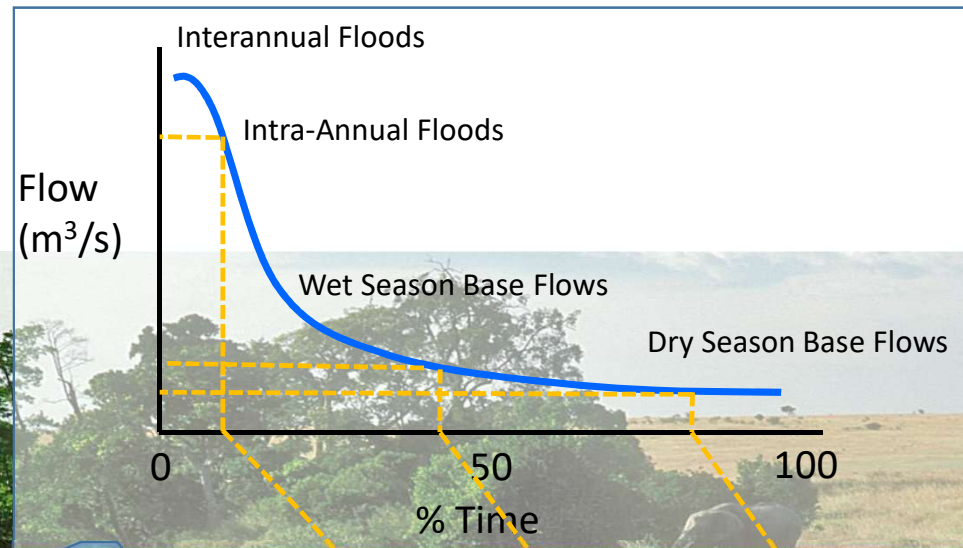


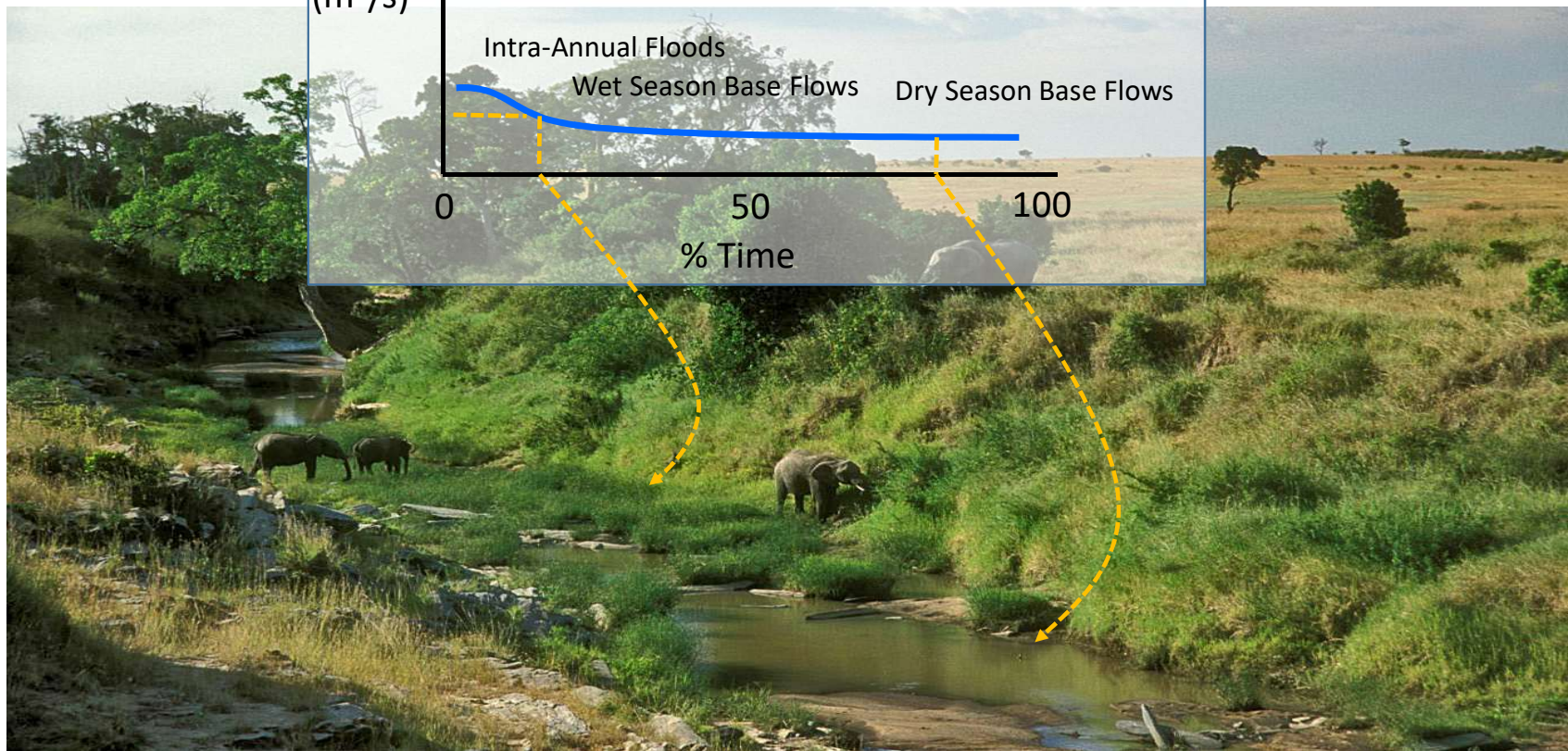
Magnitude of flow, and how it changes through time, determines the entire habitable world of aquatic species in which all of life's functions must be conducted.



