



Green Road to Kunming

Planning Environmentally Sustainable Infrastructure

WORKSHOP SERIES 2022 28 April / 19 May / 23 June / 21 July

SESSION

2

Greening the Energy Sector

19 May 2022 (Thursday) / 12:30 p.m., Philippines (GMT+8)



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Greening the Energy Sector

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River Links:

The benefits of functionally-based river basin assessments for ensuring sustainable hydropower

Alison Joubert, Cate Brown

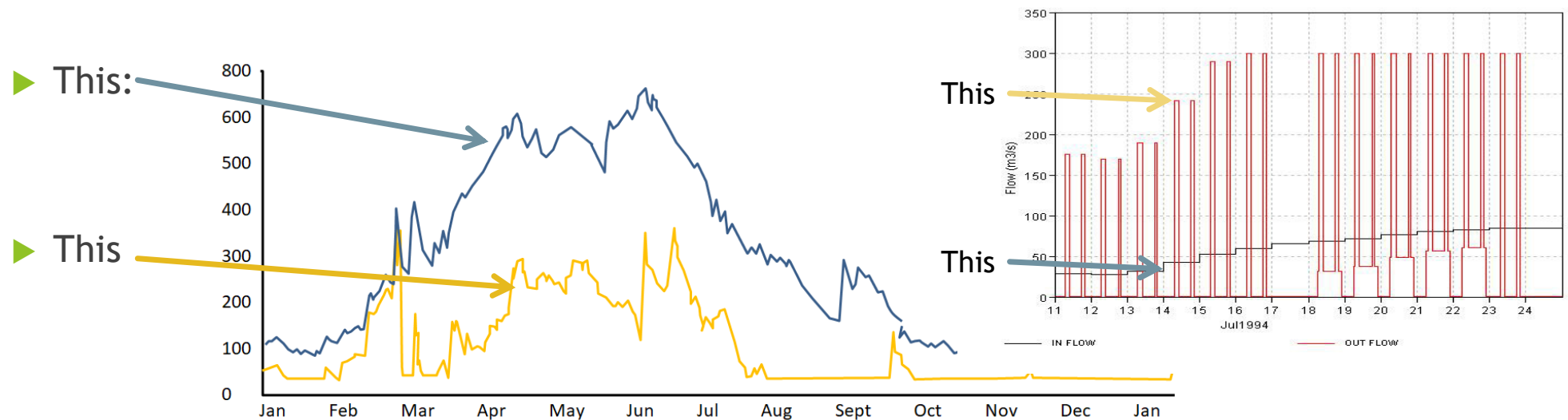


Main points

- ▶ Rivers obey the laws of physics
- ▶ Change flow and sediments - change the WHOLE system
- ▶ Biology adds complexity
- ▶ Sustainable hydropower means working with rivers
- ▶ Assessments at:
 - ▶ Basin level
 - ▶ Project level

