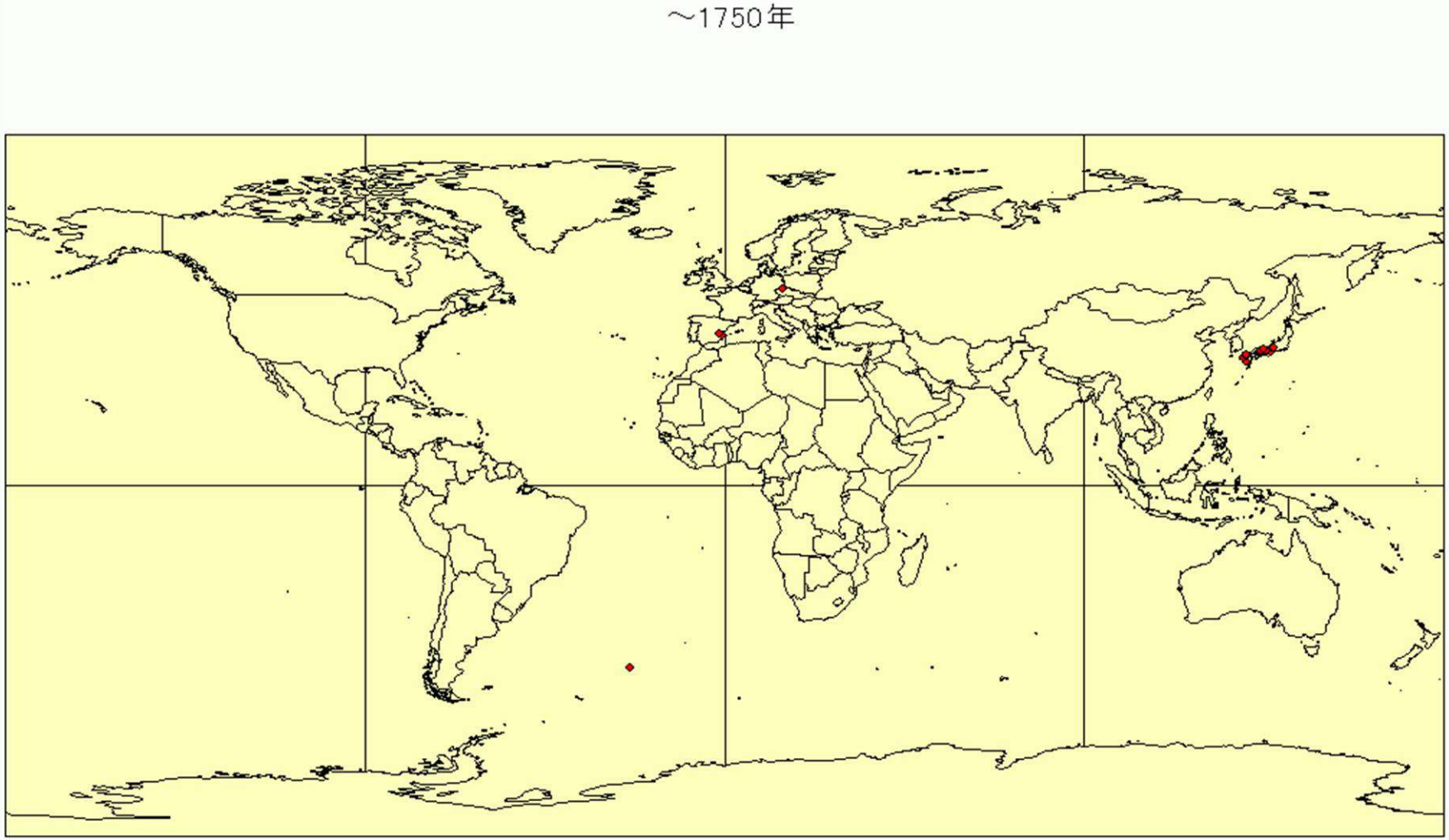
Lessons learned about the physical and aquatic response of rivers to dam removal, USA

Marmot Dam, Sandy River, Oregon USA (1913 – 2007)

Gordon Grant
PNW Research Station
USDA Forest Service
Corvallis, Oregon

John Wesley Powell Center
for Analysis and Synthesis
Working Group on
Dam Removal