As flow magnitude increases and decreases the volume of space available to aquatic organisms changes and habitats either become available or disappear.







'The Darling will die': Scientists say mass fish kill due to over-extraction and drought

Australian Academy of Science panel says urgent steps needed to restore flows

Anne Davies

@annefdavies

Sun 17 Feb 2019 23.30 GMT



1,817



▲ Two dead murray cod float on the surface of the Darling River near Menindee. Photograph: Dean Lewins/EPA

Recent fish kills in the Darling River due to low and nearly stagnant river flows that led to stratification of the water column and formation of an anoxic bottom layer. Later mixing of river waters cause anoxic event that killed thousands of fish.



Large fish populations around Menindee became concentrated within weir pools. (ABC News: Isabel Dayman)



The Darling River at Menindee was blanketed with dead fish. Supplied: Rob Gregory



Made for minds.

ECOLOGY

Dying fish and drying rivers — consequences of Europe's summer heat wave

Over the past week, dead fish have been pulled out of Germany's rivers and lakes by the ton — the extreme heat and a lack of rain have proven too much for them. Global warming is among factors altering fish habitat.

Temperature sensitive fish species killed by high temperatures in hot summer with unnaturally low river flows



Frequency, duration, and timing of flows becomes especially important when needed habitats or connectivity must be synchronized with life history events of river species. The onset of higher flows or stabilizing low flows are triggers for many fish and other riverine species to spawn.

