Dam removal: Restoring riverine habitat and ecological function in the Mid-Atlantic

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American Rivers

Rivers Connect Us®

National Inventory of Dams

78,747 Dams

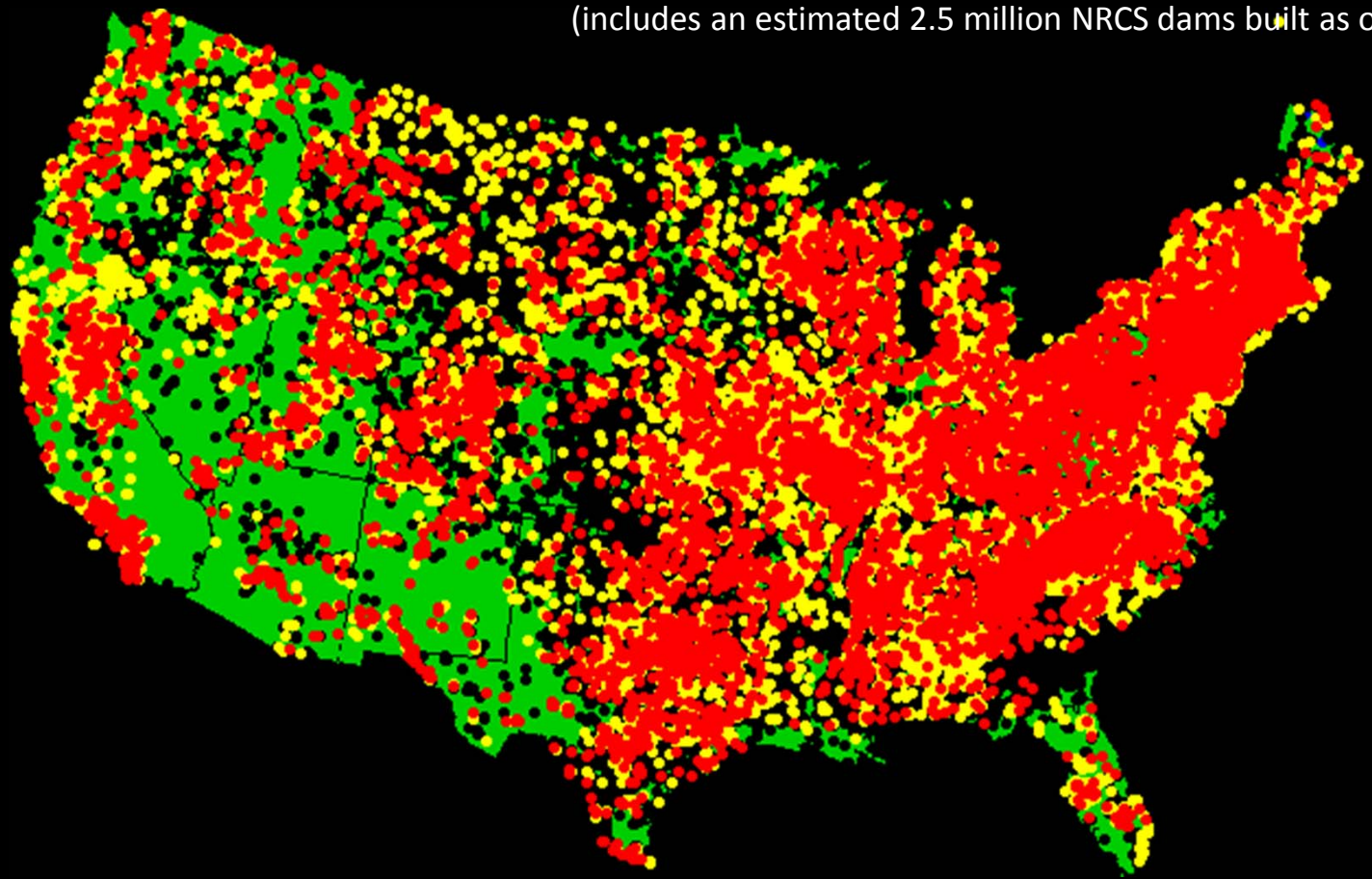
>25 ft w/ 15ac-ft capacity or >6ft w/ 50ac-ft capacity

~99,000 Dams

Regulated by states & in the USFWS Barrier Database

Several Million Dams

Status Report on the Nation's Floodplain Management Activity, 1989
(includes an estimated 2.5 million NRCS dams built as of 1977)



Dams in Pennsylvania

- ~3,000 regulated dams in PA
- ~4,000 unregulated dams?

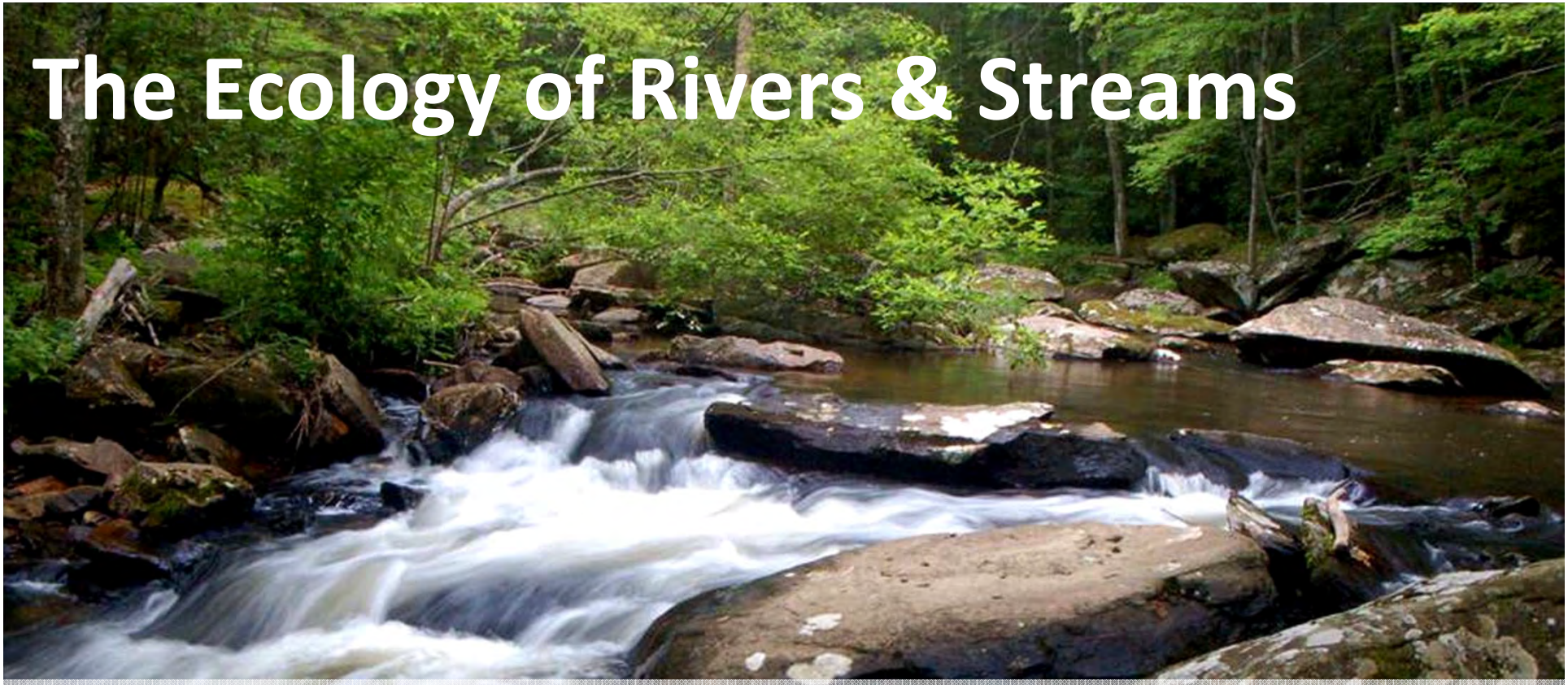
- 75% are less than 25 feet high

- 74% are privately owned
- 24% are publicly owned
- 2% are orphaned

- Hundreds are 75 + years old, many are 100 to 150 years old

- 1% provide hydropower
- 5% provide flood control

The Ecology of Rivers & Streams



- Unidirectional flow
- Integrate impacts to landscape
- Dynamic systems
- Critical to cycling and transport of sediment & nutrients
- Provide unique habitat

How dams impact rivers

- Disrupt course & flow patterns
- Impounded vs. free-flowing
- Alter water quality
- Alter sediment transport
- Decrease connectivity
- Impact biota

Why dam removal?

Dam Removal is functional restoration

- Informed by community & ecosystem perspective
- Outcome is self-sustaining & resilient
- Addresses a major cause of impairment
- Benefits multiple species & life stages
- Promotes “natural” riverine processes

Why dam removal?

- Removes risks associated with presence
  (public safety & localized flooding)
- Removes risk associated with failure
  (environmental & public safety)
- Eliminates cost of maintenance



Why dam removal?

Long-Term Costs of Ownership

- Financial burden
- Repairing/rebuilding typically costs more than removal



Removal is a <u>one-time</u> cost

Funding Dam Removal

- Few grants available for dam repair
- Federal, state, & private grants are available for river restoration

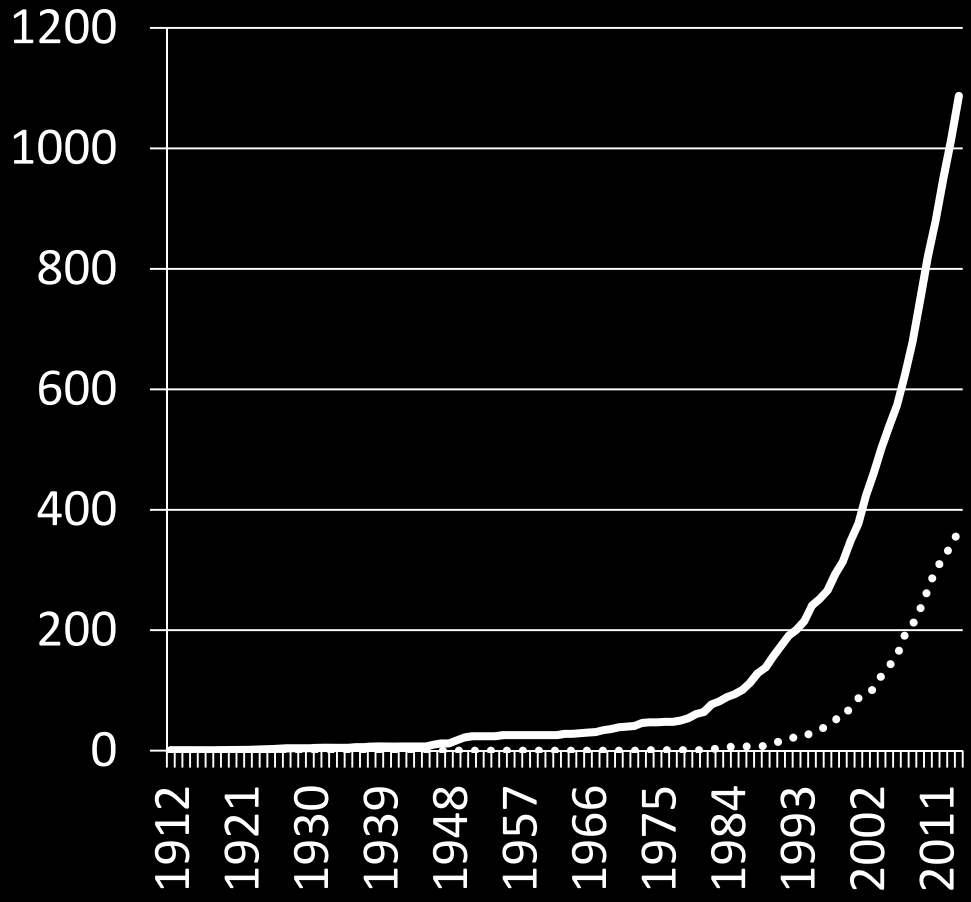
- Private Funding (dam owner, foundations)
- Natural resource damage settlements

Dam Removal is not a new concept

1963 - Five tons of dynamite to remove the Grangeville Dam, Clearwater River, Idaho