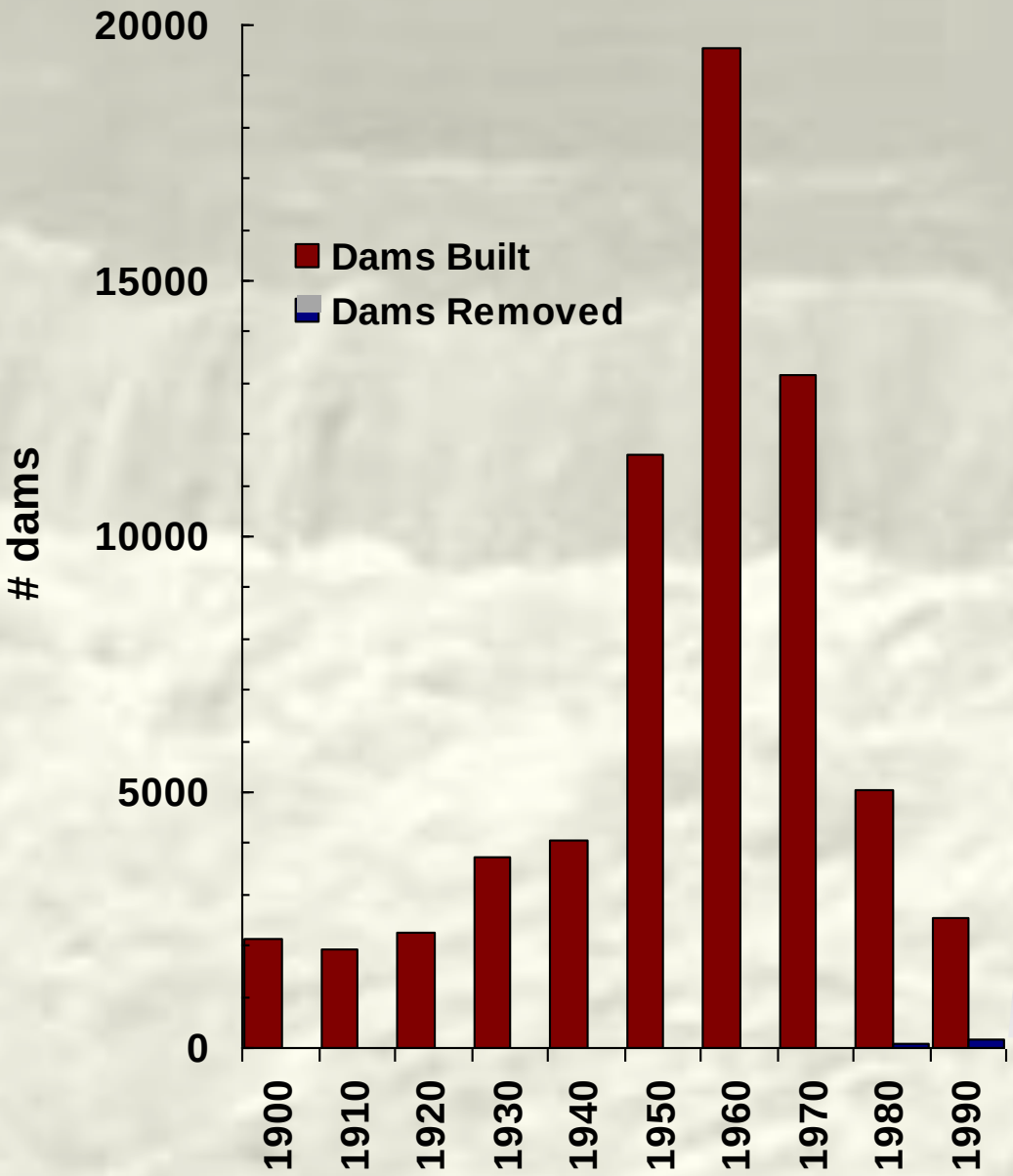


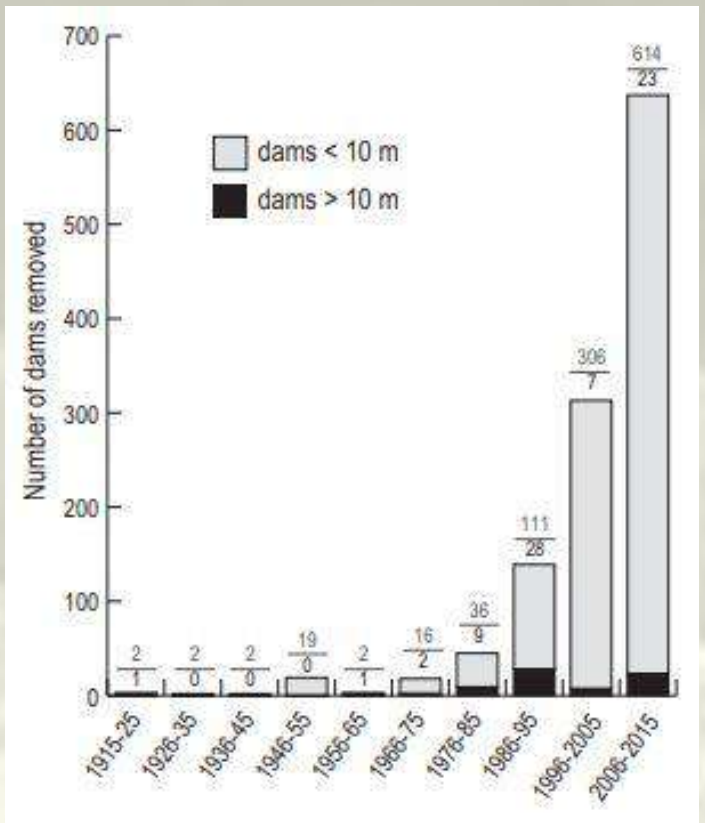
animation and compilation courtesy of:
Hiroshi Ishidaira
Yamanashi University

World Commission on Dams
13,382 dams in 2000

U.S. Dams Built and Removed

1915-2015





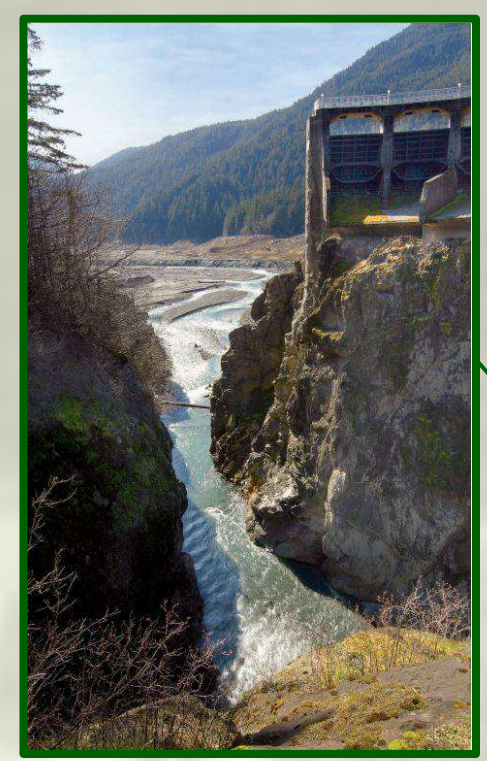
American Rivers (2016)
National Inventory of Dams (2000)

Why dam removal?

- Aging dams/dam safety
- Threatened and endangered species
- “Natural flow regime” paradigm
- River restoration
- Policy windows (i.e., FERC relicensing)
- Deregulation of energy industry
- Symbolic value

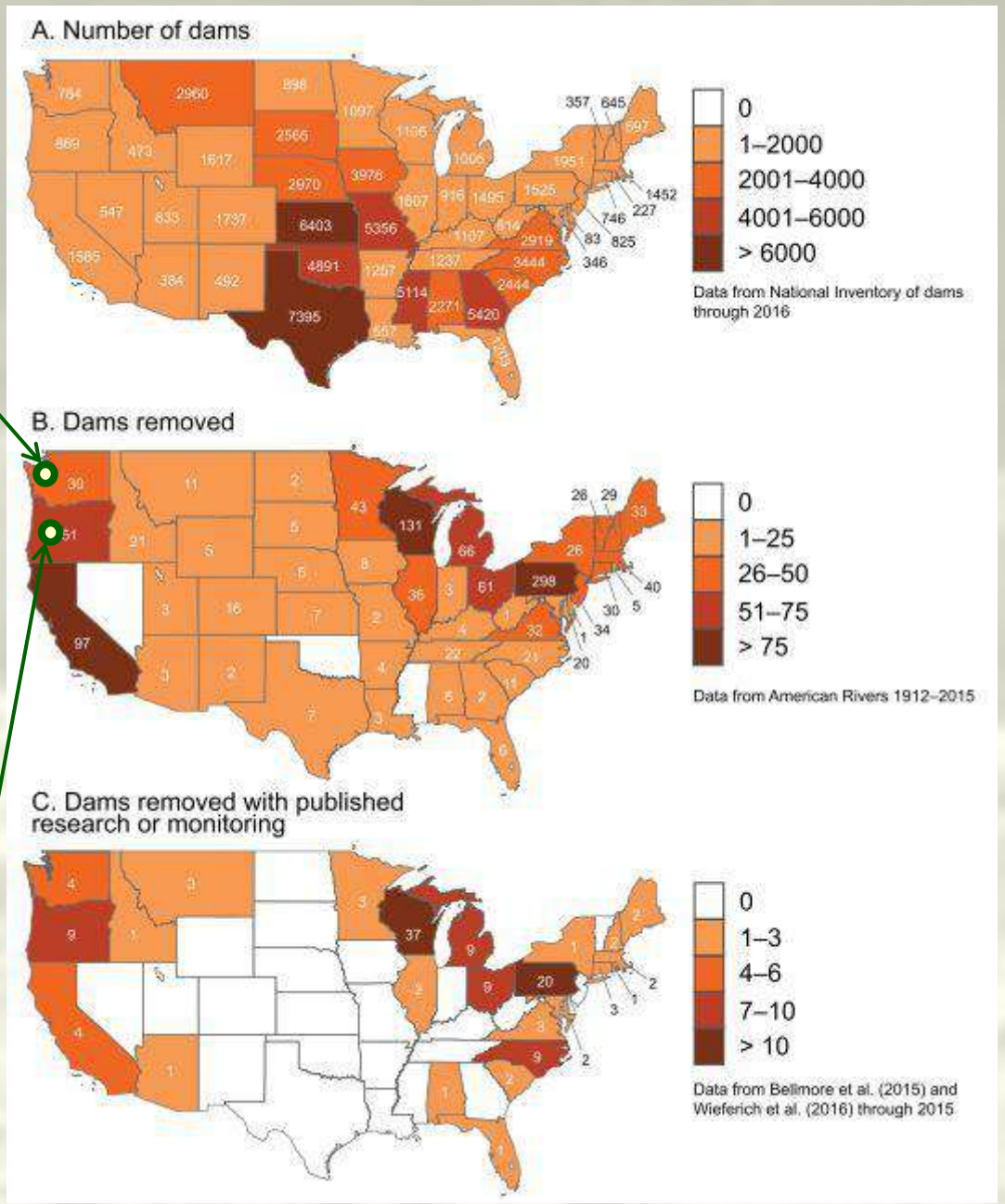
In 1981, Earth First! unfurls a 300ft plastic “crack” along the front of Glen Canyon Dam.