Rivers obey the laws of PHYSICS

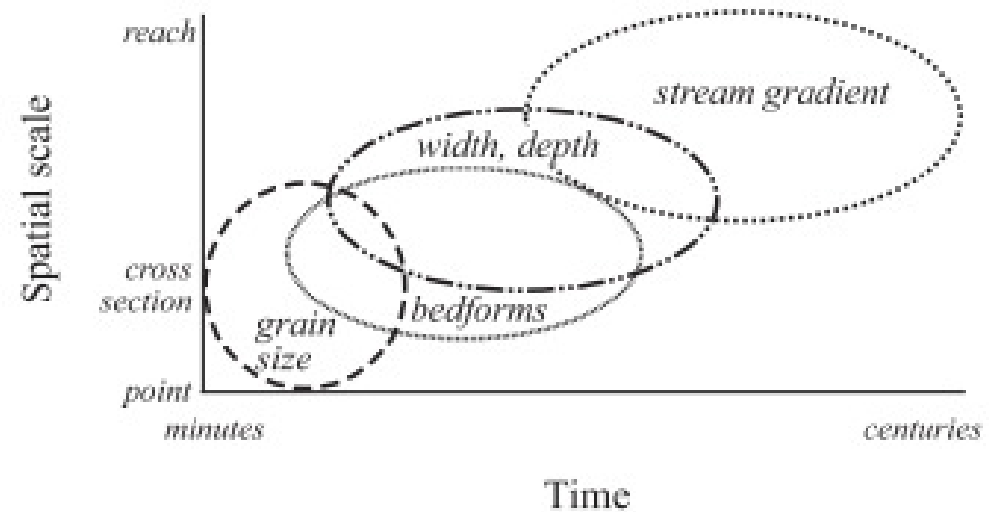
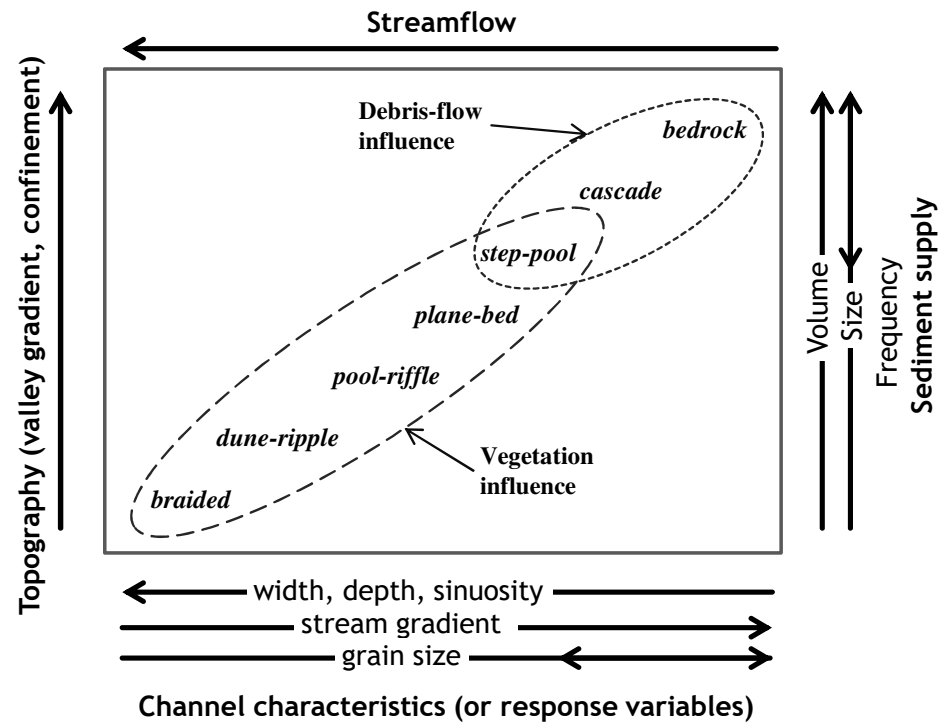
There is no way you can change a flow regime from:



And expect the river to be the same

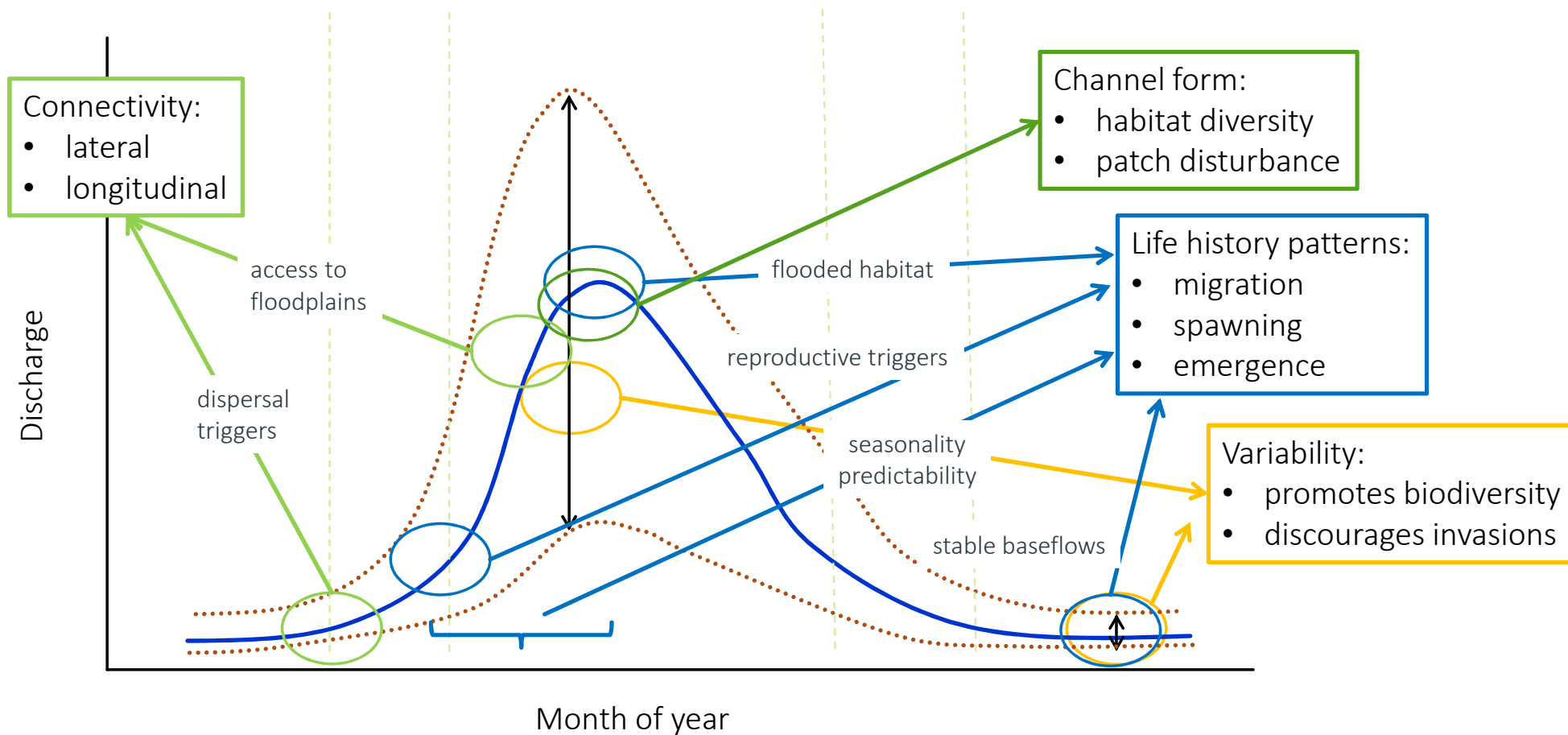
Particularly if this is sediment-free, “hungry” water