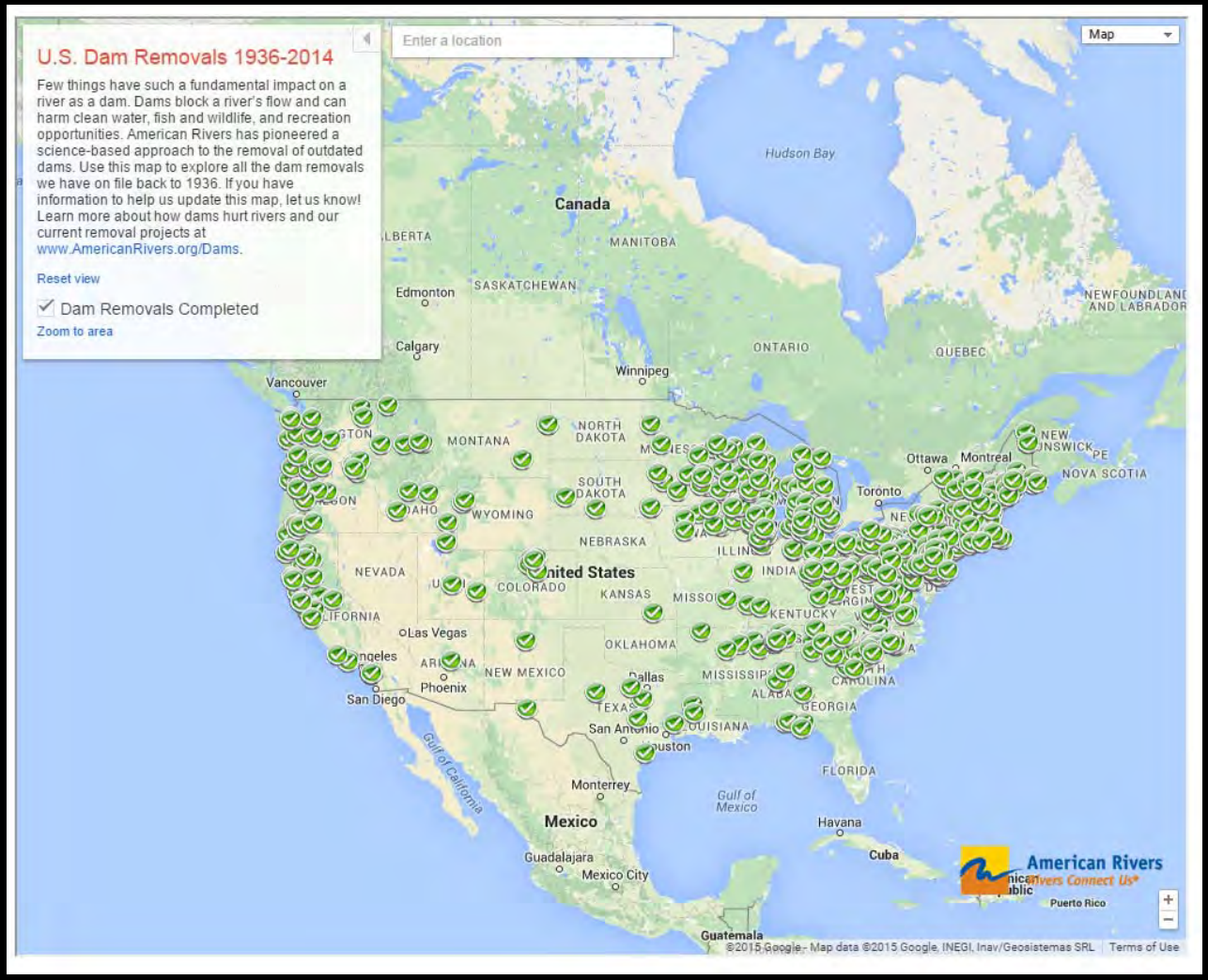
Dam Removal is not a new concept

Cumulative # of Dams Removed



+119/11 projects where removal year is unknown.

National and Regional Trends



www.AmericanRivers.org/DamRemovalsMap

1300+ dams have been removed in U.S.

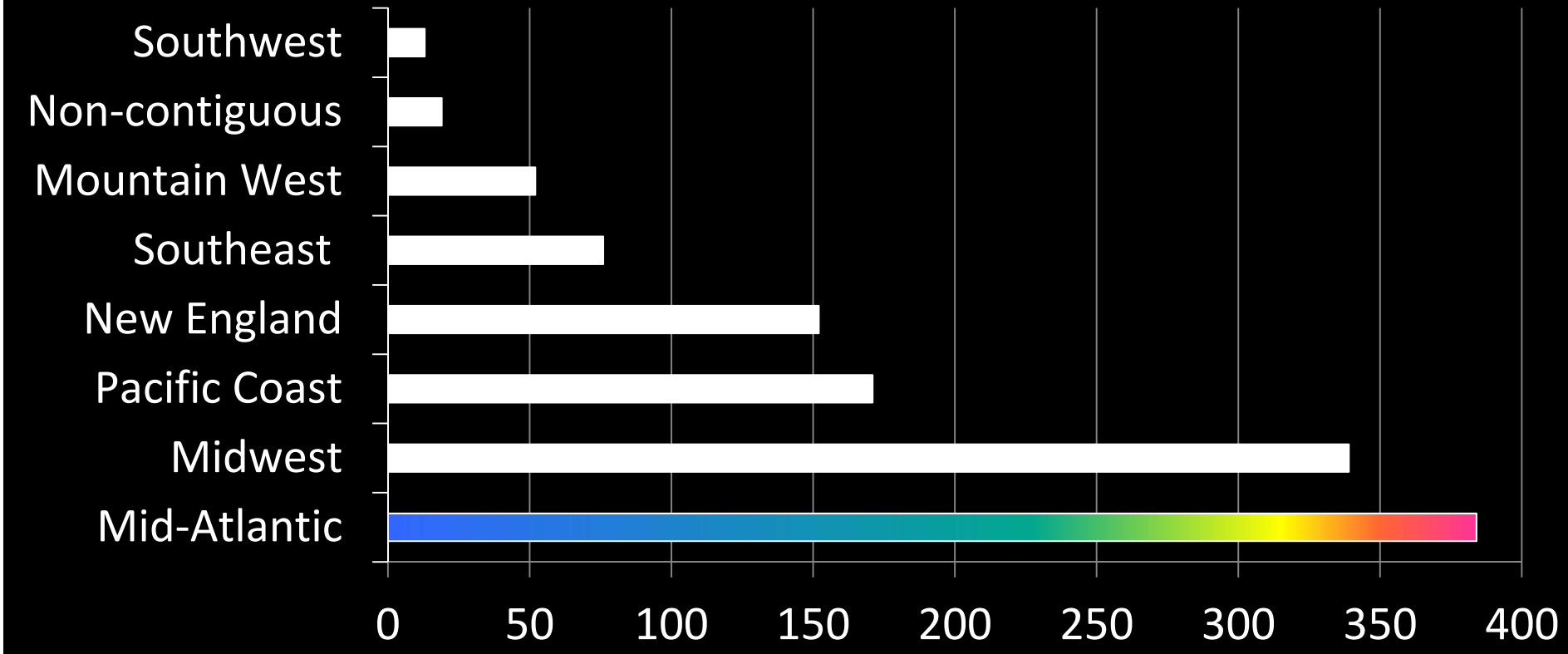
For dams that have outlived their intended function, dam removal is an option.

More than 1300 dams have been removed in U.S.

More than 298 dams have been removed in PA

Data from American Rivers 2015

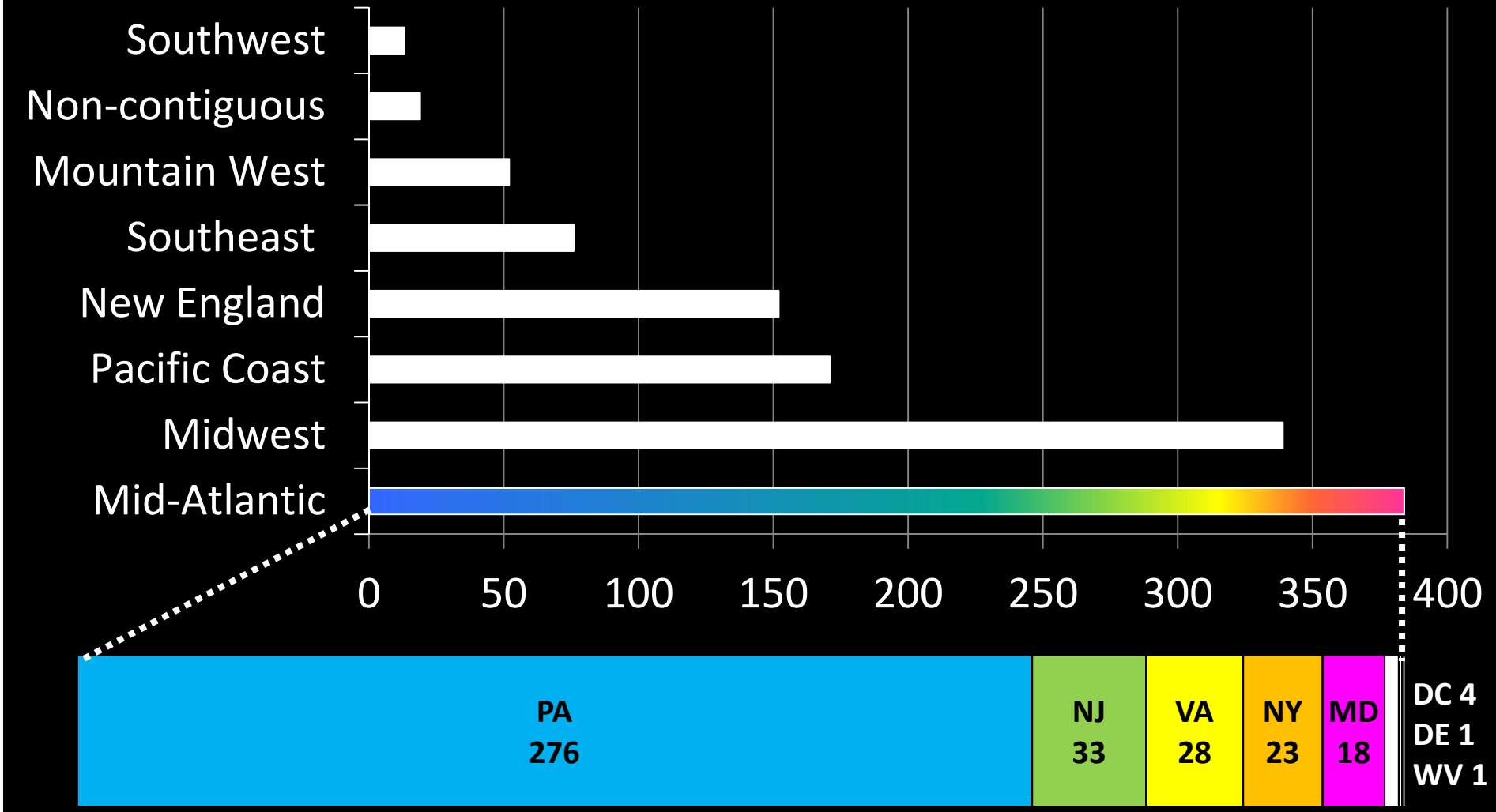
National and Regional Trends



376 dams have been removed in the Mid-Atlantic

Data from American Rivers 2014

National and Regional Trends



376 dams have been removed in the Mid-Atlantic

Data from American Rivers 2014

Why is PA the national leader?

(Rosegarden Dam, Yellow Breeches Creek)

- Formal Dam Removal program
- Permitted via “Restoration Waiver”
- Allow “in-the-wet” construction
- Allow passive sediment management
- *Report all removals, e.g. 1m high dams*

Characteristics of Removed Dams (Mid-Atlantic)

Built: 1777 to 1970

Original Purpose

- Water supply *(drinking, mining, canal)*
- Mill or industrial
- Hydroelectric
- Recreation
- Aesthetics
- Timber splash
- Ice harvest

Construction Material

- Concrete
- Masonry
- Earth
- Timber
- Metal/Sheetpile

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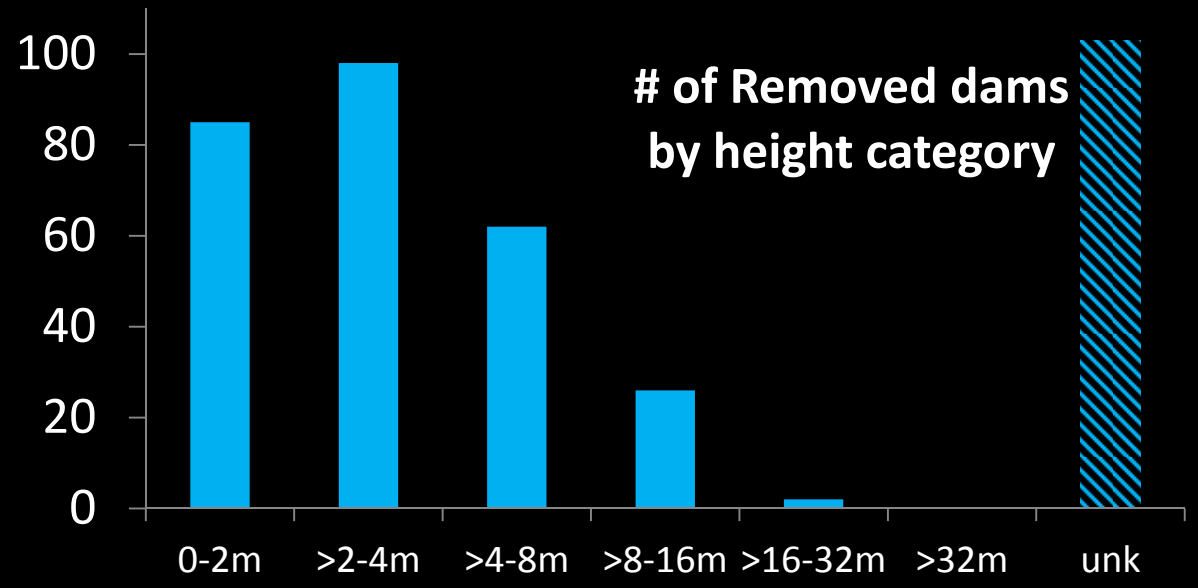

