NOAA FISHERIES

Gloucester, MA

Improving Implementation and Effectiveness Monitoring at Dam Removal Sites:

Integration with project and program planning

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Presentation Map

- Consider why we monitor dam removal sites
- Review NOAA Restoration Center's (RC) monitoring program design and basic elements
- Present RC dam removal monitoring network in Northeast U.S.
- Present example of monitoring results informing project implementation
- Questions

Why does NOAA RC monitor dam removals?

- NOAA Fisheries aims to improve diadromous fish habitat quality and access
- NOAA RC provides funding and technical assistance for dam removals
- Thus a direct interest in project outcomes:
  - implementation quality (short-term)
  - ecological effectiveness (long-term)

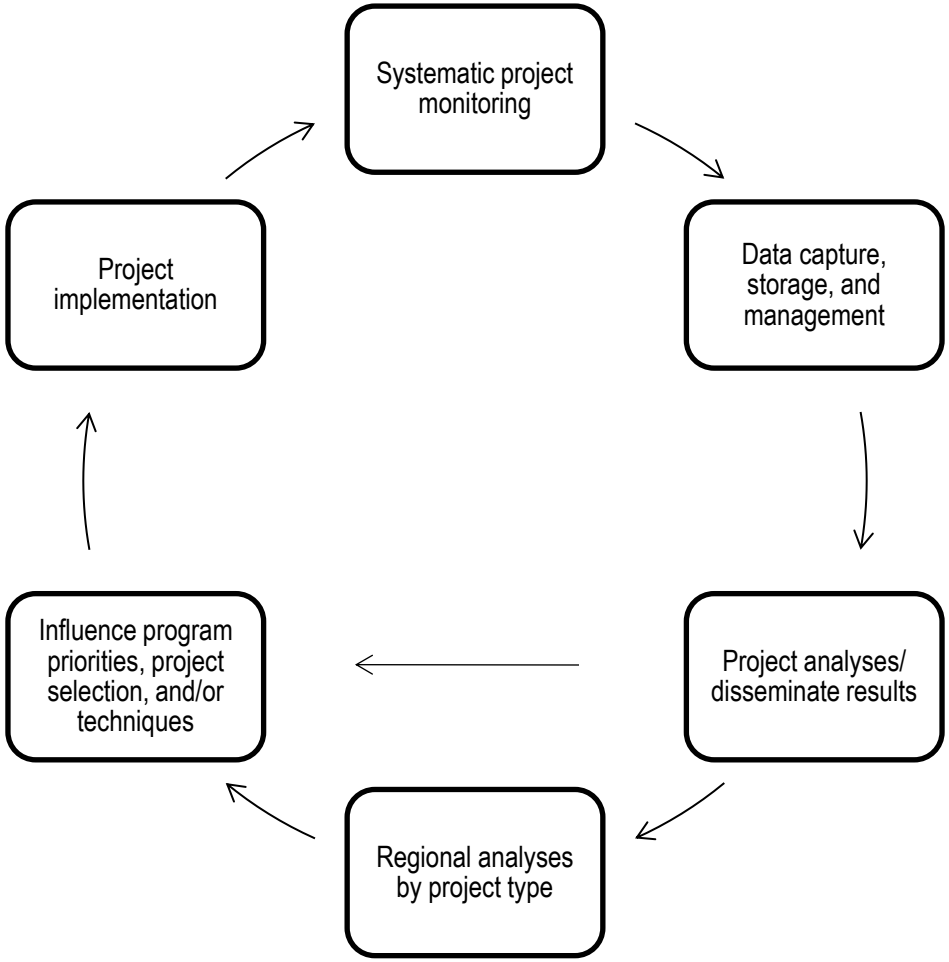
NOAA RC monitoring program: three organizing principles

1. Tiered monitoring
   - improves cost-effectiveness
   - evaluates short and long-term outcomes
2. Monitoring integrated with program planning
3. Partnerships to accomplish

Principle 1: tiered monitoring

- Tier I
  - *implementation monitoring*
  - short-term
  - provides basic project QA/QC
  - ALL PROJECTS
- Tier II
  - *effectiveness monitoring:* ecological, socioeconomic, and/or technique
  - long-term
  - addresses questions of regional importance
  - provides science base to advance RC programs and restoration practice
  - SELECTED PROJECTS