Stable low flow spawner

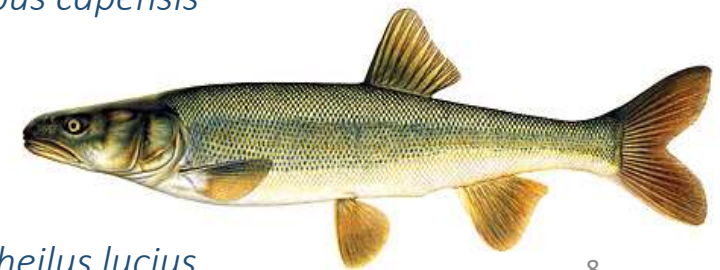


Australian Smelt: *Retropinna semoni*

High flow spawners



Clanwilliam Yellow Fish: *Barbus capensis*

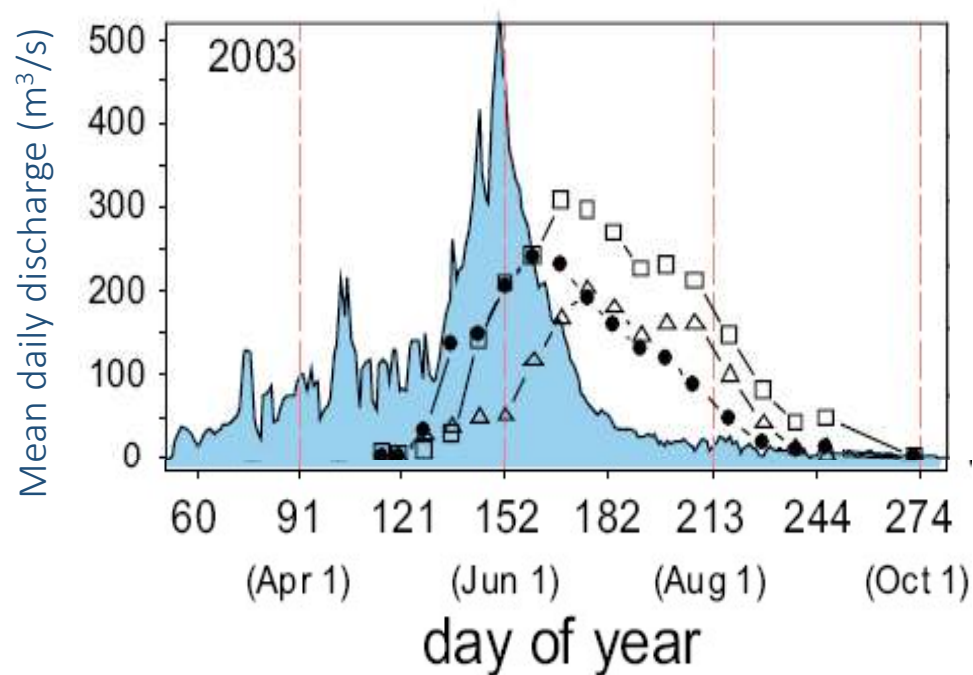


Colorado Pikeminnow: *Ptychocheilus lucius*

Riparian vegetation may also be triggered to drop their seeds at particular times annually when flow levels rise and are sustained at needed levels for sufficient time. The rate of flow decline is also important to maintain moisture levels.