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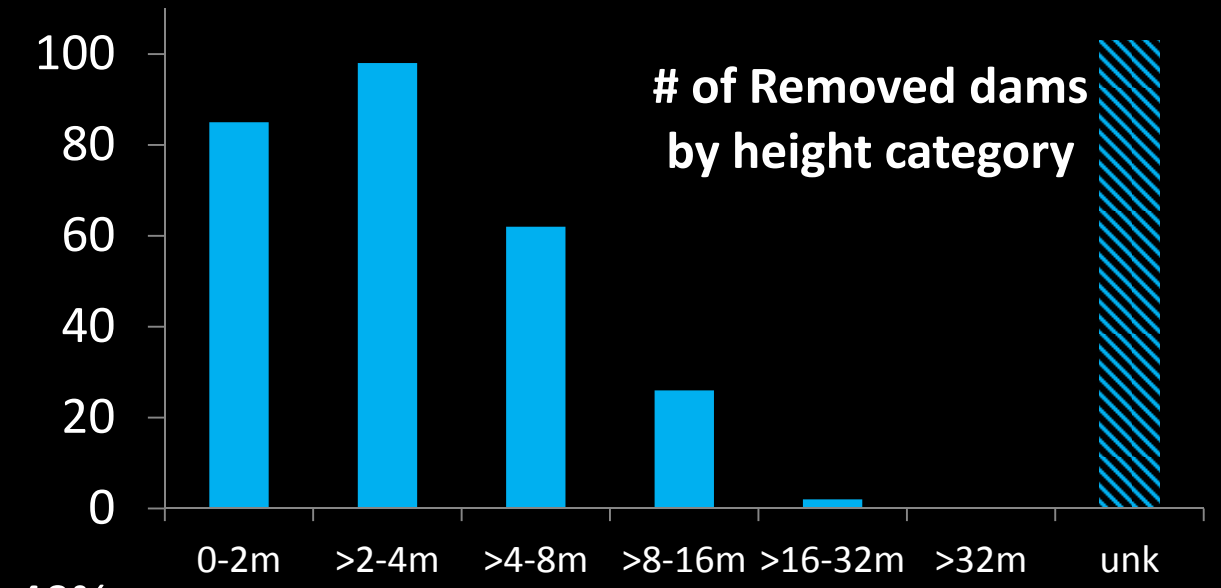
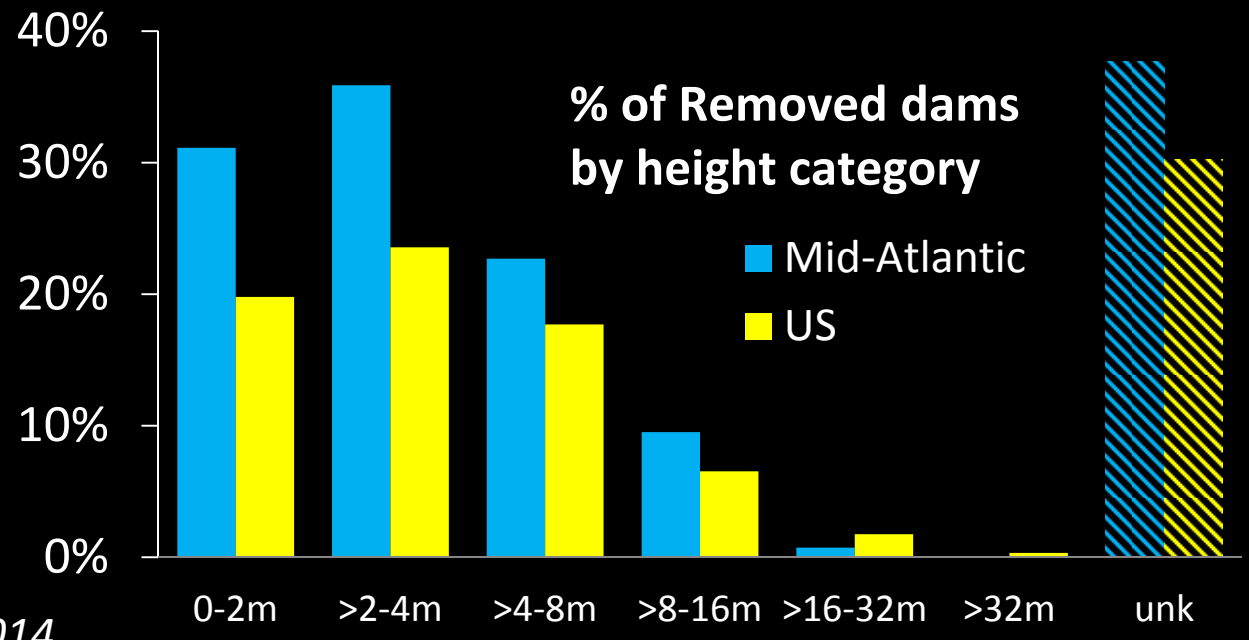




Data from American Rivers 2014

National and Regional Strategies

Increase scale of impact

Larger projects

Elwha River, WA
Glines Canyon Dam in 2011
210 ft

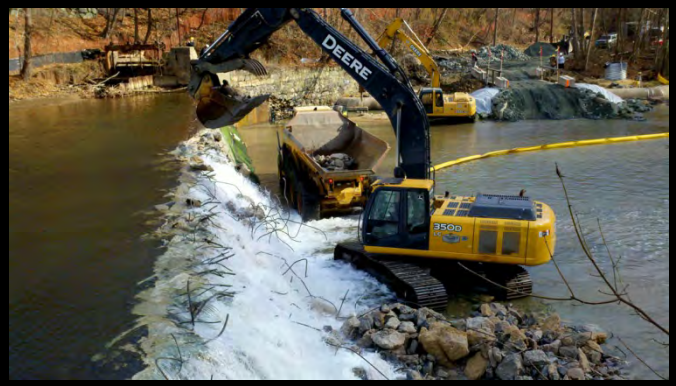
Multiple projects

Musconetcong River, NJ
4 removed 2007 to 2011
1 slated for removal in 2015
2 planned for future removal

Patapsco River, MD

2 removed in 2010,

1 slated for removal in 2015

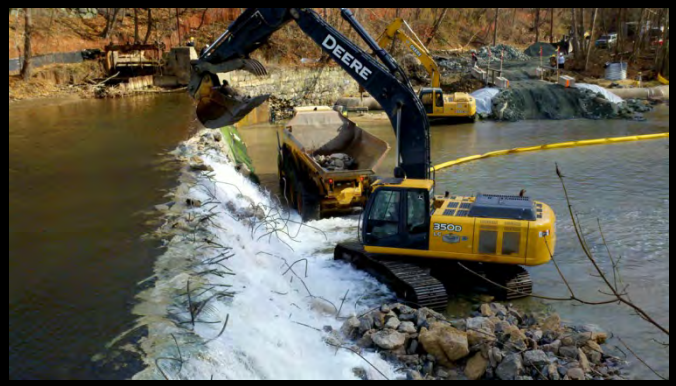


Simkins Dam, Patapsco River, MD

Patapsco River, MD

2 removed in 2010,

1 slated for removal in 2015



Simkins Dam, Patapsco River, MD

Raritan River, NJ

3 removed 2011 to 2013

Roberts Street Dam, Raritan River, NJ

Patapsco River, MD

2 removed in 2010,

1 slated for removal in 2015

Simkins Dam, Patapsco River, MD

Raritan River, NJ

3 removed 2011 to 2013

Roberts Street Dam, Raritan River, NJ

Darby Creek, PA

3 removed in 2012

Kent Park Dam, Darby Creek, PA

Patapsco River, MD

2 removed in 2010,
1 slated for removal in 2015

Simkins Dam, Patapsco River, MD

Raritan River, NJ

3 removed 2011 to 2013

Roberts Street Dam, Raritan River, NJ

Darby Creek, PA

3 removed in 2012

Kent Park Dam, Darby Creek, PA

Yellow Breeches, PA

6 removed 2000 to 2011

Rosegarden Dam, Yellow Breeches, PA

National and Regional Strategies

Increase # of opportunities:

- Incentivize removals
- Influence regulatory climate

National and Regional Strategies

Increase # of opportunities:

- Incentivize removals
- Influence regulatory climate

Increase # of projects:

- Increase capacity
- Build awareness

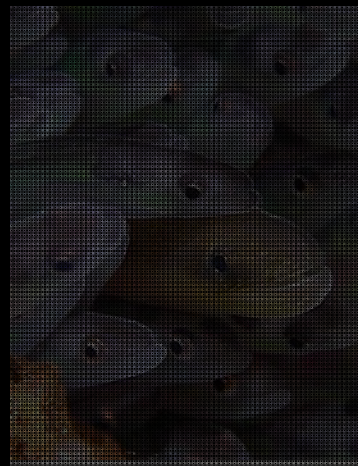
The Practice of Dam Removal

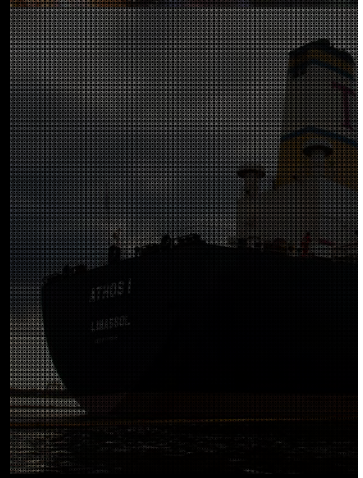
1. Ownership
2. Funding

3. Threatened & endangered species
4. Invasive species
5. Sediment & contaminants
6. Social & cultural impacts
7. Infrastructure conflicts
8. Replacing current uses
9. Material disposal