Bruce Babbitt takes a sledgehammer to Quaker Neck Dam in North Carolina, as U.S. Secretary of the Interior in 1997



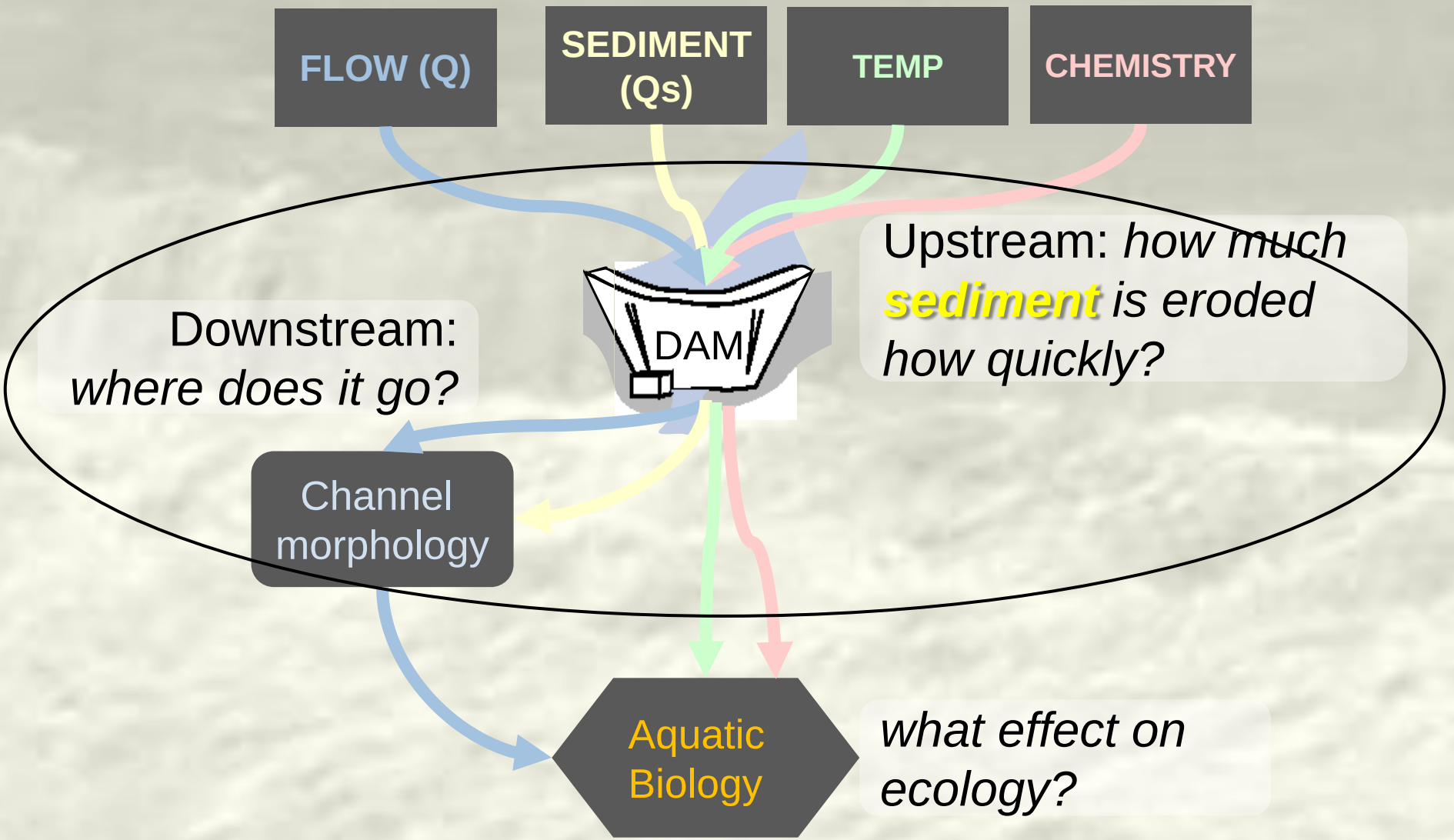
Elwha Dam, Elwha River, WA

Brownsville Dam, Calapooia River, OR



Foley et al. 2017

Key questions for dam removal



Geomorphic lessons learned

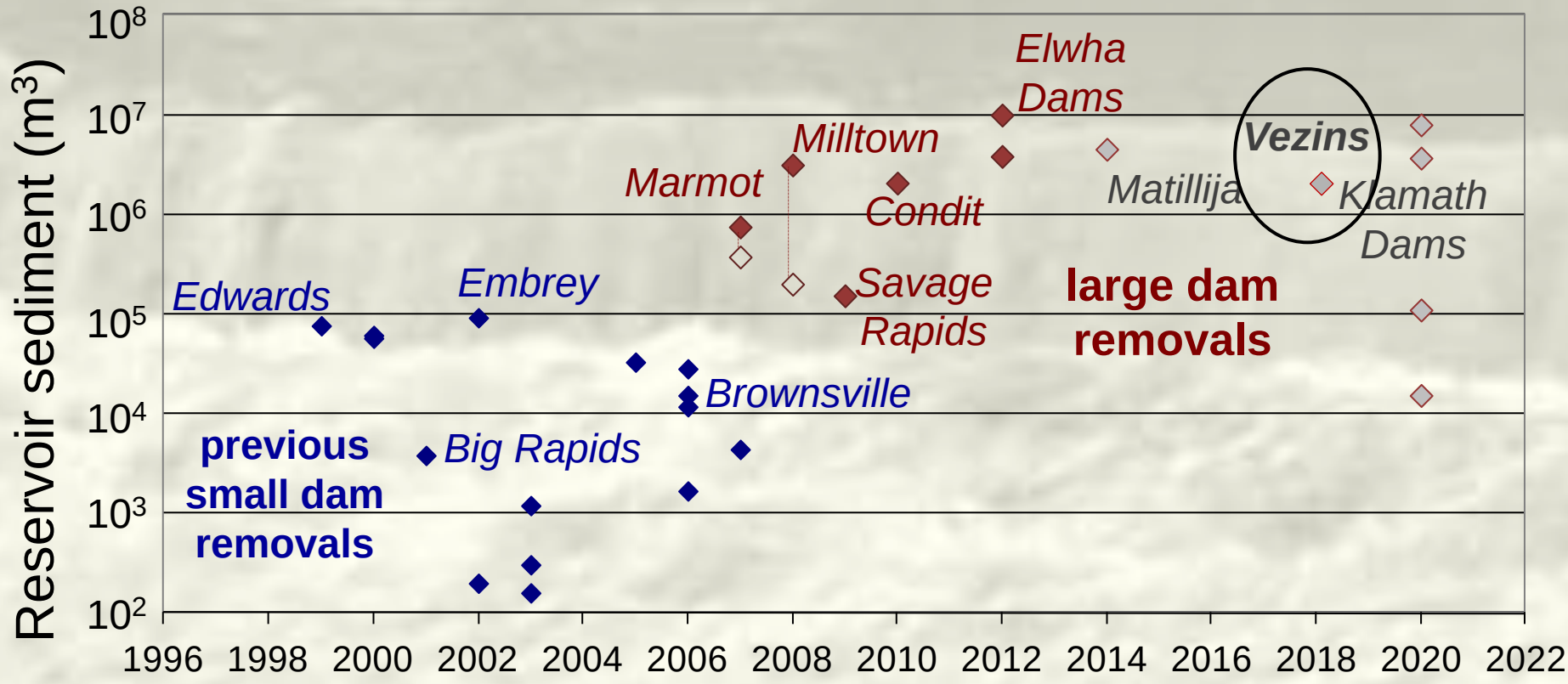
- Response to removal of large versus small dams is different

Large dams ≠ Small dams

- >15 meters high
- >$10^5 m^3$ sediment volume
- Reservoirs usually **partially filled** with sediment
- Progressive/staged dam removal

- <15 meters high
- <$10^5 m^3$ sediment volume
- Reservoirs often **filled** with sediment
- Typically “blow & go” dam removal