Change the flow and sediments - change the WHOLE system



Source: Buffington 2012, 2013

Biology adds complexity



Sustainable hydropower means working with river functions and functioning

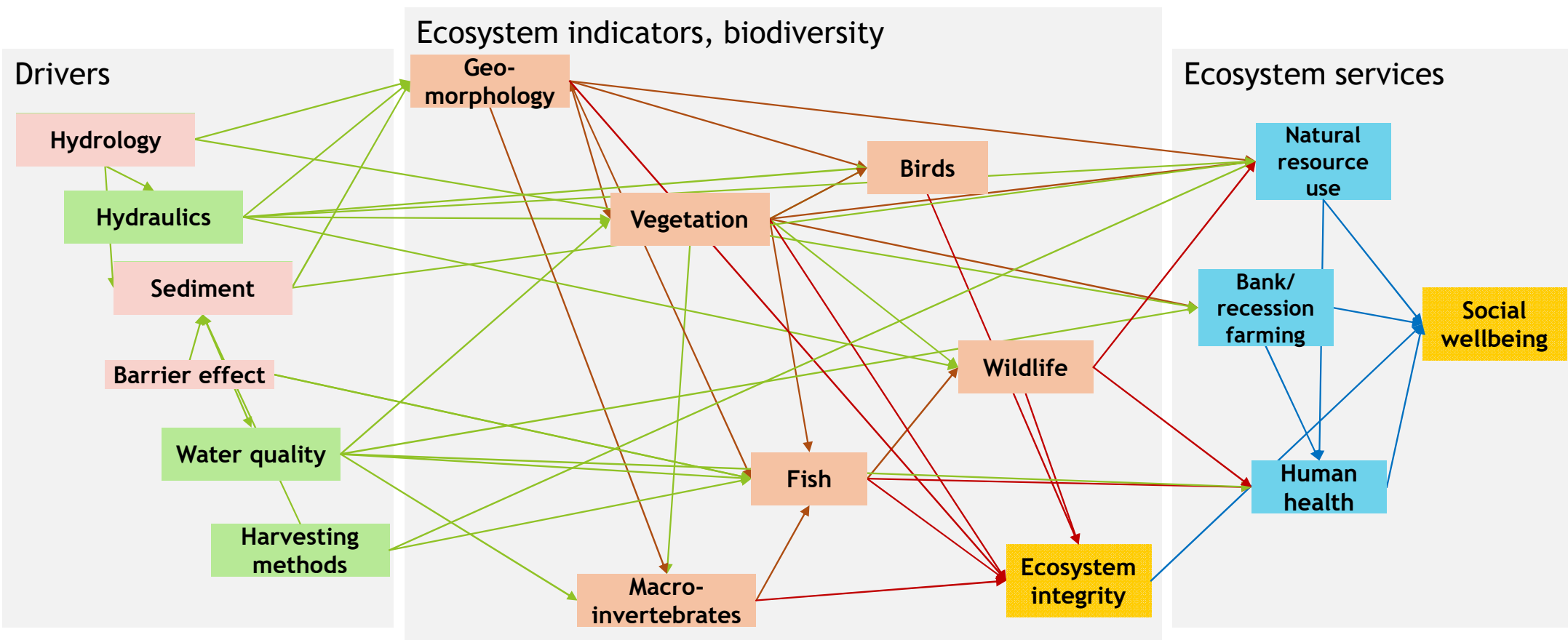
Basin-wide assessments of the cause and effect links in river systems, which integrate:

- ▶ Physical and chemical processes
- ▶ Biological processes
- ▶ Ecosystem services
- ▶ (Various approaches / methods. We use DRIFT)

Support planning for:

- ▶ Climate resilience
- ▶ Biodiversity conservation
- ▶ Human safety and livelihoods