10. Monitoring

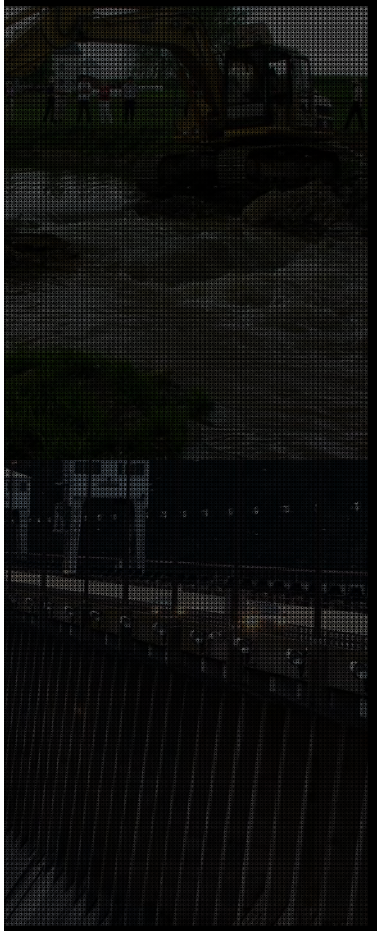
Ownership

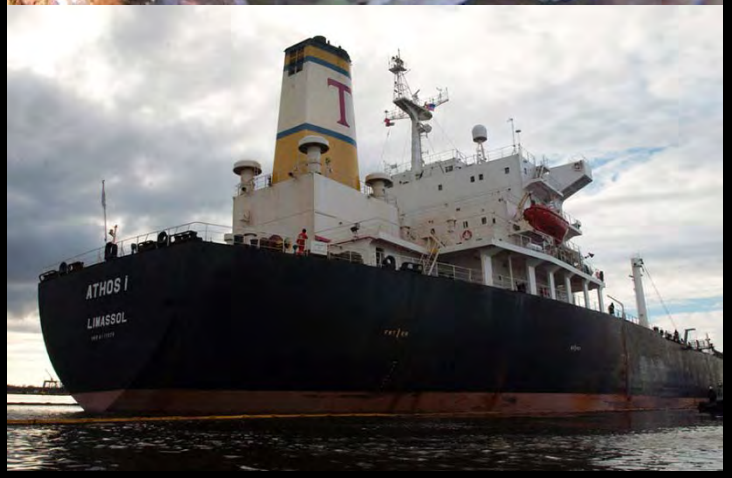


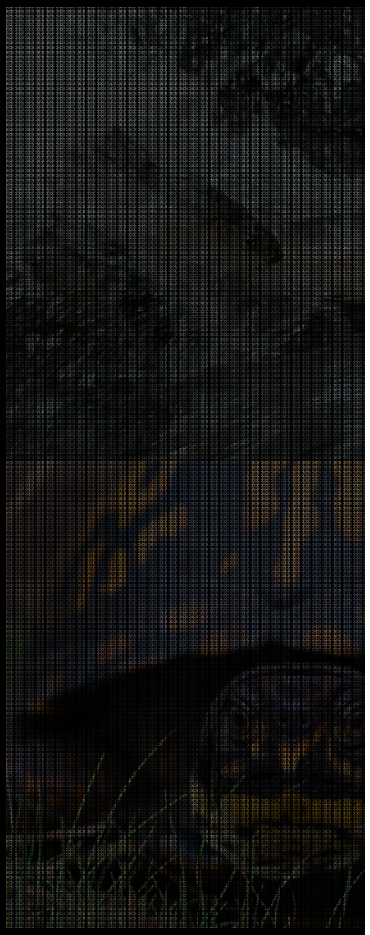


Need dam owner support

Funding





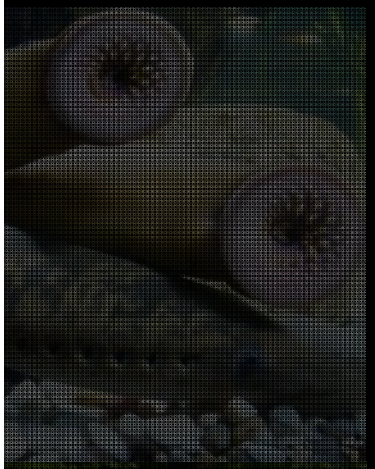


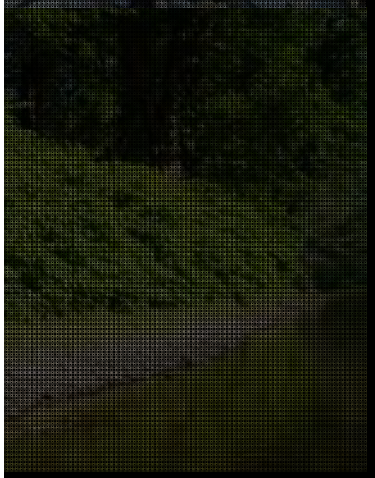
Threatened & Endangered Species

Invasive species

species

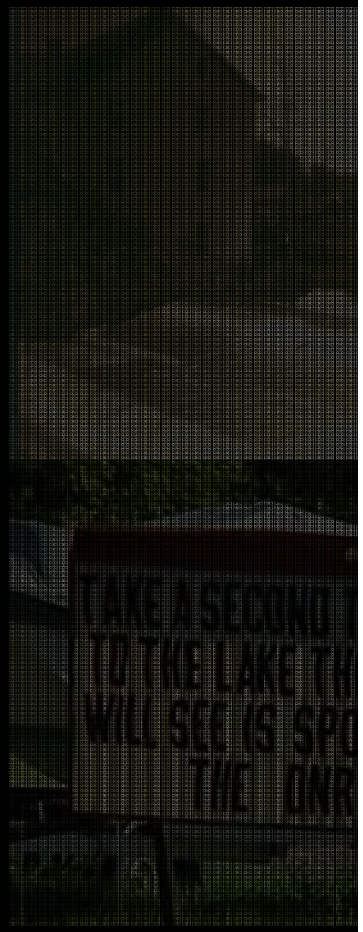
Sediment & Contaminants





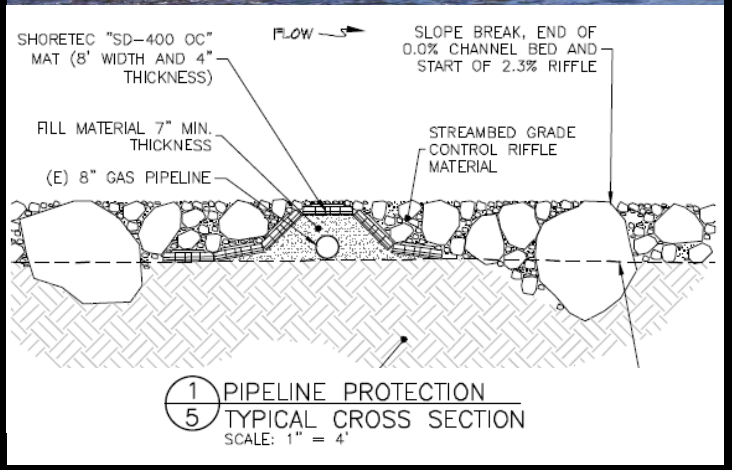
Social &

Impa

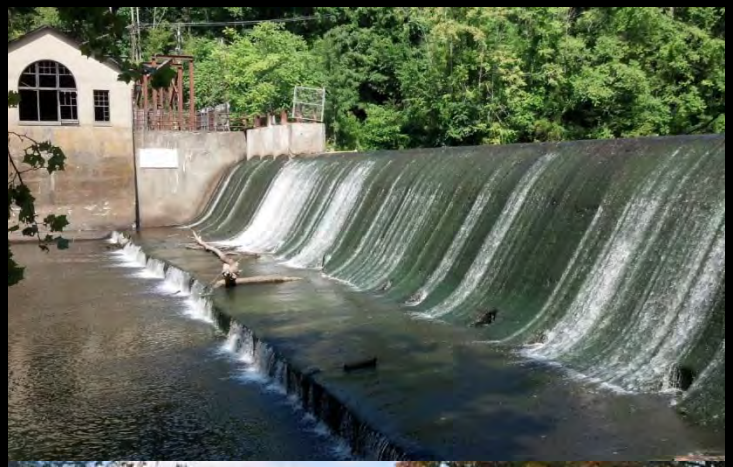


Social & Cultural Impacts

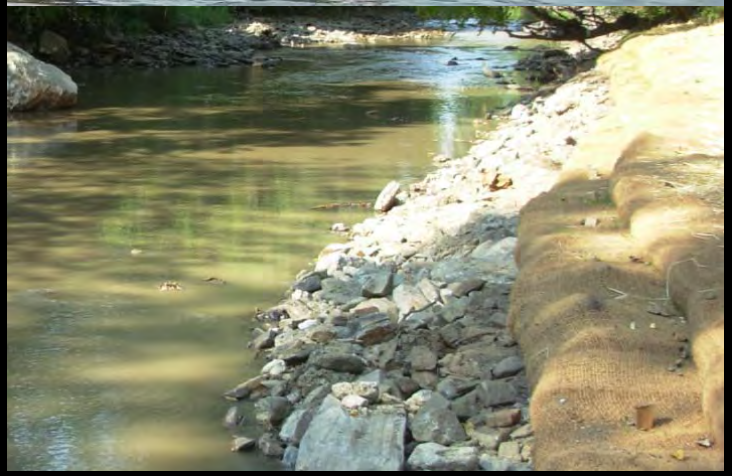
Infrastructure Conflicts



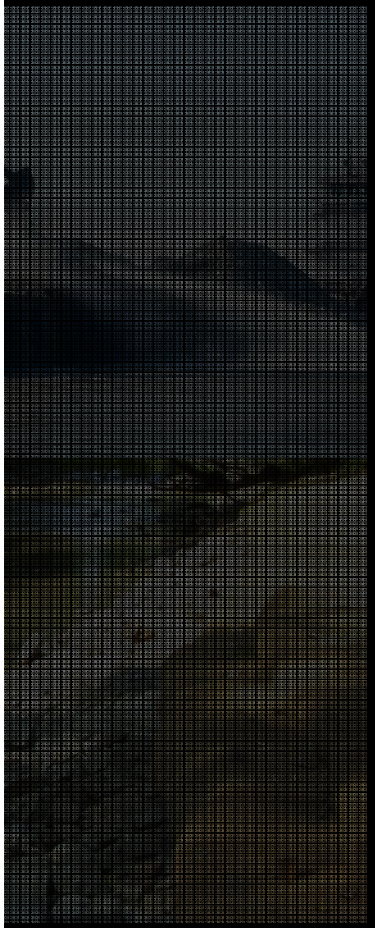
Replacing Current Uses



Material Disposal



Disposal



Monitoring

Dam removal science synthesis – U.S.

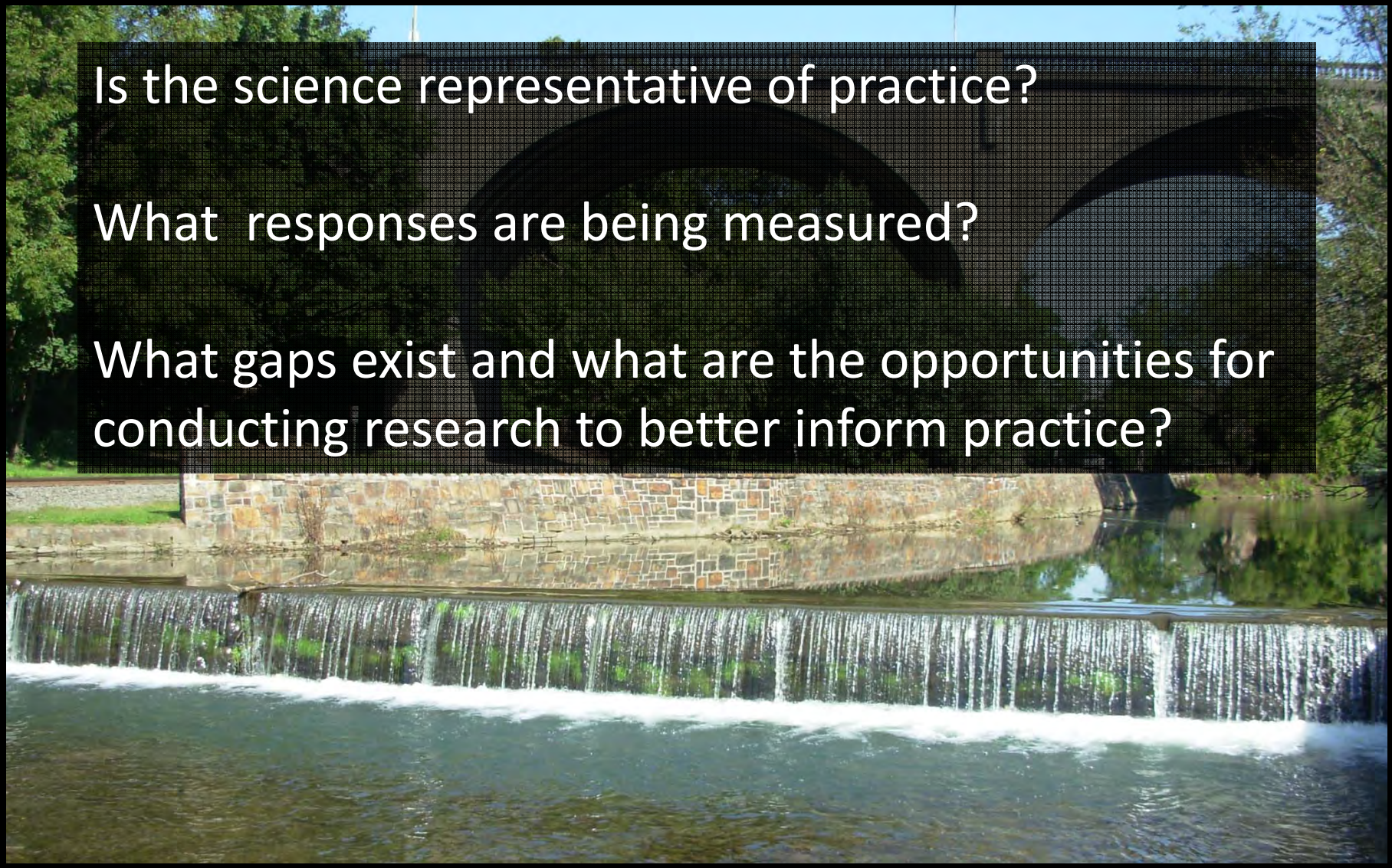
- USGS
- NOAA
- US Forest Service
- Bureau of Reclamation
- American Rivers
- Dartmouth College
- Oregon State University
- University of Montana

Elwha Dam, Elwha River, WA

Dam removal science database

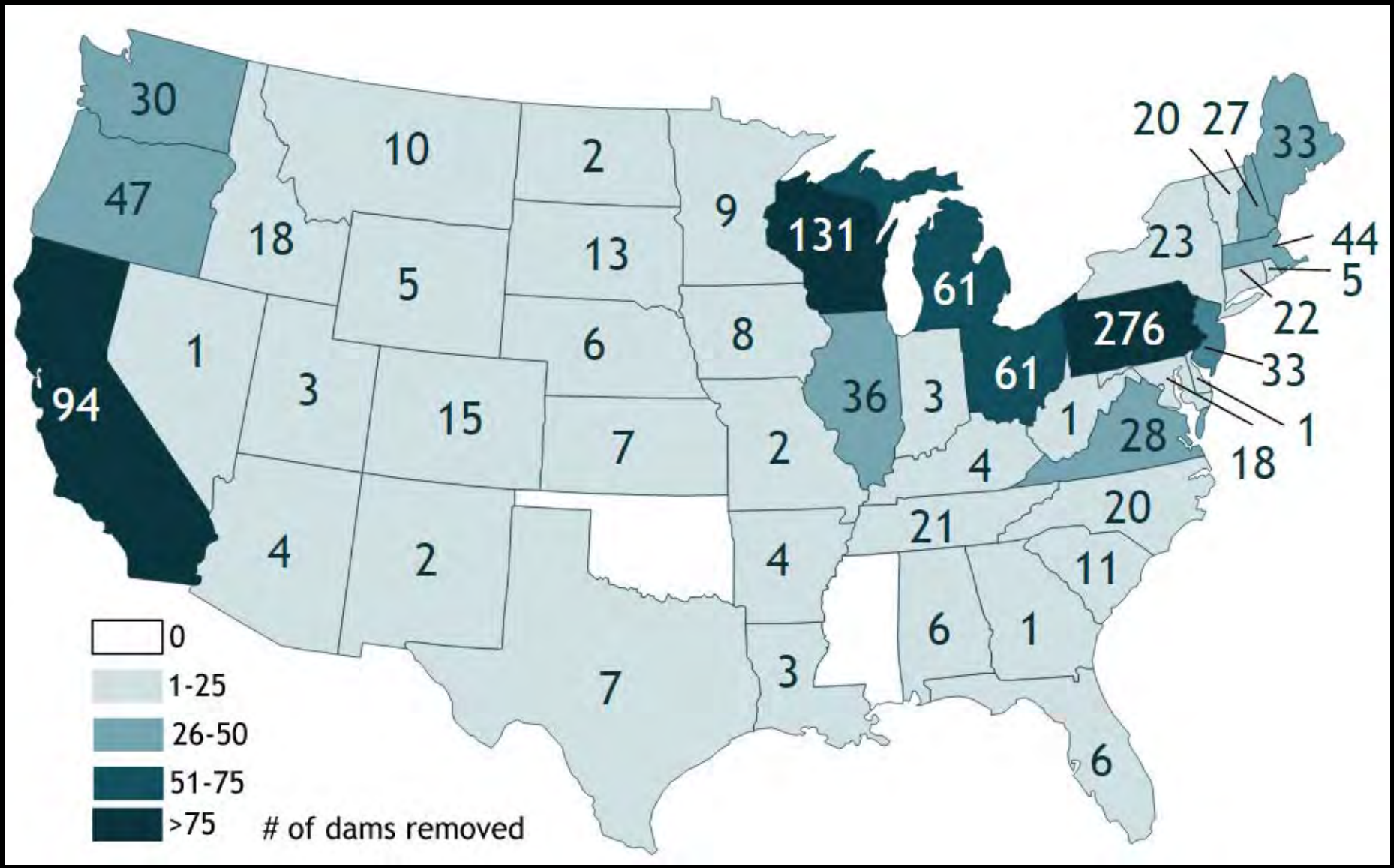
Bellmore, J.R., K.M. Vittum, J.J. Duda, and S. Greene. 2015. USGS dam removal science database. Available online at http://doi.org/10.5066/F7K935KT.