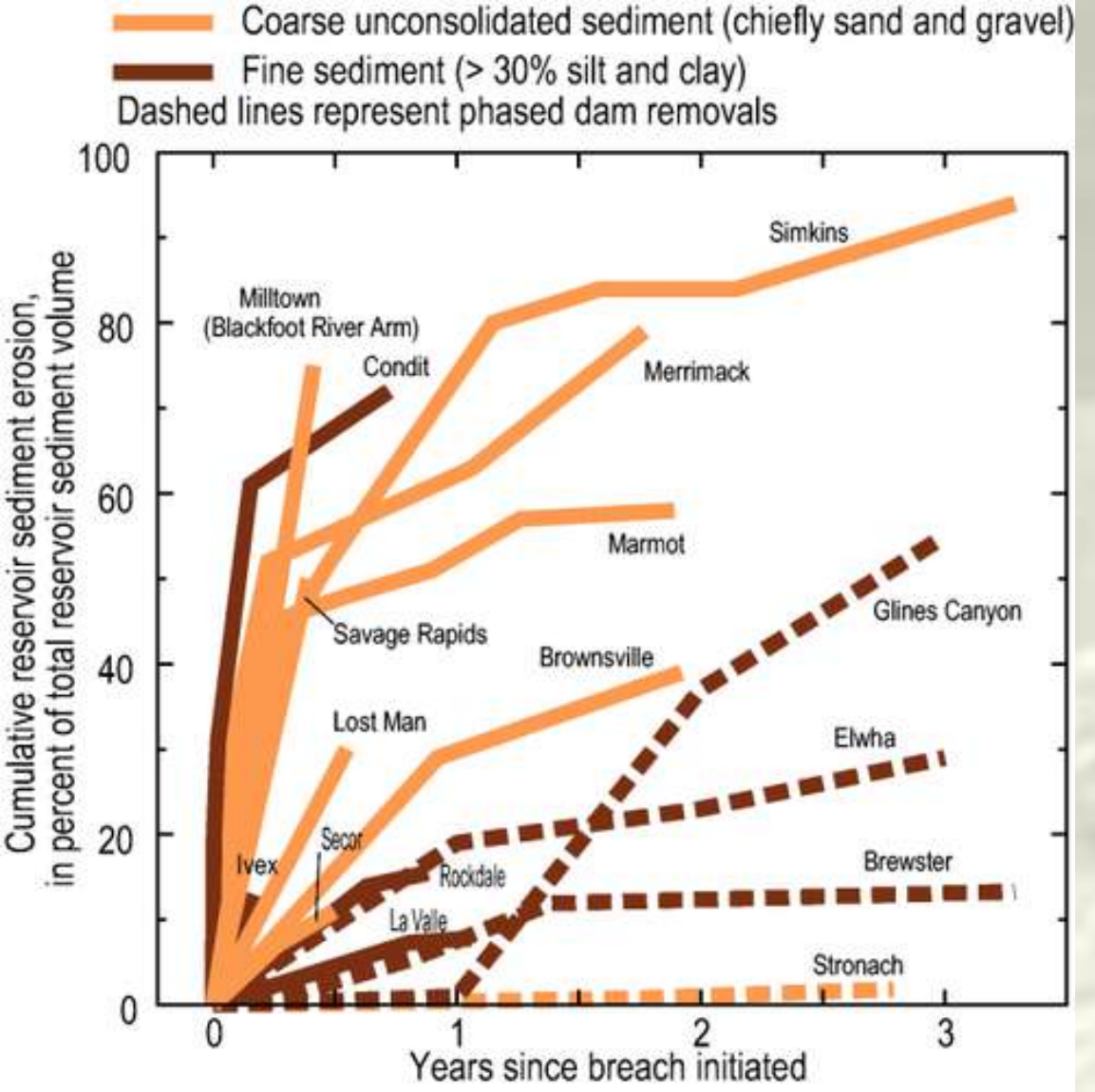
Sediment released by dam removals



Grant & Lewis, 2015

Geomorphic lessons learned

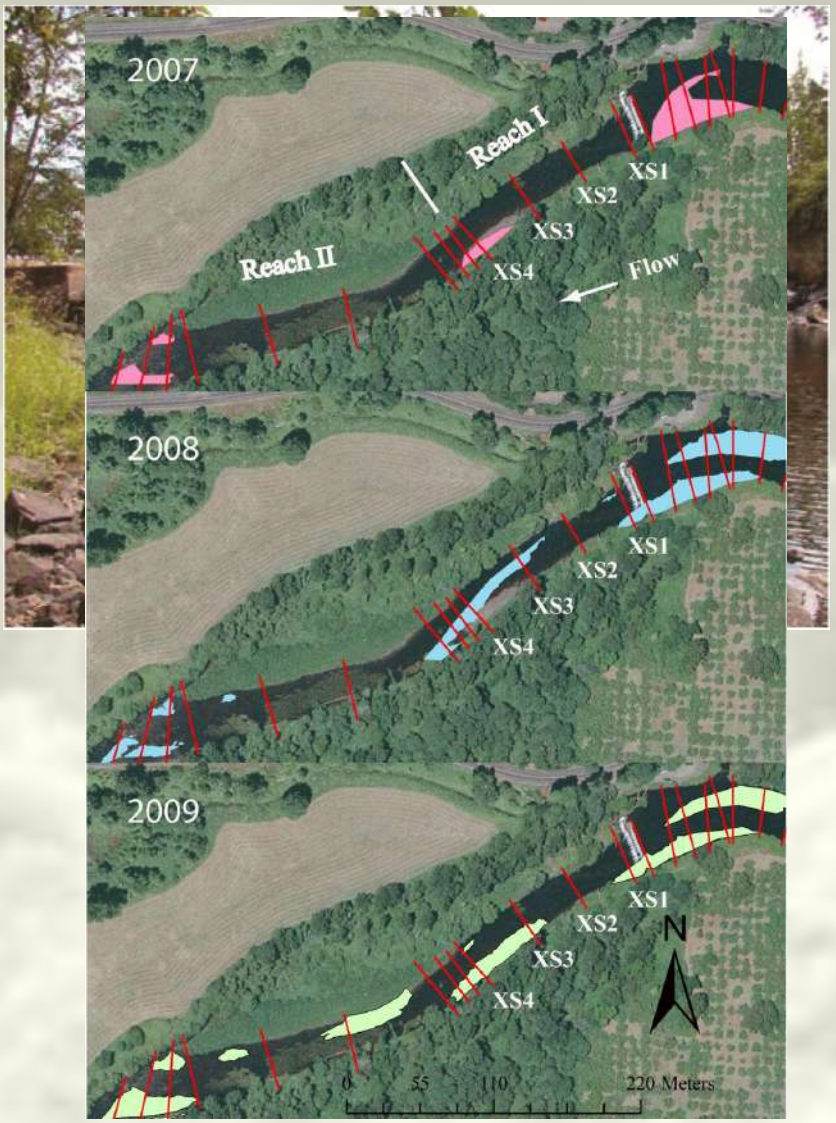
- Response to removal of large versus small dams is different
- Rate of sediment transport from reservoir is a function of grain size, volume of sediment, and how dam was removed



Water Resources Research, Volume: 53, Issue: 7, Pages: 5229-5246, First published: 10 July 2017, DOI: (10.1002/2017WR020457)

Geomorphic lessons learned

- Response to removal of large versus small dams is different