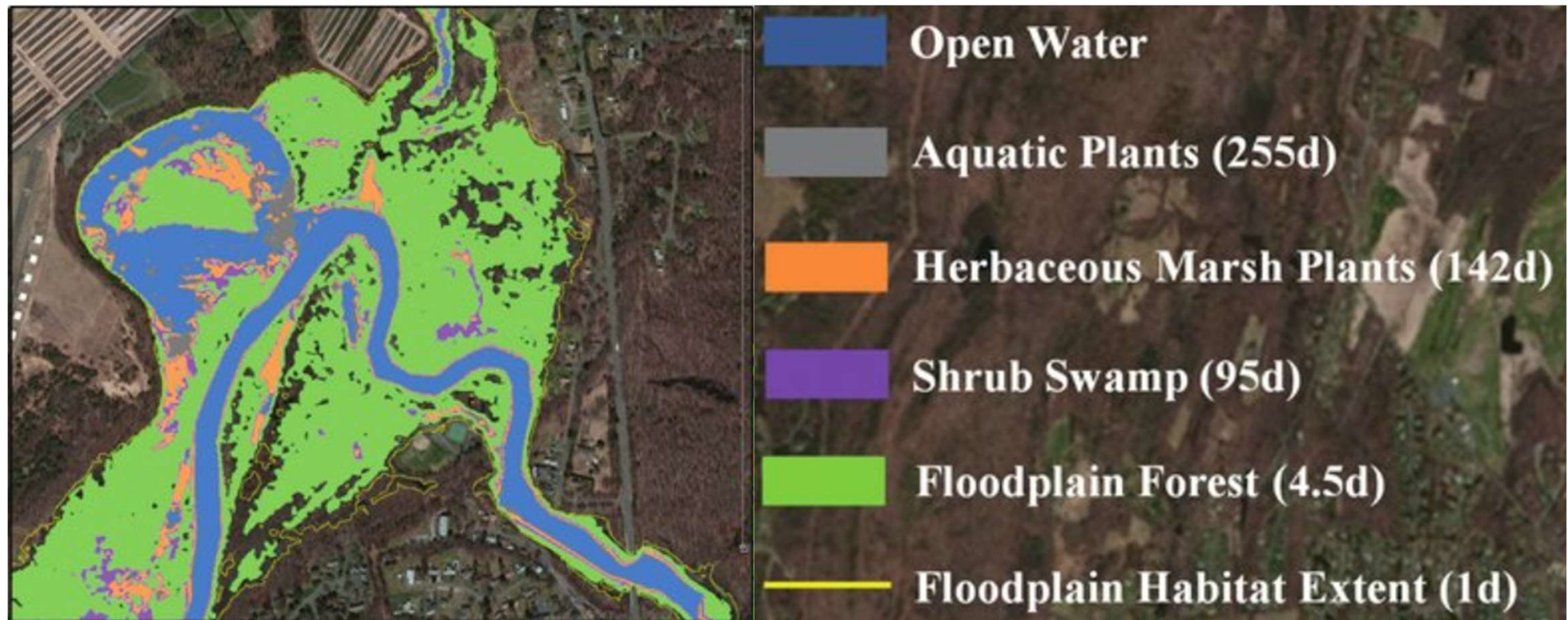


Populus fremontii



Populus seedlings

The structure and composition of floodplain and riparian plant communities often reflect the hydroperiod (or duration of flooding).