Status and trends of dam removal science



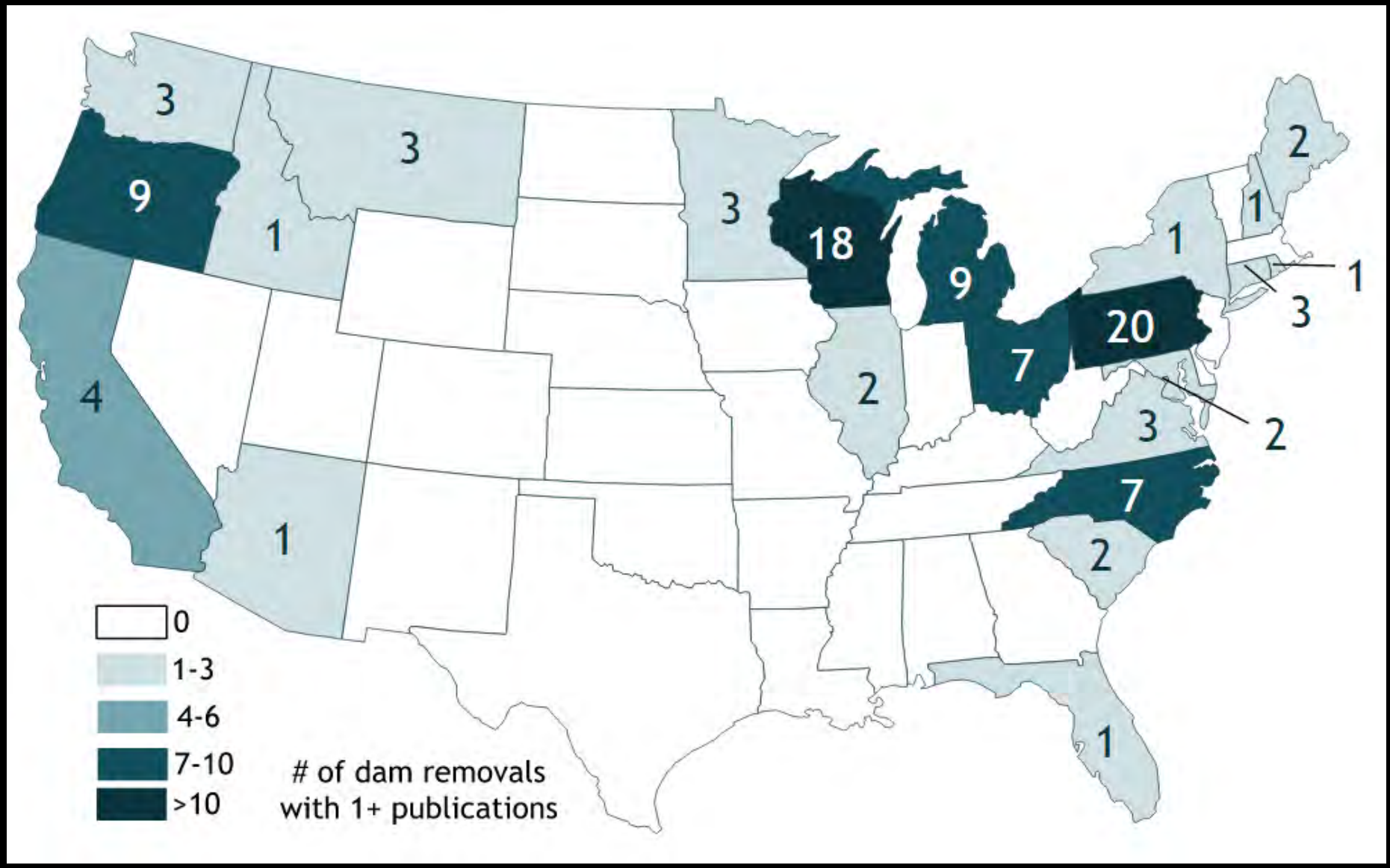
Bellmore et al. *in review*

Dam removals by state (1912-2014)

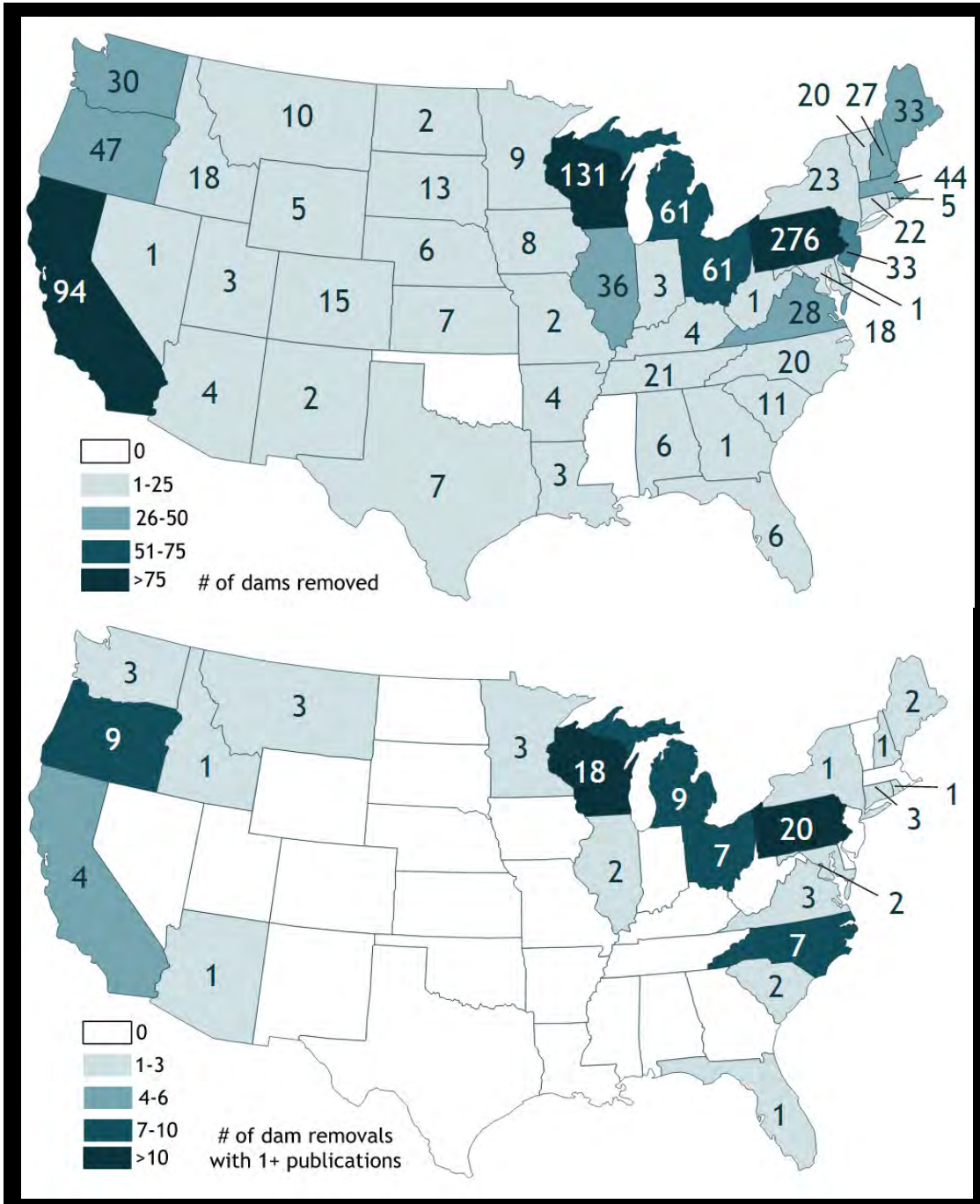


Data from American Rivers 2014

Dam removal studies by state



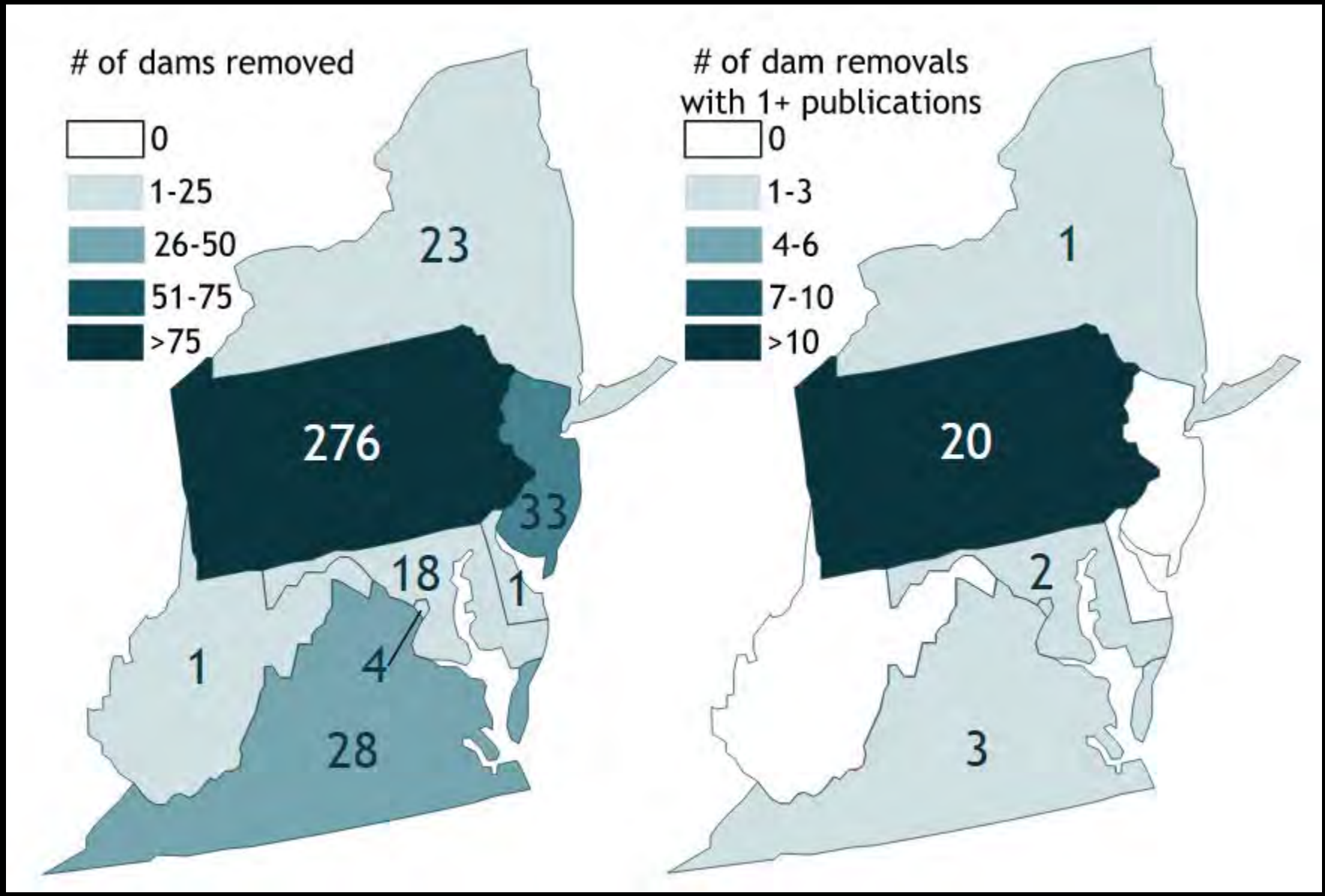
Data from Bellmore et al. 2015, USGS Database