- Rate of sediment transport from reservoir is a function of grain size, volume of sediment, and how dam was removed
- Downstream effect on channel form scales with volume and rate of sediment release, channel energy



Sediment Deposition below Brownsville Reservoir

(*Zunka*, 2012)

Marmot Dam

Geomorphic lessons learned

- Response to removal of large versus small dams is different
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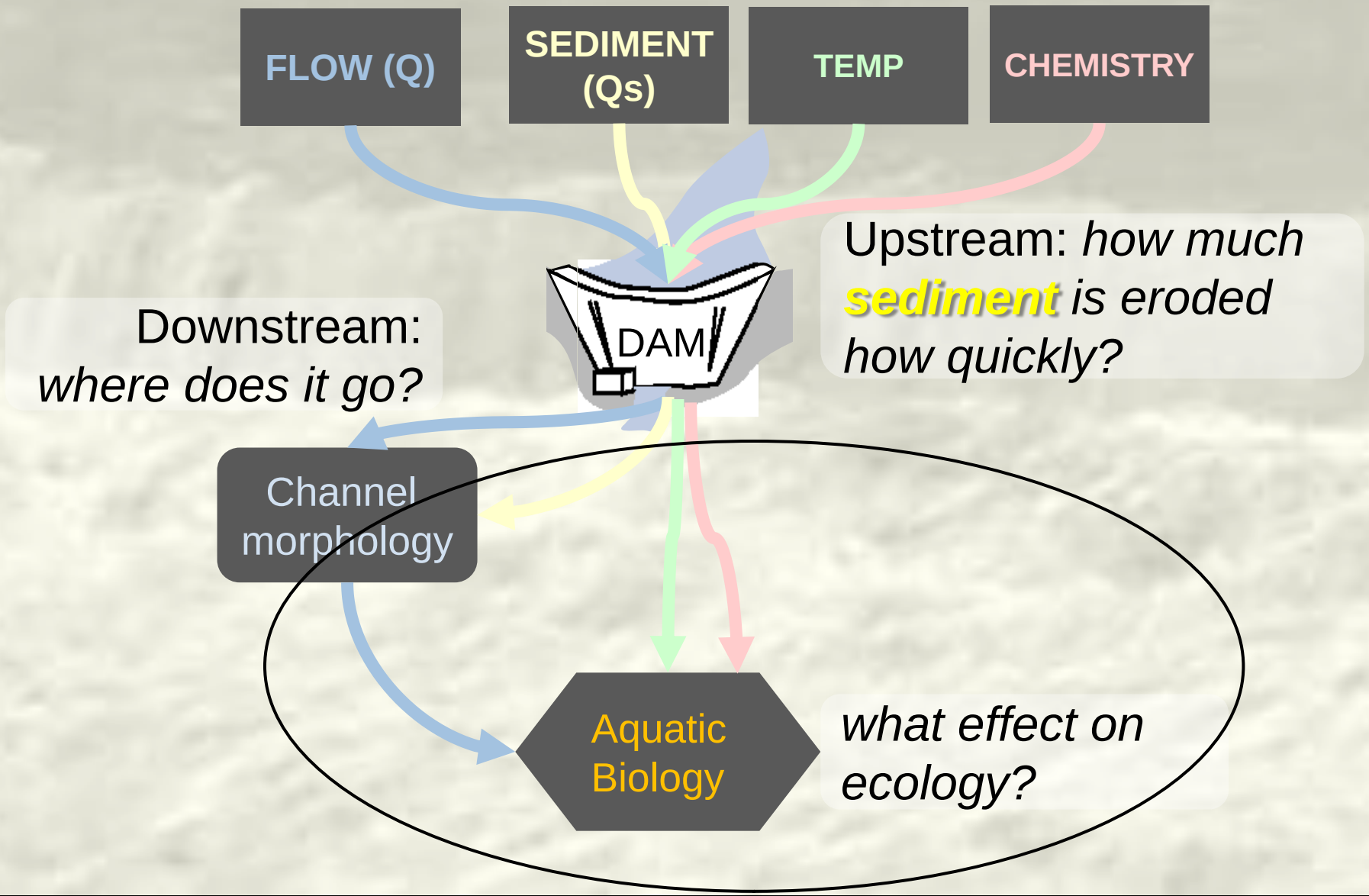
∴ Removal of small dams with limited storage has minimal physical effects on downstream rivers