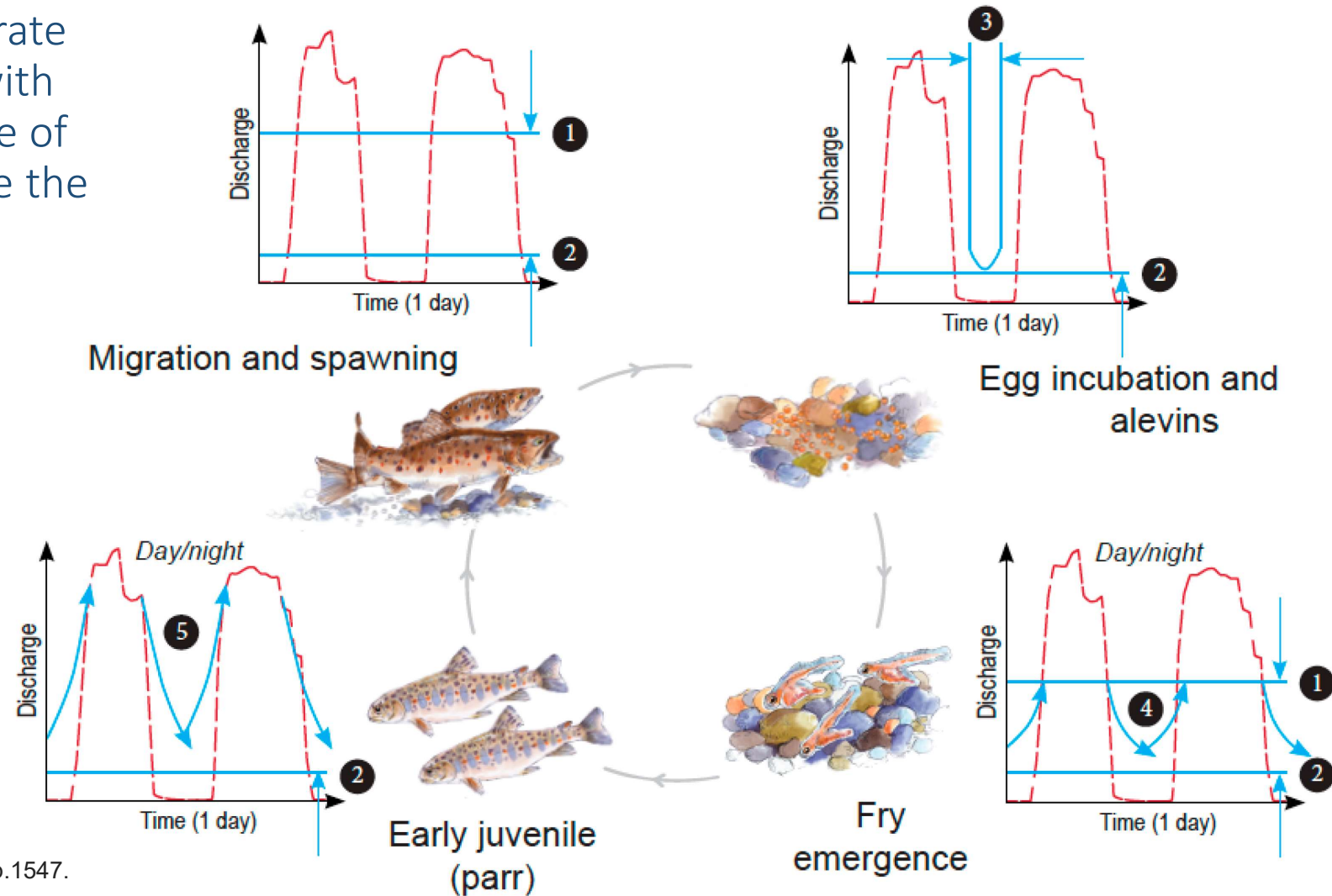


Julian, D.W. et al., 2015. Decision support system for water and environmental resources in the Connecticut River basin. *Journal of Water Resources Planning and Management*, 142(1), p.04015038.

Summary

- Riverine ecology and water quality are closely coupled to the river flow regime, described most simply by the magnitude, frequency, duration, timing, and rate of change of flow.
- Alteration of any of these components of a flow regime causes stress, inhibits natural processes, degrades ecological condition, and makes river organisms more vulnerable to other pressures such as contamination and invasion of exotic species. Multiple alterations compound the stresses and impacts.
- Today, we have sufficient knowledge of flow-ecological relationships to set reliable environmental flow levels.

Extreme alterations in rate of change associated with hydropeaking and some of the strategies to reduce the negative ecological consequences.



