Elwha River
Dam Removal: Before and After

Emily Cavaliere
PhD Candidate
University of Saskatchewan
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Dams and Dam Removal

* The US: 2000 dams – high risk or needing repair in 2015
  * By 2020 - 50% of US dams will be 50 years old
* Canada: 933 large dams – many thousands more smaller dams
* Dams have a limited lifetime...
  * Risks...

Source: Canadian Dam Association's register of dams (2003)

https://www.ec.gc.ca/eau-water/default.asp?lang=En&n=9D404A01-1&wbdisable=true#intorduction
Dams

Figure 1 — Typical Reservoir Sediment Profile*

Typically, sedimentation in the reservoir behind a dam takes the form of progressively finer materials being deposited as the flows approach the dam.


Elwha River
Glines Canyon Dam
Elwha Dam
Elwha River

- Olympic Peninsula, WA
- Flows North to Strait of Juan de Fuca
- In Olympic National Park

Elwha River

- Supported salmon populations
- Two dams built in the early part of the 1900s
- 2 dams were removed
  - Aging structure (sediments)
  - Fish Habitat
  - Lower Elwha Klallam Tribe
Fish in front of the dams

Dams on the Elwha River

Sediments behind the dams

Removal and Restoration

* In 1992, Congress passed the Elwha River Ecosystem and Fisheries Restoration Act
* $325 million USD
Collaboration in the Elwha

* Lower Elwha Klallam tribe
* US National Parks Service
  * Olympic National Park
* US Department of Interior
* Working together to restore and understand fish returns to the Elwha
Elwha Sediment

* 30 megatons of sediment
* Why do we care?
* What happens to the sediments after the dams are removed?
Elwha Sediment & Bank Stabilization

- Predict sediment deposited in the river or on the flood plain
- Stabilization – hold sediment & maintain good salmon breeding habitat
- Plants – need nutrients for growth
  - Sediment nutrients
Nitrogen and phosphorus limited
* Low concentrations – likely hard for plants to colonize
* Large P binding, 99.99% P bound
  * Ferric oxyhydroxide and calcium
P Availability: Sorption
Different Processes

a. Before Dam Removal

- Upriver
- Reservoir
- Downriver

- Water column
- SRP
- Formation & deposition of particulate P
- Release of interstitial SRP
- Sediments
- Formation of interstitial SRP

b. After Dam Removal

- Upriver
- Dewatered Reservoir
- Downriver

- Water column
- SRP
- Release from particulate P
- Mixing release of interstitial SRP
- Resuspended sediments
Post-Dam Removal
Dam Removal

Sediments

Sediment Fate

- Unpredictable sediment pulses, despite deconstruction techniques to control release...
  - Large quantities (>86%) moved in second year following removal – larger than average discharge
  - A fraction deposited in the river
  - Of the 30 mega tonne of sediment, 65% was eroded
  - Increased delta by 60 ha

- Ritchie et al. 2018; Magirl et al. 2014
Sediment

Plant Community
Nutrient Limitations

* Remaining reservoir sediments
* Plant growth
* Mycorrhizal inoculation
  * Difficult further away from established plant communities
* Cortese & Bunn 2017

https://www.mdpi.com/2073-4395/7/4/75
Biological Implications on the Elwha Delta

* Community shift – estuary from brine to freshwater
* Pioneering vegetation increased on new habitats
* Concurrent increases in N and P during removal (estuary)

* Foley et al. 2017
Salmon in the Elwha

- Mainstem of river – little impact of sediment movement (floodplain)
- Landlocked species return to sea (bull trout)
- Likely some impact on salmon species – sediment reduced return to Elwha
- As of 2018, counts indicate near 20-yr average
- Some indication that some salmon species are inhabiting newly open areas

Daily News 2017; Northwest Treaty Tribes 218; Quinn et al. 2017; Peters et al. 2017

Lessons for Saskatchewan

- High costs - $325 million USD for Elwha removal (not necessarily restoration)
- Unpredictable sediment release
- Targeted restoration likely required
  - Sediment stabilization
  - Species at risk
- Sediment toxicity?
- Restoration to what...
- Collaboration!
References

- https://www.mdpi.com/2073-4395/7/4/75
- https://www.nps.gov/olym/learn/photosmultimedia/photogallery.htm