Bellmore et al. *in review*

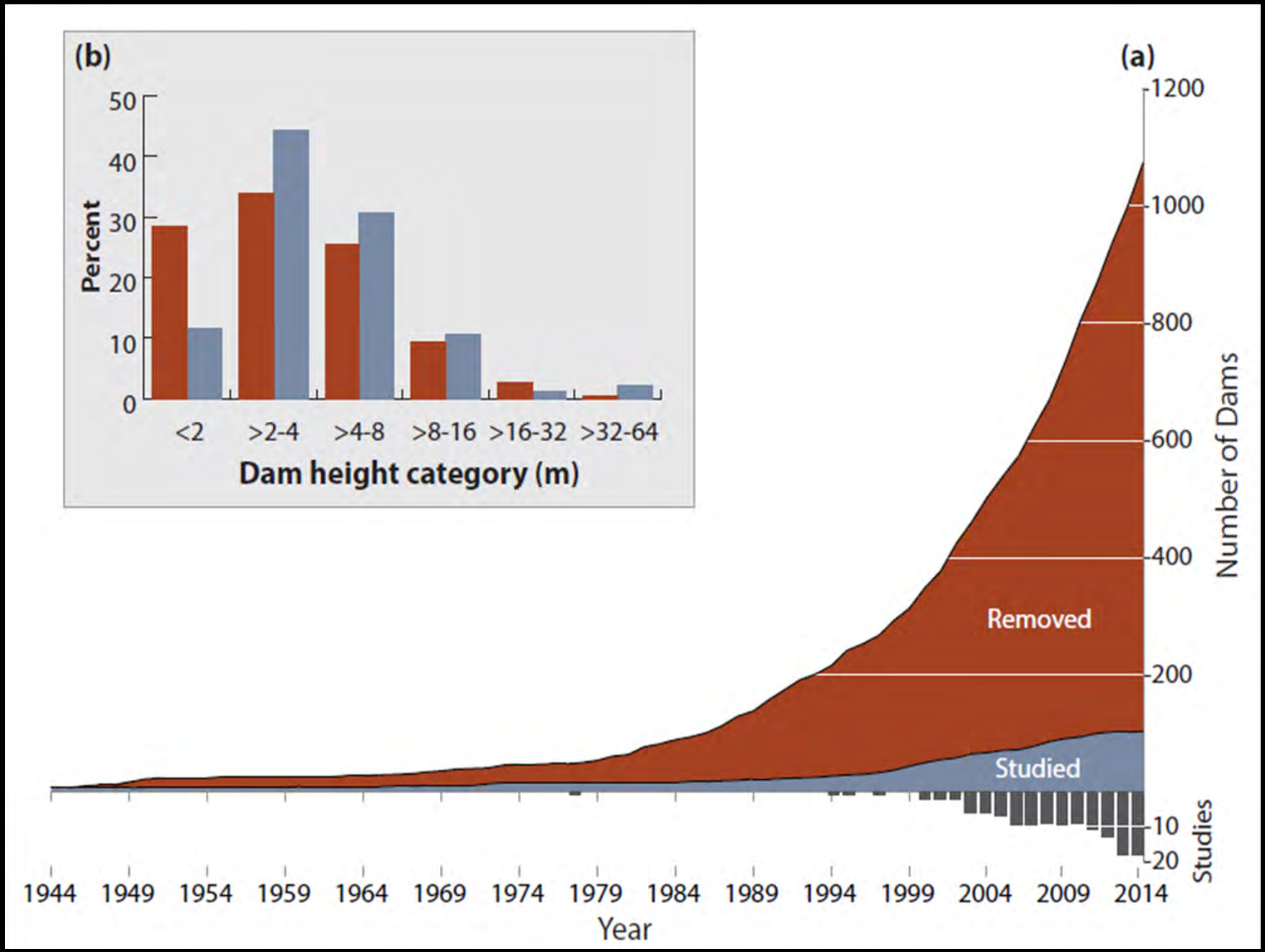
- Distribution of studies and removals is similar.
- Few studied dam removals in the interior of the US.
- Several states with a many removals but few or no studies.

Mid-Atlantic dam removals and studies



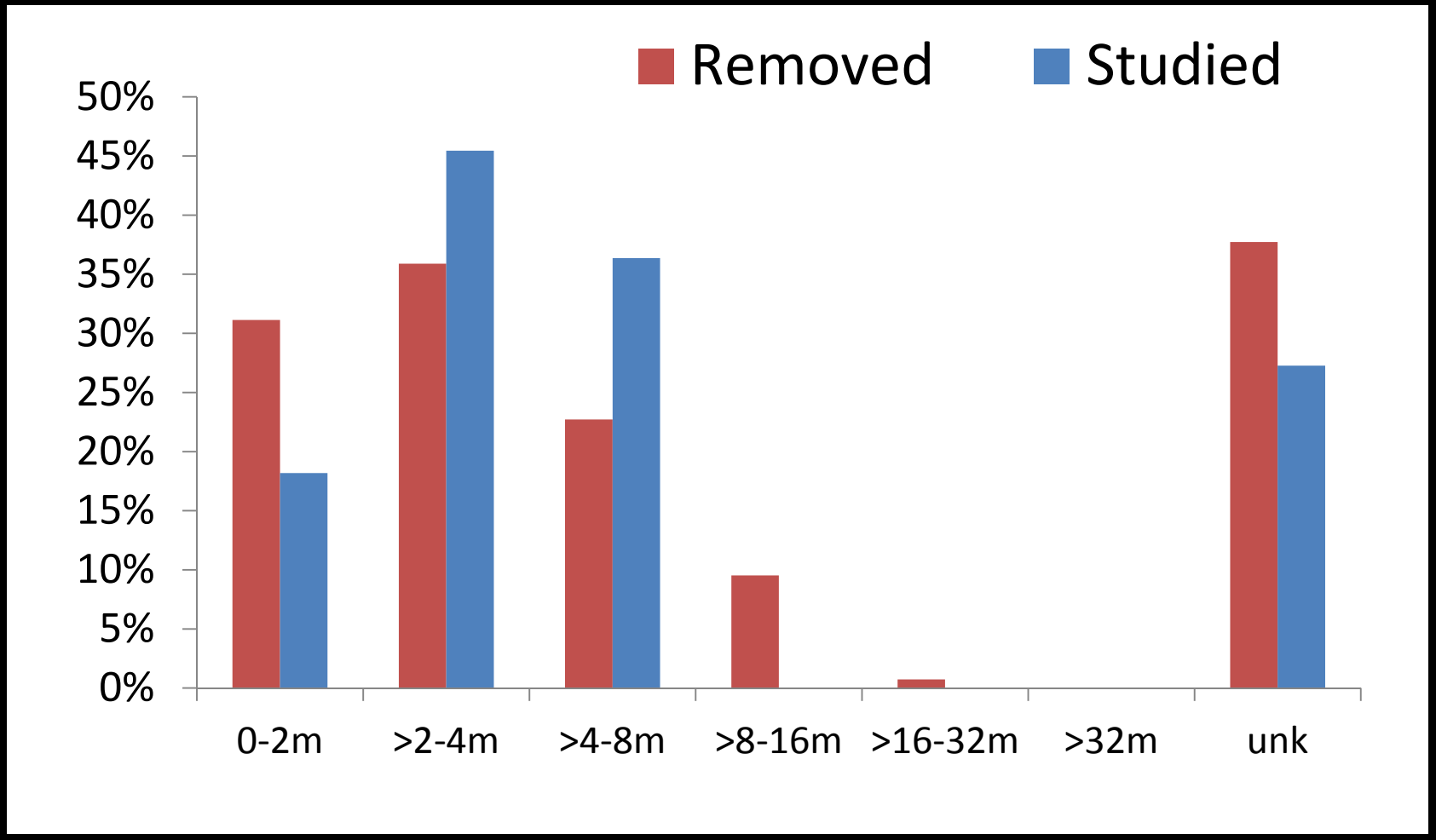
Data from American Rivers 2014 and Bellmore et al. 2015, USGS Database

	Dam	Removal Year	Study Year(s)
PA	Williamsburg Station	1996	2009
	Snavely Mill	1997	2009
	Castle Fin	1997	2005
	Hellberg's	1999	2008
	Manatawny	2000	2003, 2005 (2), 2006 (2)
	Hinkletown	2000	2008
	Franklin Mills	2000	2008
	Good Hope	2001	2005
	Hammer Creek	2001	2010, 2013
	Reedsville Mill	2004	2009
VA	Woolen Mills	2005	2009
	Embrey	2007	2010
NY	Fort Covington	2009	2011, 2013
MD	Simkins Dam	2010	2013



Bellmore et al. *in review*

Mid-Atlantic dam removal studies by height



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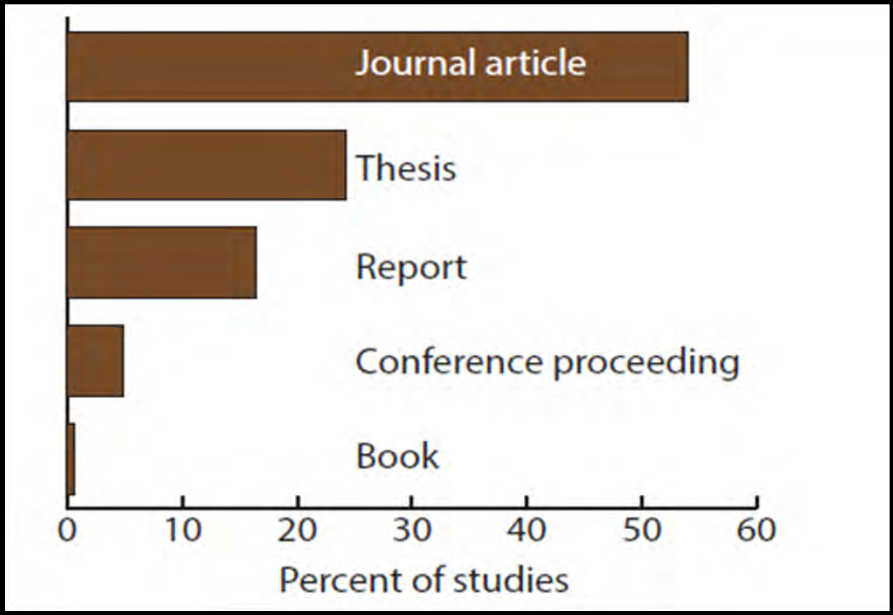
National dam removal science synthesis



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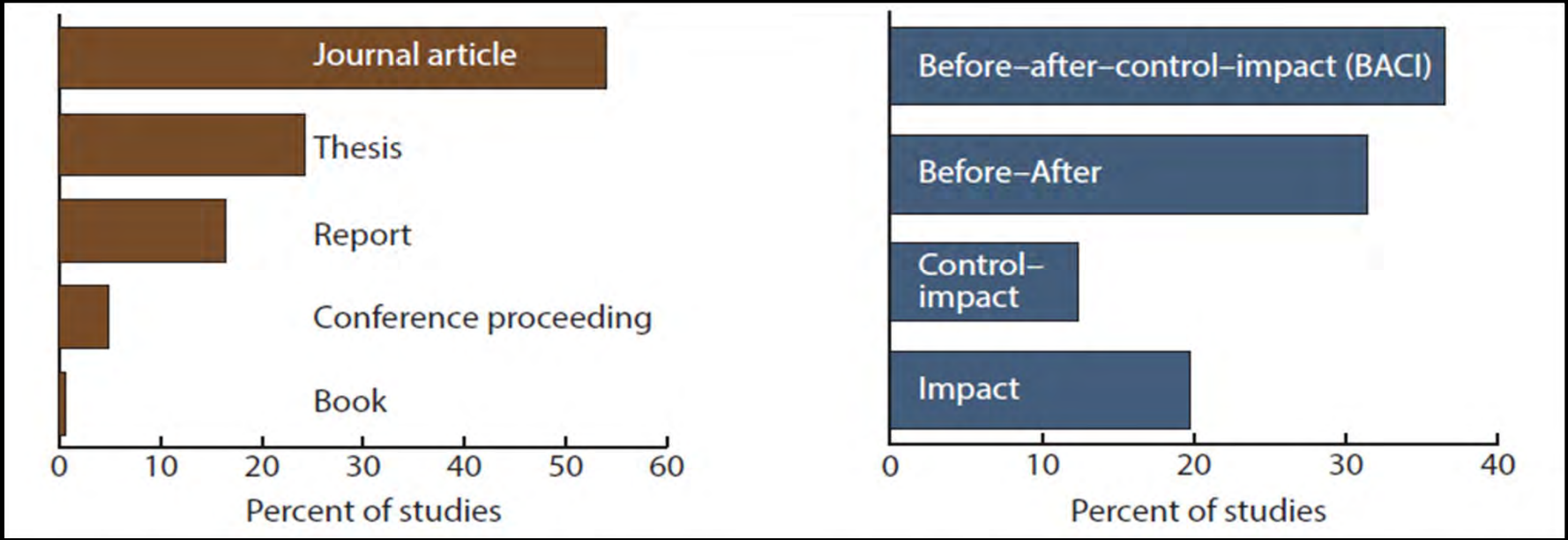

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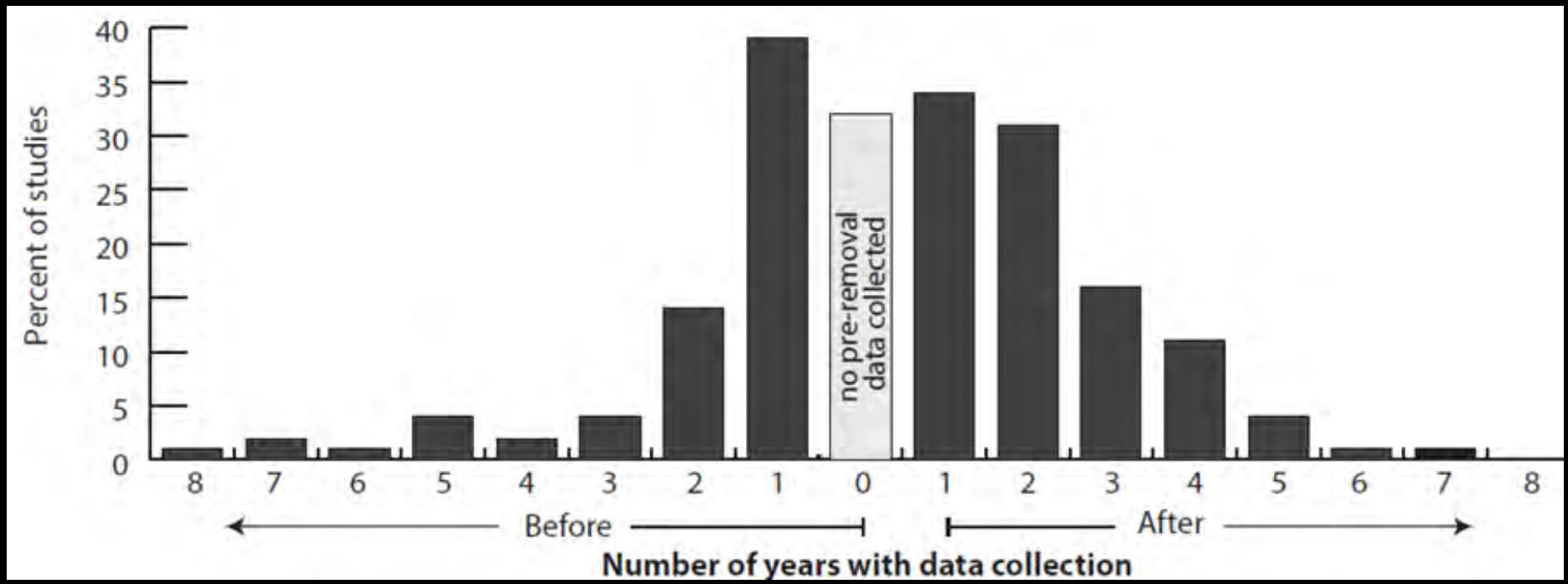