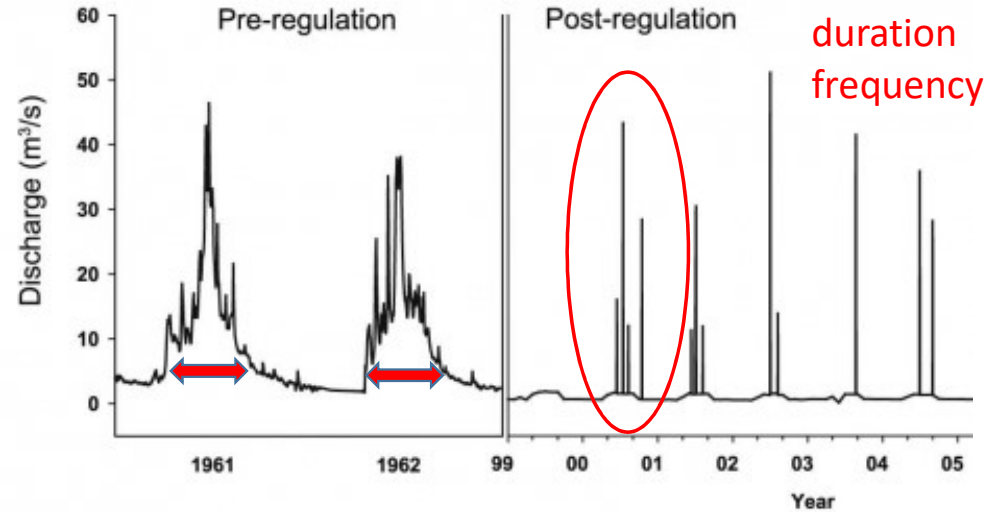
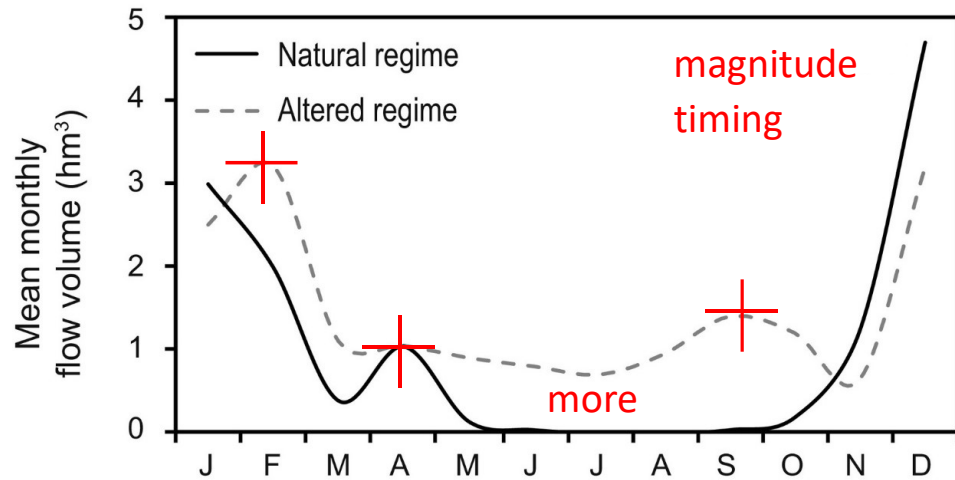
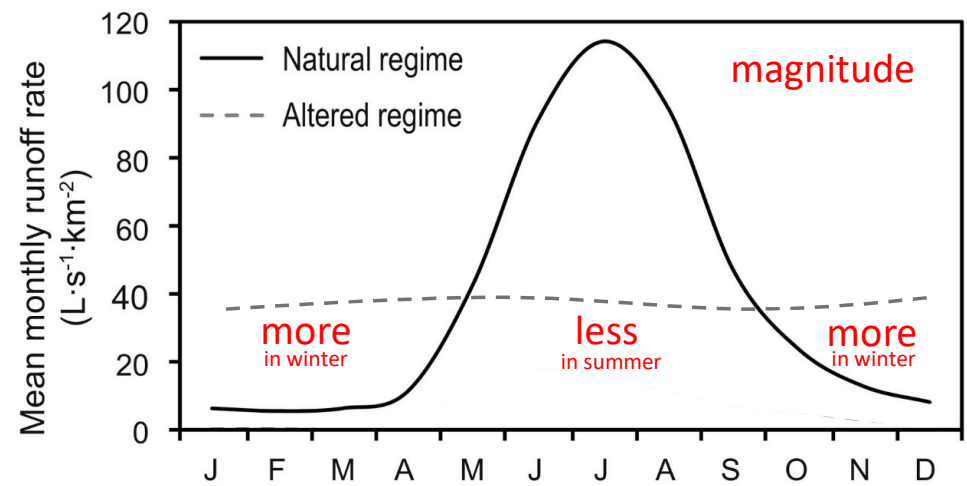
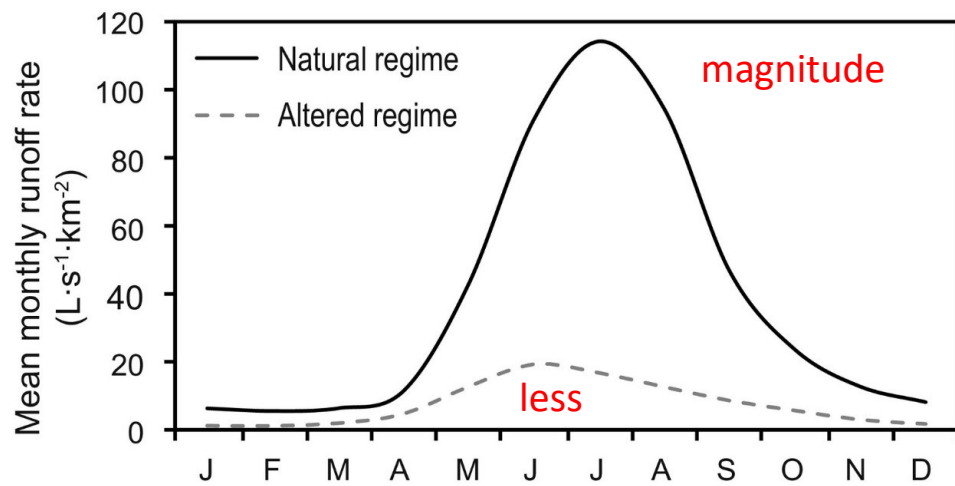
British Columbia