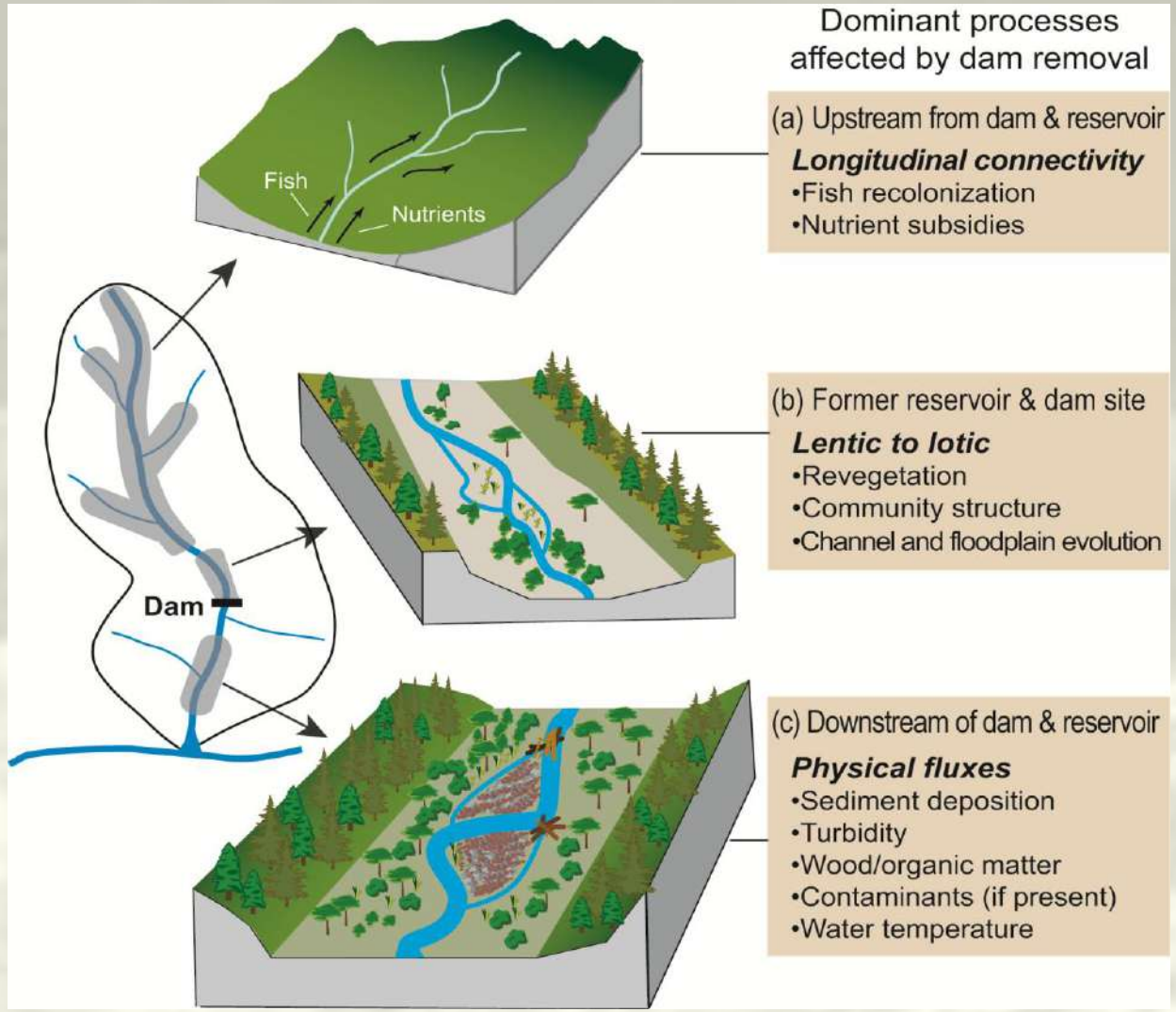
Key questions for dam removal



Ecological lessons learned

- Response varies by stream reach relative to former dam and reservoir

Stream reaches influenced by dam removal



BioScience, Volume 69, Issue 1, January 2019, Pages 26–39, https://doi.org/10.1093/biosci/biy152

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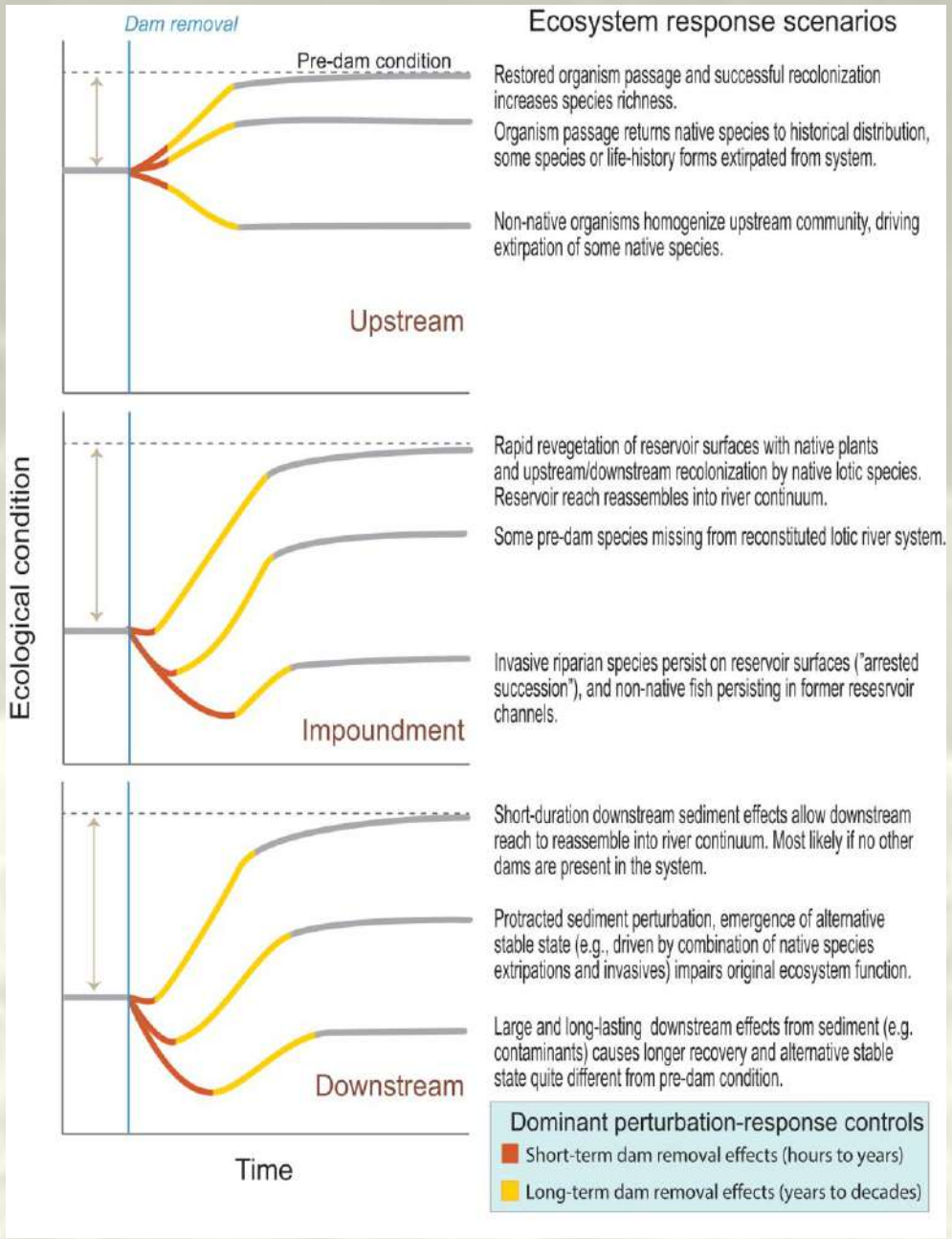
Ecological lessons learned