Principle 2: integrated monitoring

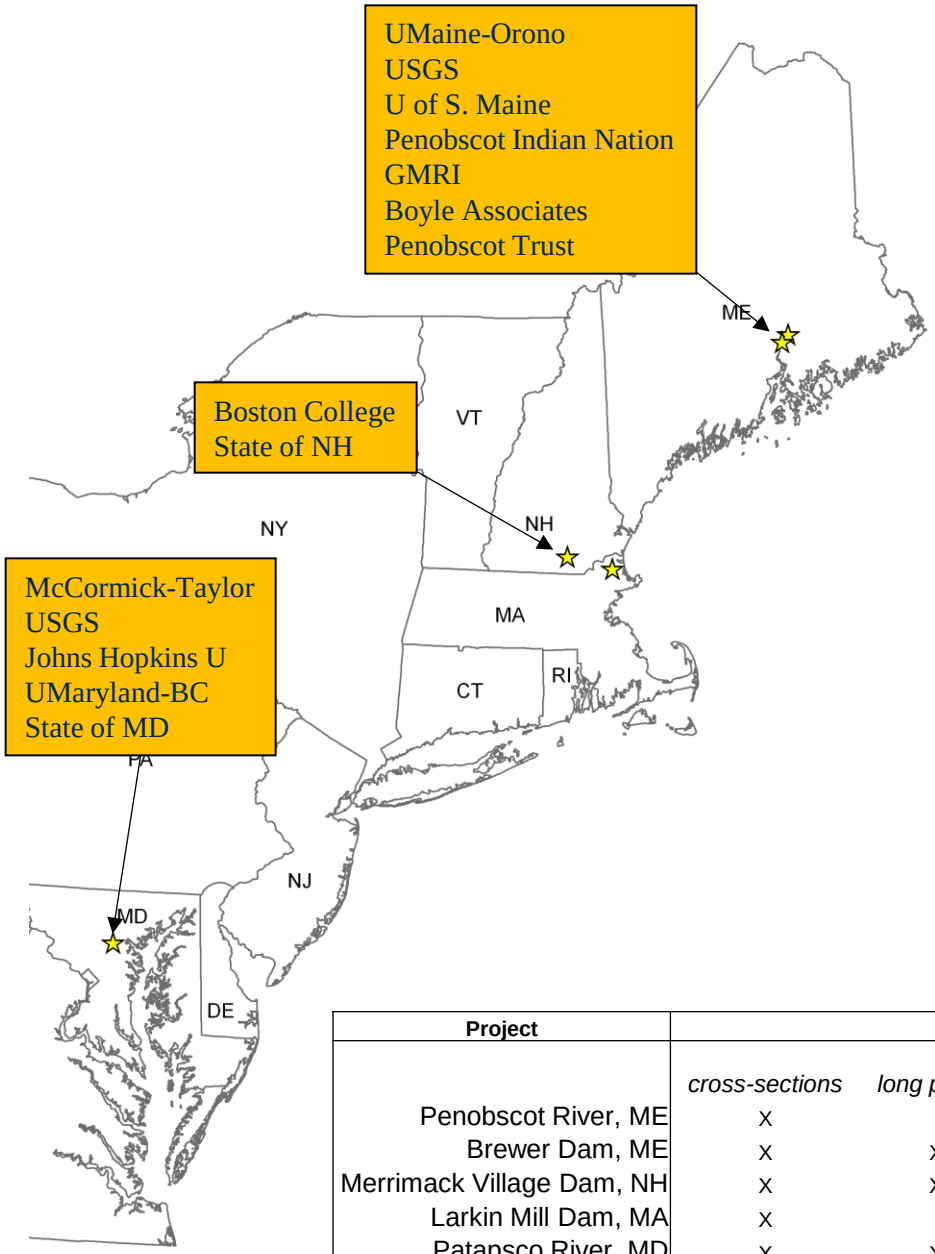


Tier I dam removal monitoring

- All NOAA RC-funded dam removals (since 2009)
- Primary ecological metrics:
  - site passability (as-built survey)
  - upstream presence/absence of target species
- Socioeconomic metrics too
- Before-After (BA) design
- Evaluated within 1 year post-project

Tier II dam removal monitoring

- Selected sites
- Evaluates ecological, socioeconomic, and/or technique effectiveness
- Standard metrics and methods—some flexibility for site requirements
- Before-After, Control Impact (BACI) design
- Long-term data collection (i.e., > 5 years post-project)