River Links



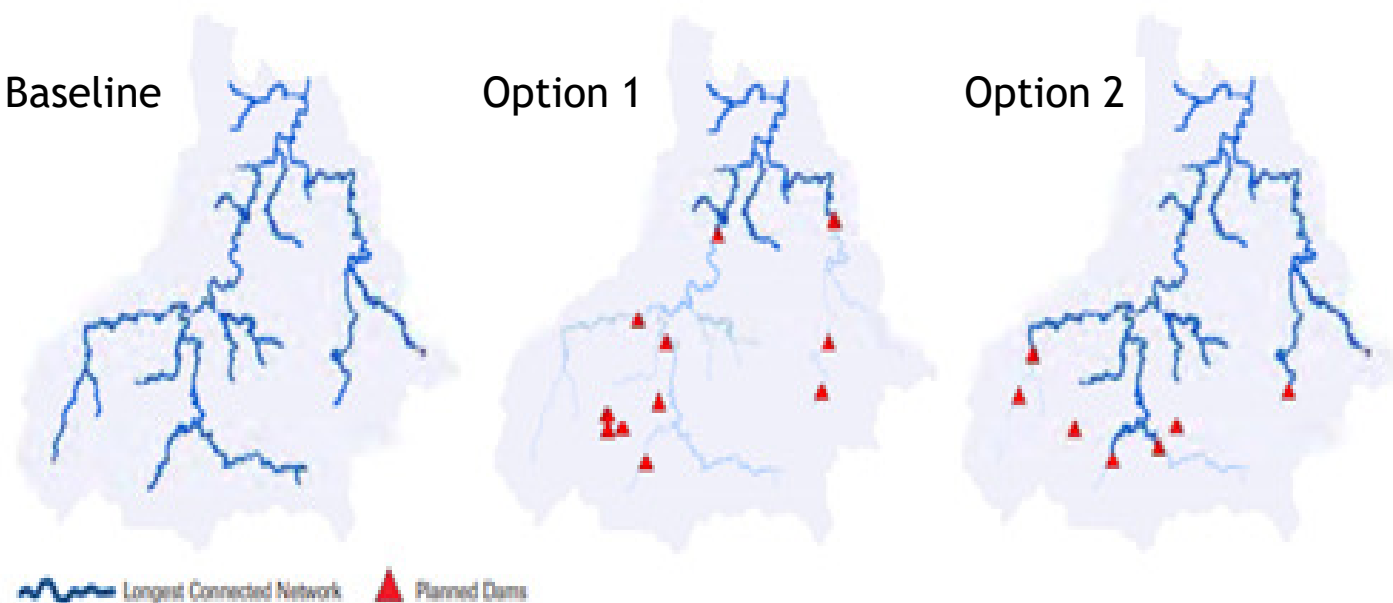
Basin level

Location, location, location

Use functional river links to identify and rank hydropower development options according to the potential severity of local and basin-wide impacts on ecosystems

Example: Coatzacoalcos Basin

- ▶ Options 1 and 2 may have the same energy yield
- ▶ Both impact flow regimes, but impacts lower for Option 2
- ▶ For sediment and biota:
 - ▶ Option 1 impacts ~75% of the basin
 - ▶ Option 2 impacts ~ 10% of the basin



Source: TNC 2015, Opperman 2016

Set the sustainable development space

- ▶ Stakeholders agree on the allowable alteration of a river system:

- ▶ so that a basin can retain natural processes
- ▶ species diversity and abundance
- ▶ vital ecosystem services
- ▶ associated cultural values
- ▶ while allowing for an agreed level of development

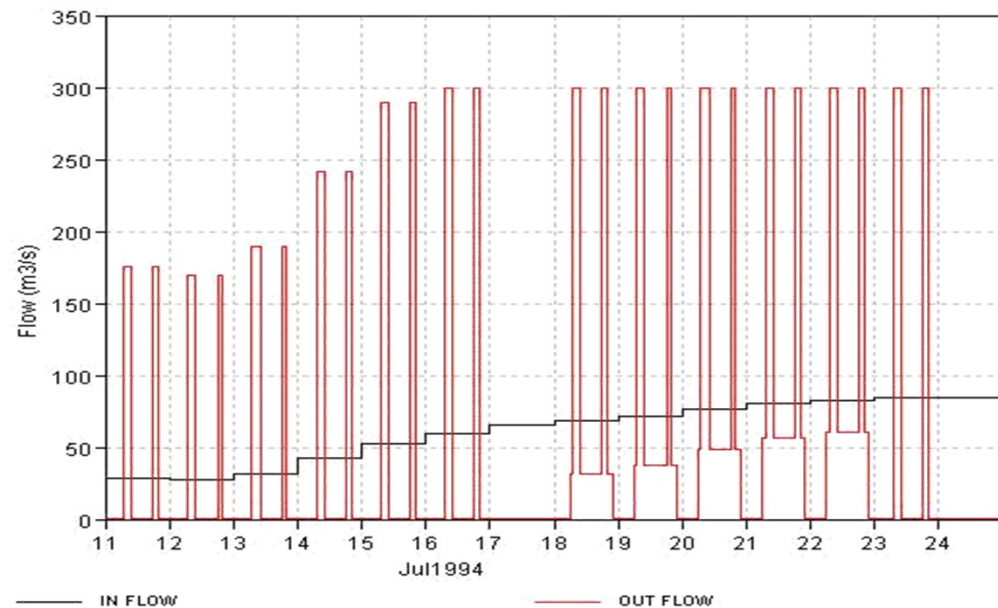
- ▶ Multiple projects magnify the impacts