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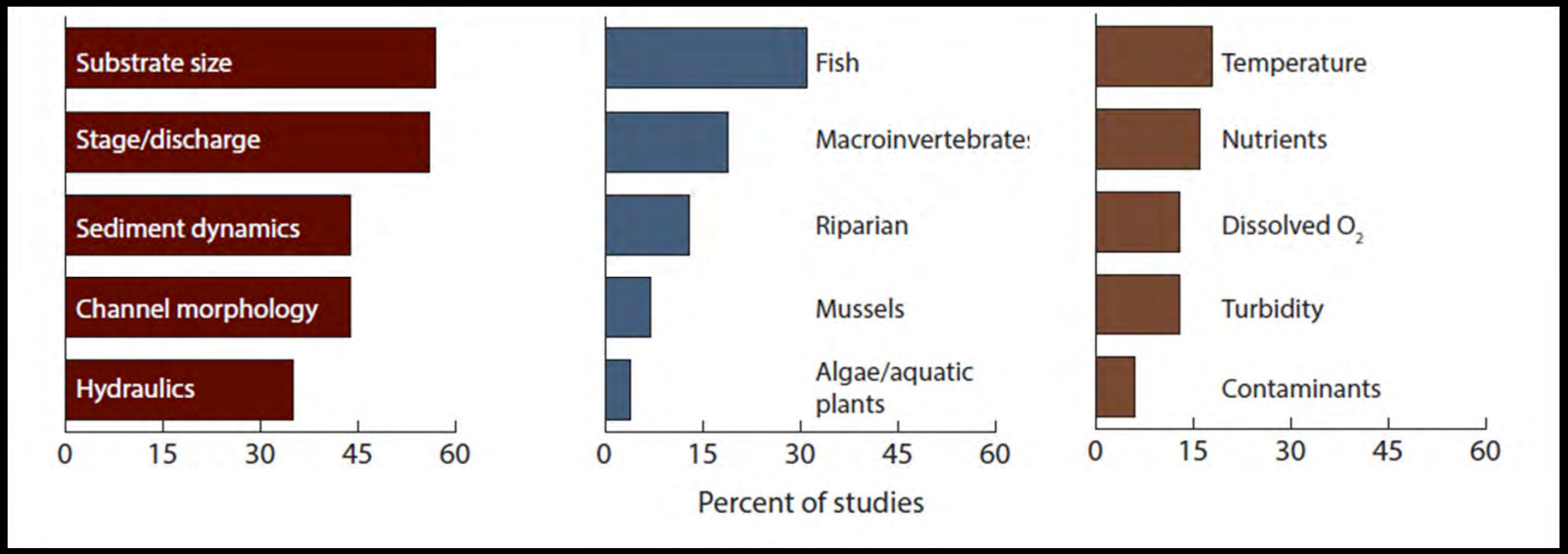

Bellmore et al. *in review*

On-going science: Columbia Lake Dam, Paulins Kill

~6m high

BACI Design

2+ years of pre-removal data

- Macroinvertebrate community composition
- Resident fish community composition
- Presence/absence and demography of eel
- Presence/absence, identity, and timing of anadromous fish
- Continuous temperature, DO, TSS sampling
- Cross sections
- Bathymetry
- Embeddedness

On-going science: Bloede Dam, Patapsco River

~11m high

BACI Design

7+ years of pre-removal data

- Macroinvertebrate community composition
- Resident fish community composition
- Presence/absence and demography of eel
- Presence/absence, identity, and timing of anadromous fish
- Water quality point sampling
- Continuous Q and TSS
- Cross sections
- Sediment mapping and transport modeling

Gaps in science of dam removal?

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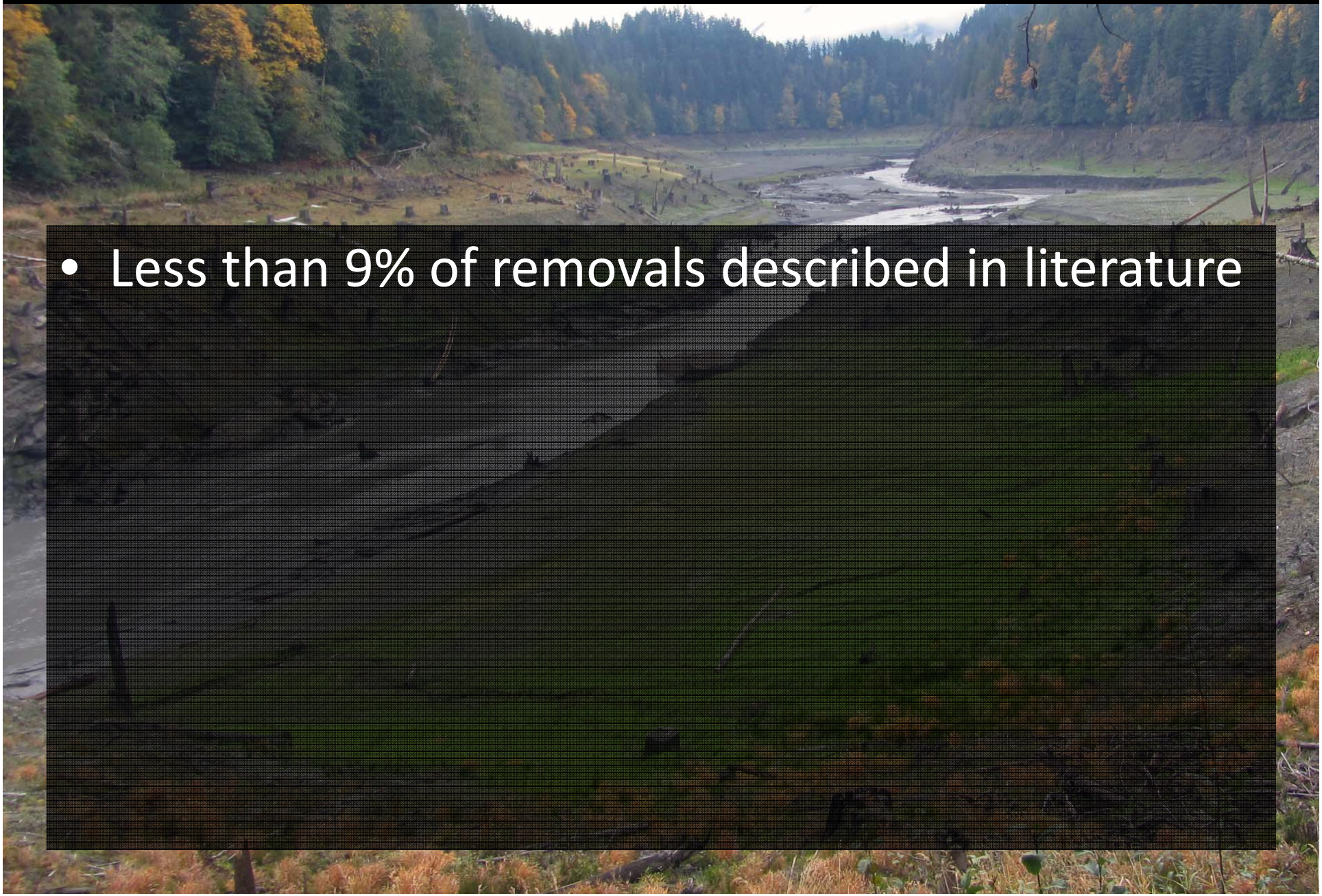
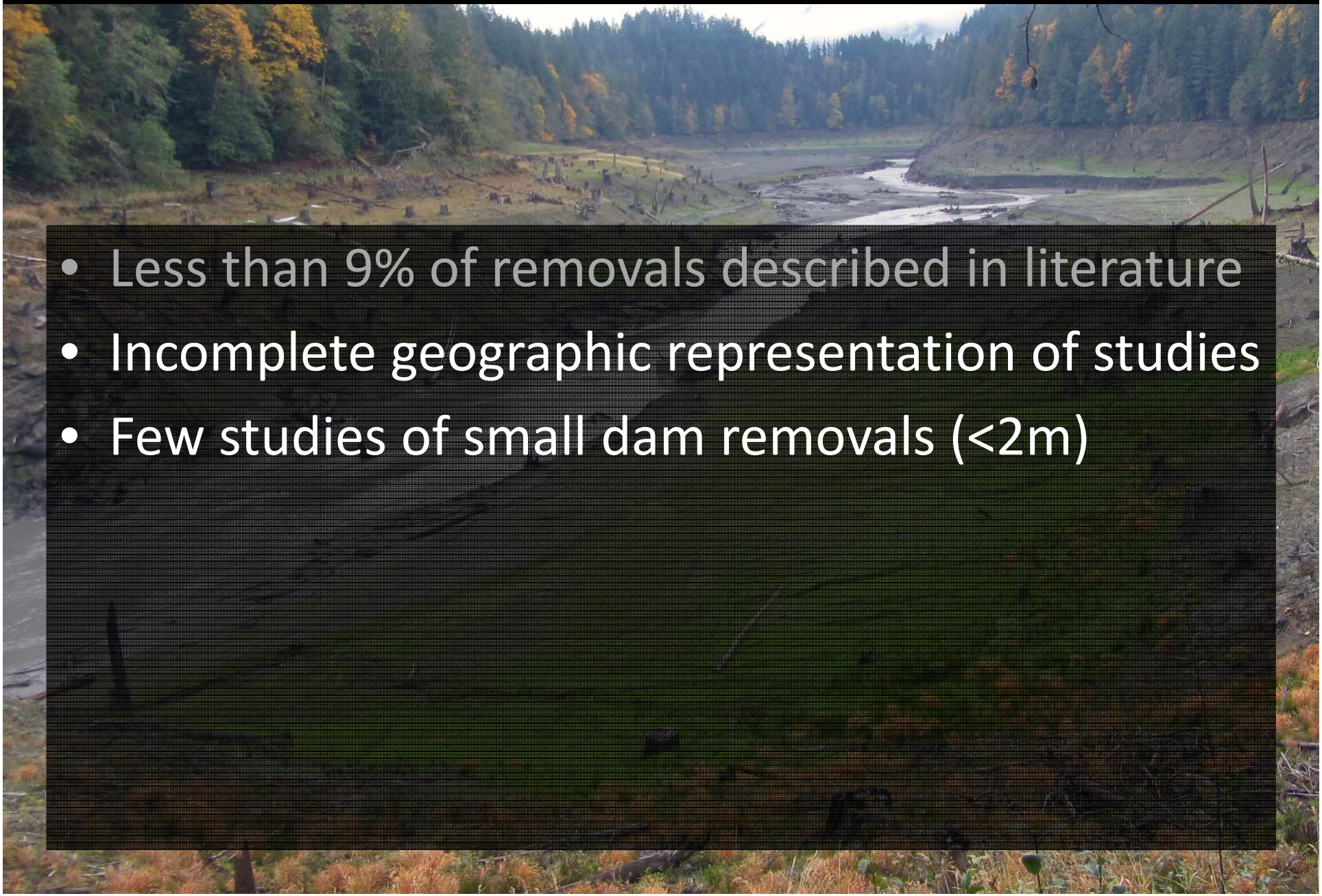


- Less than 9% of removals described in literature

Gaps in science of dam removal?