- Response varies by stream reach relative to former dam and reservoir
- Reaches undergo different trajectories following dam removal

Ecological response trajectories following dam removal



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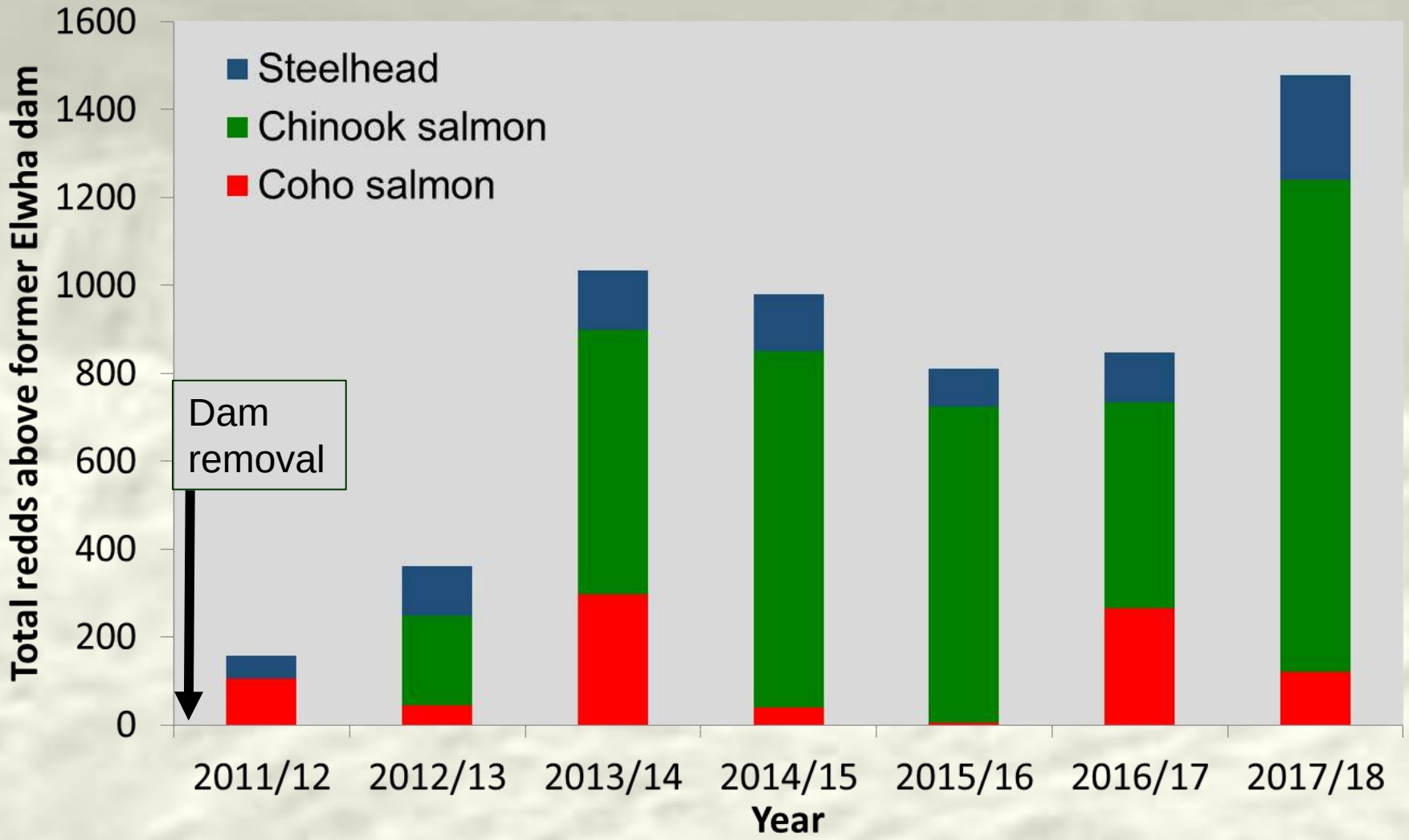
Ecological lessons learned

- Response varies by stream reach relative to former dam and reservoir
- Reaches undergo different trajectories following dam removal
- In general, fish and other organisms respond rapidly to removal