Individual project level

Minimise impacts on the flow of water

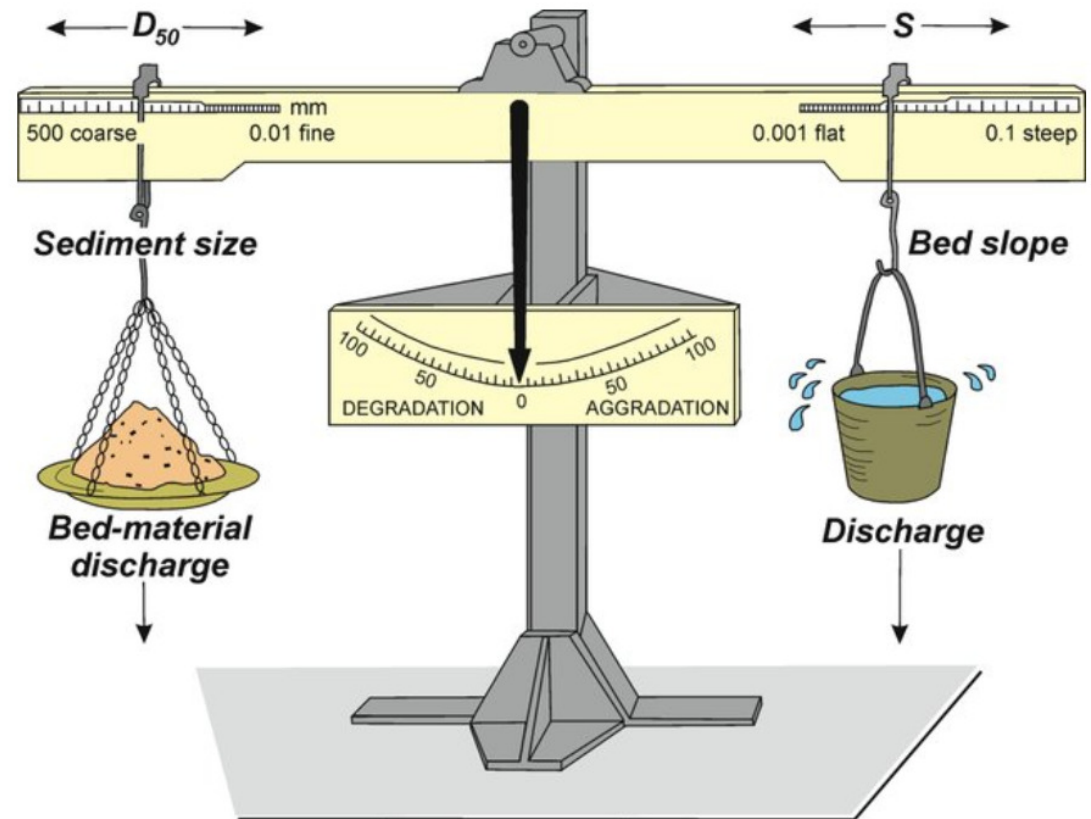
- ▶ Dewatered reach
 - ▶ Maintain seasonal flows (though reduced)
- ▶ Downstream of the tailrace
 - ▶ Maintain seasonal flows
 - ▶ Avoid releasing peaking flows directly into the river:
 - ▶ Baseload power generation
 - ▶ Re-regulation dam



Minimise impacts on the flow of sediment

Channel is stable if sediment load and size is in balance with water flow and river slope

- ▶ If sediment load decreases, bed will erode
- ▶ If sediment size decreases, bed will erode
- ▶ If flow increases, bed will erode
- ▶ Peaking flows - bank erosion / slumping



Minimise impacts on the “flow” of plants and animals

There are direct impacts on biota from changes to the flow and sediment regimes

Also: Many animals and plants move along rivers, e.g.: fish, eels, prawns, insect larvae, plant seeds/parts

Fish:

- ▶ Upstream migration - potentially solvable:
 - ▶ attraction design to enable fish to locate the entrance, which involves design of the powerhouse, spillway, abutments and training walls
 - ▶ fishway design and water flows (requires >10% of low flows and >1% of high flows) to attract and pass fish
- ▶ Downstream migration (adults migrating; larval drift):
 - ▶ reservoir length
 - ▶ water velocities in the reservoir
 - ▶ turbines, e.g., trash racks that guide fish safely to a downstream bypass
 - ▶ spillway design for safe downstream passage of fish.

Summary

- ▶ Rivers obey the laws of physics
- ▶ Change flow and sediments ... change the WHOLE system
- ▶ Biology adds complexity
- ▶ Sustainable hydropower means working with rivers
- ▶ Basin-wide assessments of cause and effect links in river systems, which integrate:
 - ▶ Physical and chemical processes
 - ▶ Biological processes
 - ▶ Ecosystem services

An aerial photograph showing a two-lane asphalt road with yellow double lines, bordered by metal guardrails, winding through a dense, lush green forest. The perspective is from above, looking down at the road as it curves through the trees.

THANK YOU!

ADB