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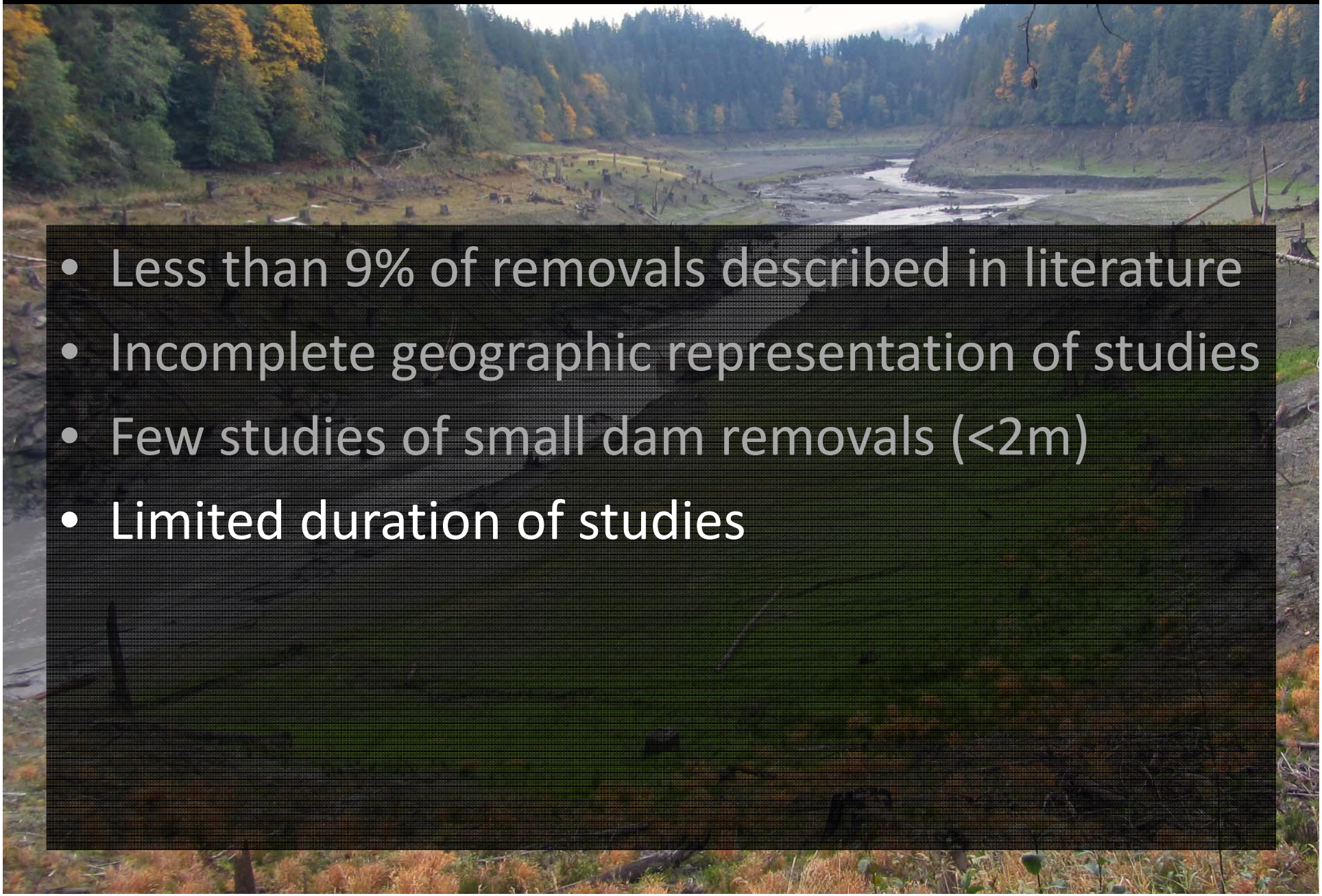
- Incomplete geographic representation of studies
- Few studies of small dam removals (<2m)

Gaps in science of dam removal?



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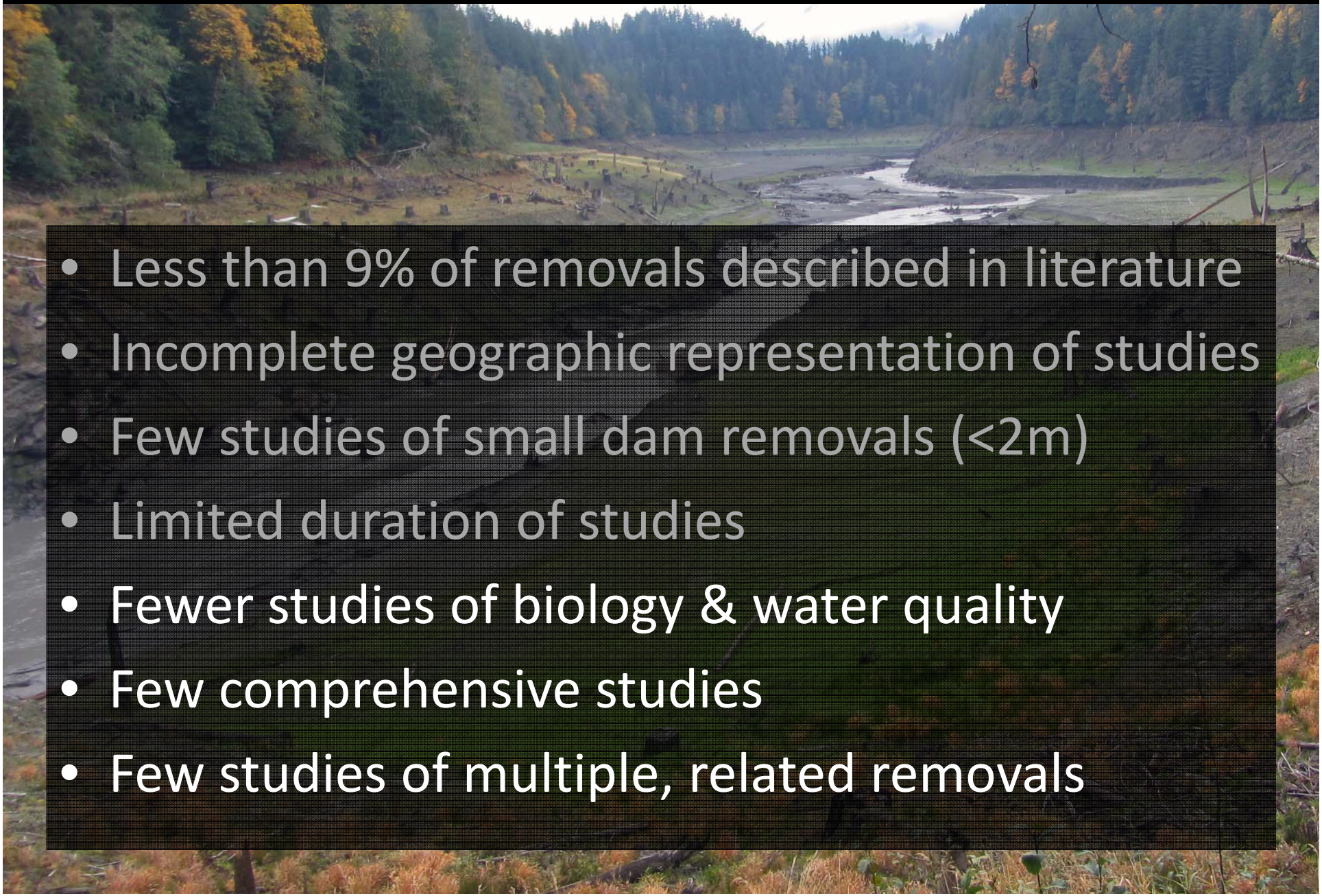
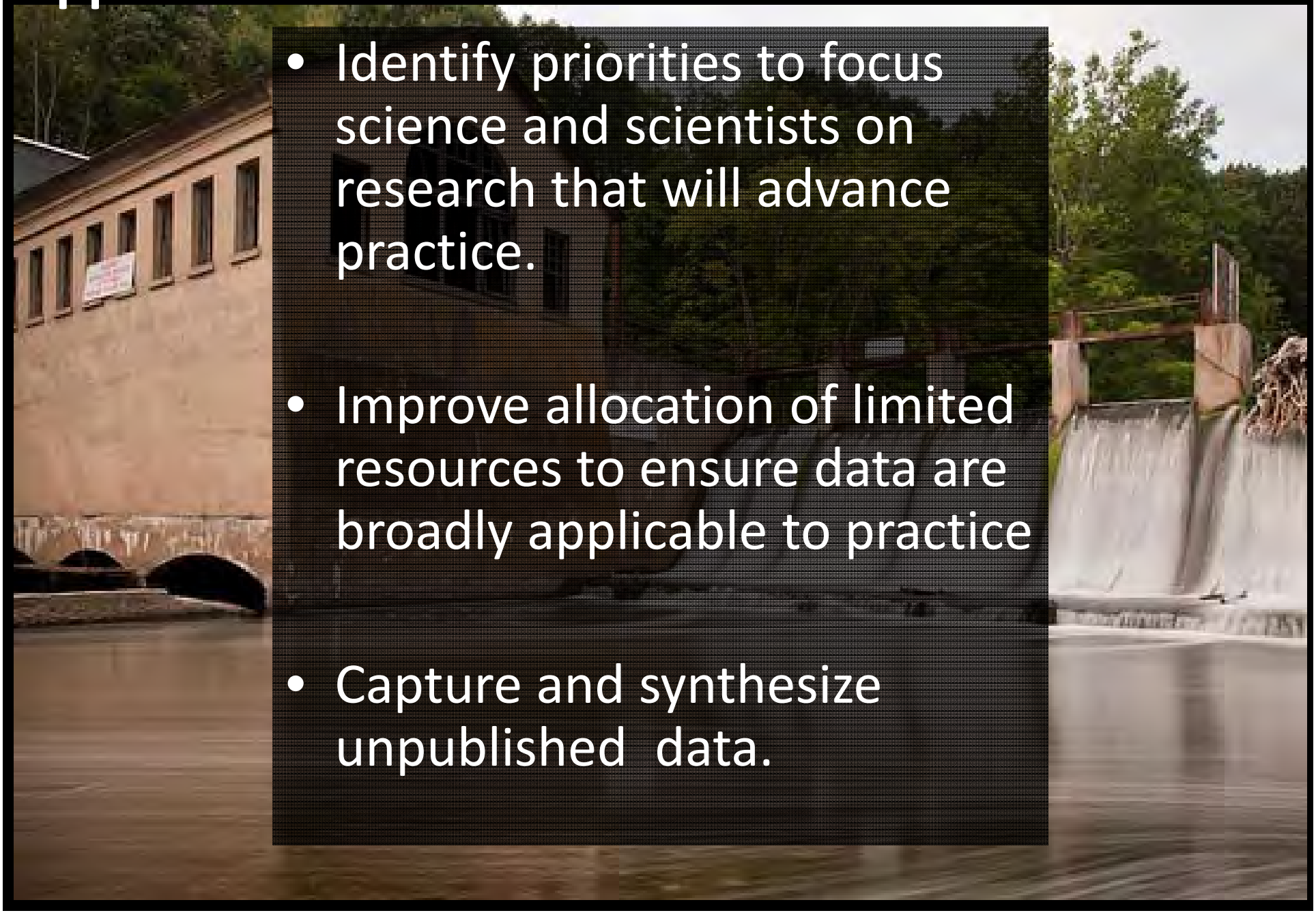
Gaps in science of dam removal?



- Less than 9% of removals described in literature
- Incomplete geographic representation of studies
- Few studies of small dam removals (<2m)
- Limited duration of studies
- Fewer studies of biology & water quality
- Few comprehensive studies
- Few studies of multiple, related removals

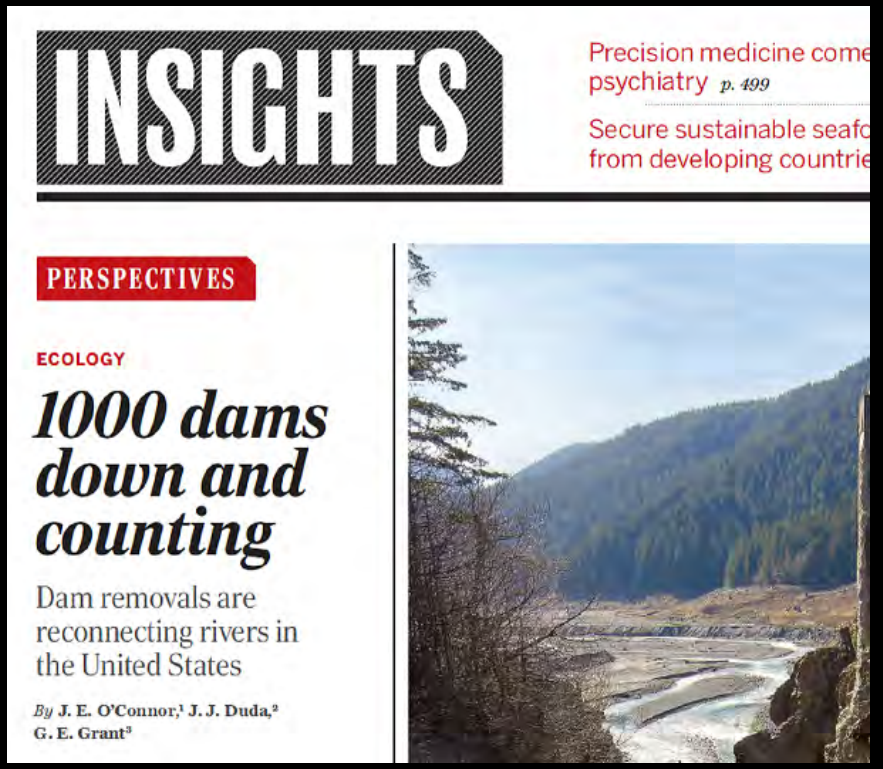
Opportunities



- Identify priorities to focus science and scientists on research that will advance practice.
- Improve allocation of limited resources to ensure data are broadly applicable to practice
- Capture and synthesize unpublished data.

National synthesis papers

- 1000 Dams down and counting ► (O'Connor et al. 2015, Science)


INSIGHTS

Precision medicine come
psychiatry p. 499

Secure sustainable seafo
from developing countrie

PERSPECTIVES

ECOLOGY

1000 dams down and counting

Dam removals are reconnecting rivers in the United States

By J. E. O'Connor,[1] J. J. Duda,[2] G. E. Grant[3]

- Breaking down barriers: Review and synthesis of dam removal research in the United States (Bellmore et al. *in review*, Frontiers in Ecology)
- Common management concerns associated with dam removal *(Tullos et al. in review, JAWRA)*
- The role of geographical context in determining the trajectory of biophysical response to dam removal (Foley et al. *in prep*)
- Dam removal: The state of the Science (Pess et al. *in prep*)

Pennsylvania Dam Removals


Rosegarden Dam
Yellow Breeches Creek
Removed August 2011

Norristown Farm Park Dam

Stony Creek

Removed August 2011

American Legion Dam - WB Perkiomen Creek - Removed June 2012

Hoffman Park Dam

Darby Creek

Removed September 2012

Kent Park Dam – Darby Creek - Removed September 2012

Hiestand Saw Mill Dam

Chiques Creek

Removed June 2015

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