Hundreds of spawning salmon killed in Squamish river; BC Hydro admits responsibility

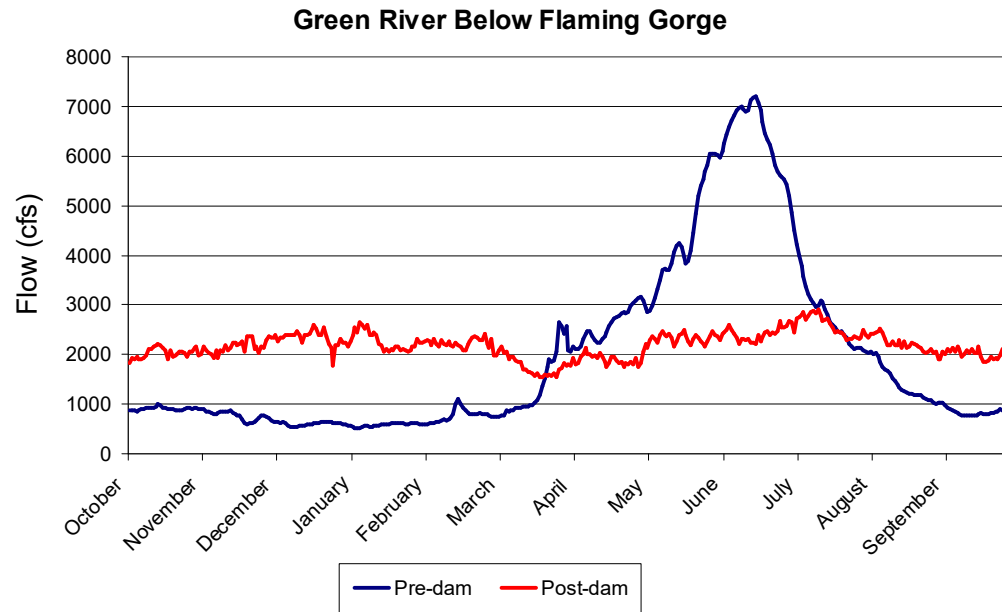
British

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Stranded pink salmon on the Cheakamus River, September 2019



