

## Rivers as relatives or ancestors

All (Western, non-Indigenous) human uses oriented toward human use & benefits.  
 Few reciprocate, give back to the river.

<b>Western Society</b>	<b>Indigenous Cultures; relatives/ancestors</b>
Confine/imprison/channelize	Allow to migrate freely
Dam/block/destroy identity (river -> lake)	Allow to flow freely; be a river
Withdraw water/take w/out limit	Allow to flow
Treat as sewers/dump waste into	
Poison (dump toxic waste into)	
Denude/remove forest/clearcut	
Fence off / obstruct visitation by other relatives	Allow other relatives/wildlife to visit
(over)harvest fish; decrease/eliminate river beings	Harvest some fish; let most be

<b>Structure/Practice</b>	<b>Effect on Relative</b>	<b>Indigenous analog</b>
Dikes, Levees, concrete causeways	Imprison; restrict movement	Let river move
Dams	Drown, Block, strangle, destroy identity	Let river flow
Diversions, withdrawals w/out limit	Diminishes; =vampire	Limited, in agricultural groups
Treat as sewers/dump waste into	S**t on	
Point discharges & contam.runoff (dump toxic waste into)	poisoned	
Denude/remove forest/clearcut	starve, strip naked	
Fence off	isolate, deny visits by relatives	
(over)harvest fish	starve, deny visits by relatives	Harvest some fish; let most be
Develop basin (TIA)	Cook/overheat	
Splash dams/log drives	Brutally beaten	
LWD removal	Shrunken/limbs cut off	LWD restoration
Clear forest/bank & development (Impervious surfaces)	Brain damage (↓memory)	

Primary anthro. threats to streams & rivers (adapted from Allan & Castillo 2007. *Stream Ecology*, 2<sup>nd</sup> ed.)

	Proximate causes	Abiotic effects	Biotic effects
Habitat alteration	Damming, water diversions	↓ natural flow variability Altered habitat Sever up/downstream linkages	↓ dispersal & migration Δs in water quality Δs in spp composition
	Channelization	↓ habitat & substrate complexity Lower base flows	↓ biological diversity, favor tolerant species
	Land use changes: deforestation, intensive agriculture, urban development	Altered energy inputs ↑ delivery sediment & contaminants Flashy flows	Δs spp composition Δs trophic dynamics Facilitate spp invasions
Invasive species	Aquaculture Sports fishing Pet trade Ornamental plants	Invasive spp Δ habitats Few other effects	↓ native spp Biotic homogenization Ecosystem-level effects
Contaminants	Nutrient enrichment: ag., sewage treatment Atmospheric deposition	↑ [N], [P] Δ nutrient ratios	↑ productivity, algal blooms, Δ spp composition
	Acidification (SO <sub>2</sub> , NO <sub>x</sub> )	↓ pH, ↑ [Al <sup>+</sup> ]	Physiological & food chain effects
	Toxic metals: mining, industrial emissions, waste disposal	↑ [trace metals] (e.g., Hg,Cu,Zn,Pb,Cd)	Toxic effects: biomagnification
	Organic toxins	↑ [PCB], endocrine disruptors, pesticides	Physiol. & toxic effects
Overexploitation	Commercial harvest: food, pet trade, recreational fisheries	Usually none	Δ spp composition Δ trophic dynamics Facilitate invasions
Climate change	Temperature changes	Milder winters Δ evapotransp. & flows	Range shifts: physiol. tolerances Increased productivity
	Precipitation changes	Δ flow regimes Greater flashiness	Disturbance impacts