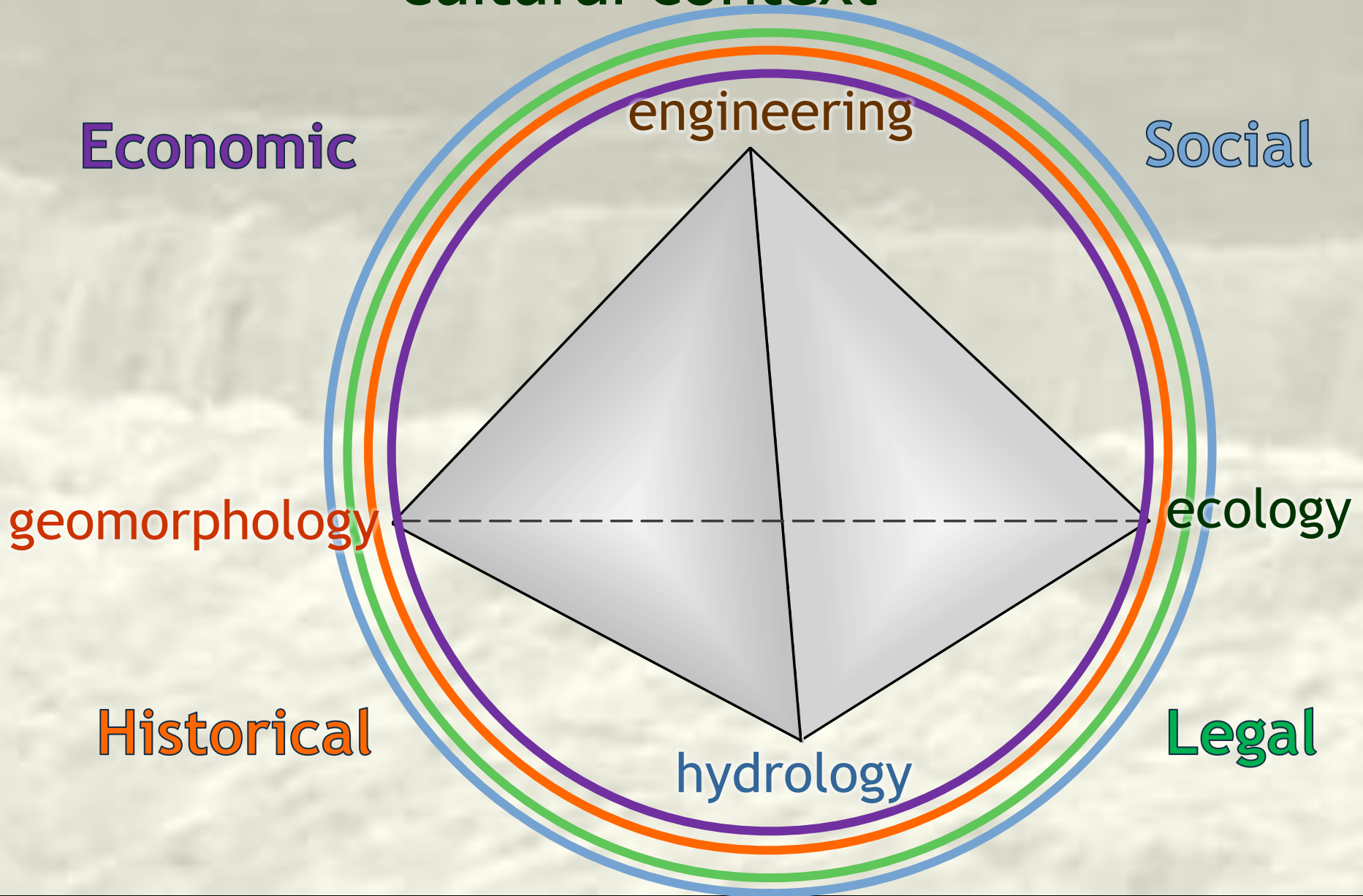
Salmon recolonization above former Elwha dams

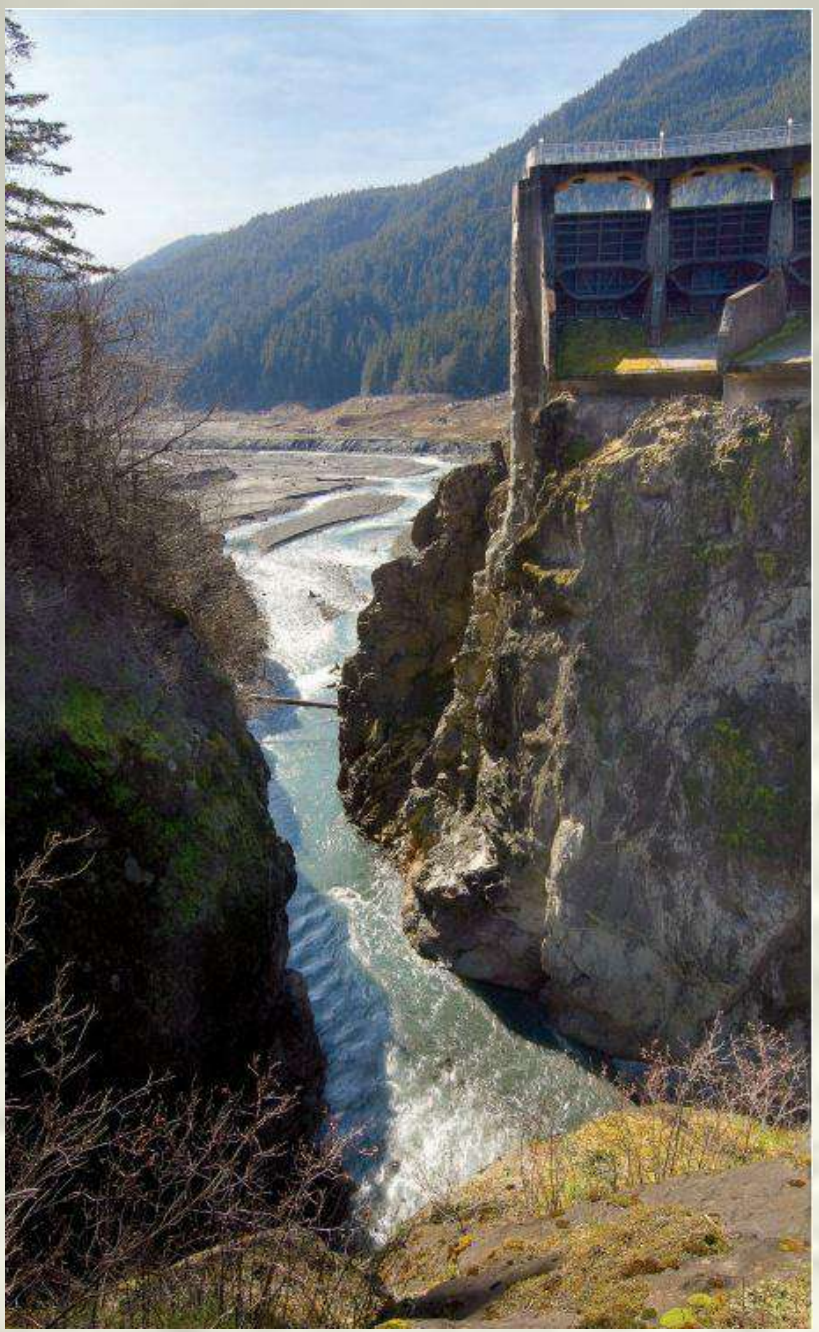


Some other lessons…

- Ask good questions that address both local issues and broader understanding.
- Build science around a few key removals. Focus on the ones most likely to answer critical questions.
- Build strong partnerships with scientists, NGOs, citizens, and governments.

Dam removal science occurs within a cultural context





For more information and lists of publications please visit:

Watershed Processes Group
http://wpg.forestry.oregonstate.edu/

John Wesley Powell Center for Analysis and Synthesis
https://www.usgs.gov/centers/powell-ctr