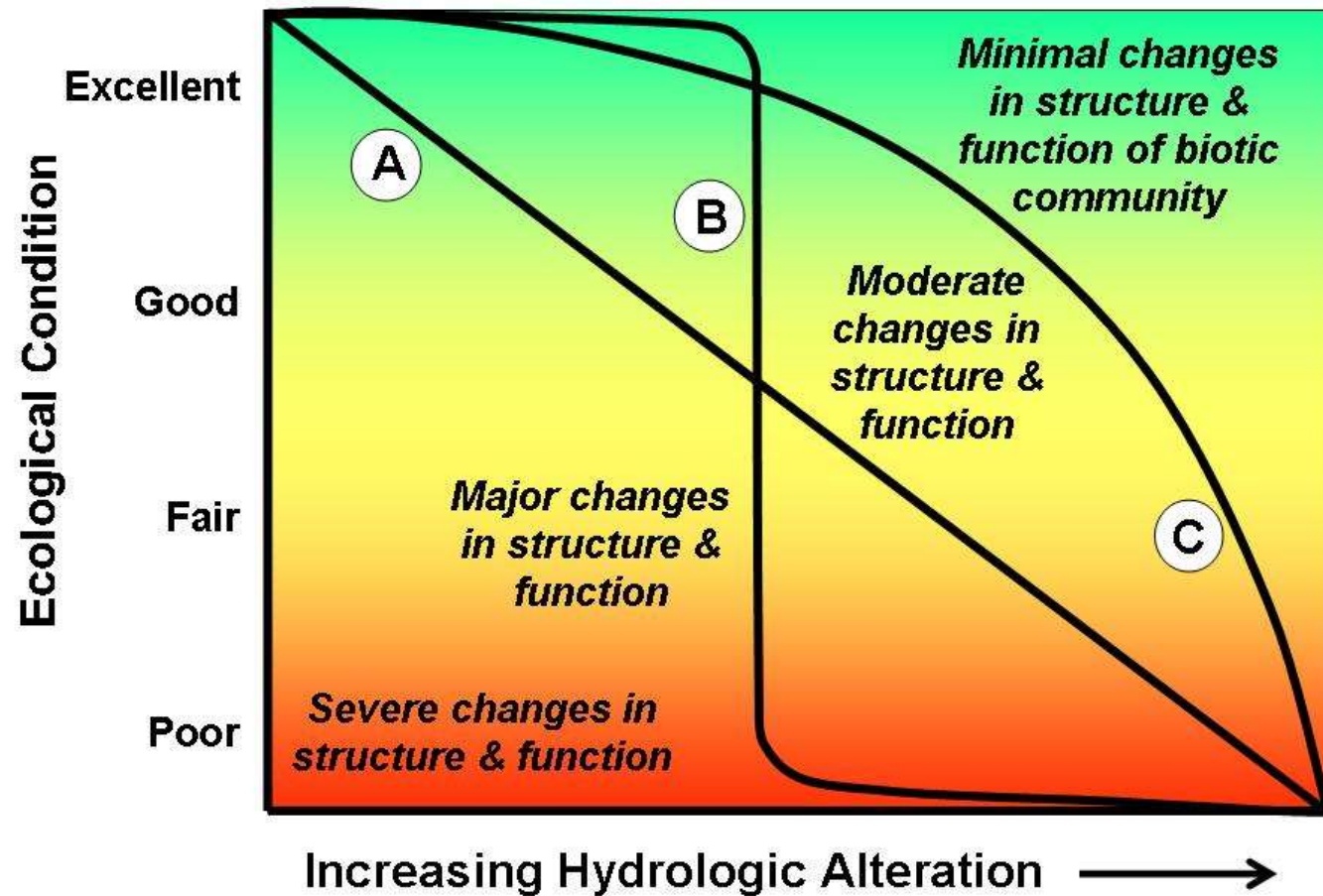
- 1) Hayes, D.S., et al. 2018. Advancing towards functional environmental flows for temperate floodplain rivers. *Science of the Total Environment*, 633, pp.1089-1104.
- 2) Mannes, S., et al. 2008. Ecological effects of a long-term flood program in a flow-regulated river. *Journal of Alpine Research*, (96-1), pp.125-134.



Gentle winter low flows provide the overwintering habitats needed by the pike minnow and allow fish to conserve energy when little food is available.

Flow Alteration - Ecological Response Relationships

Ecological Condition =
Ecosystem structure and
function.



Source: The Nature Conservancy