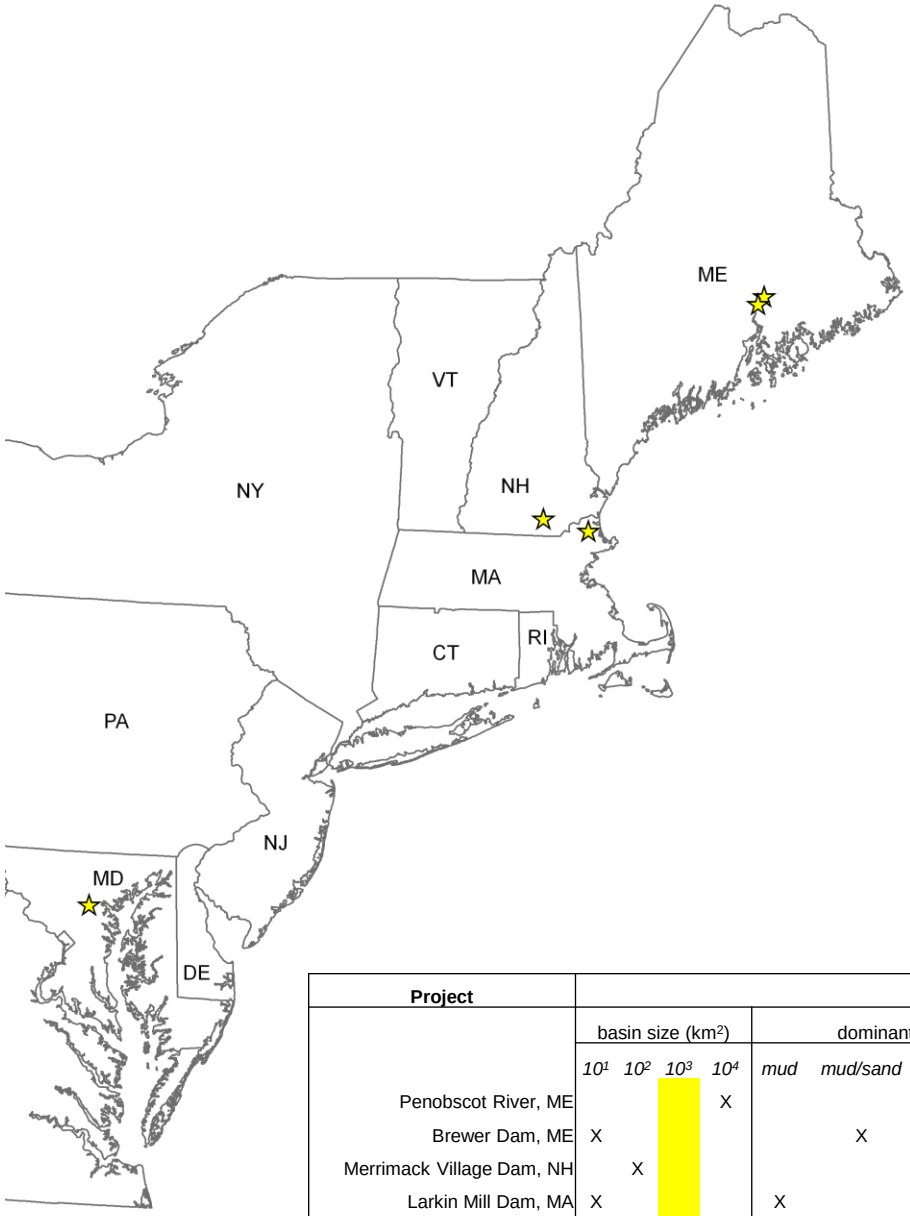


Northeast Region Tier II sites: dam removal

- 5 sites to date
- Evaluating parameters recommended in regional monitoring guidance

(Collins et al., 2007)

Project	Parameter							
	cross-sections	*long profile*	*grain size*	*photo points*	*vegetation*	*WQ*	*macroinvertebrates*	*fish*
Penobscot River, ME	x		x	x	x	x	x	x
Brewer Dam, ME	x	x	x	x		x		x
Merrimack Village Dam, NH	x	x	x	x	x	x	x	x
Larkin Mill Dam, MA	x		x	x				
Patapsco River, MD	x	x	x	x		x	x	x

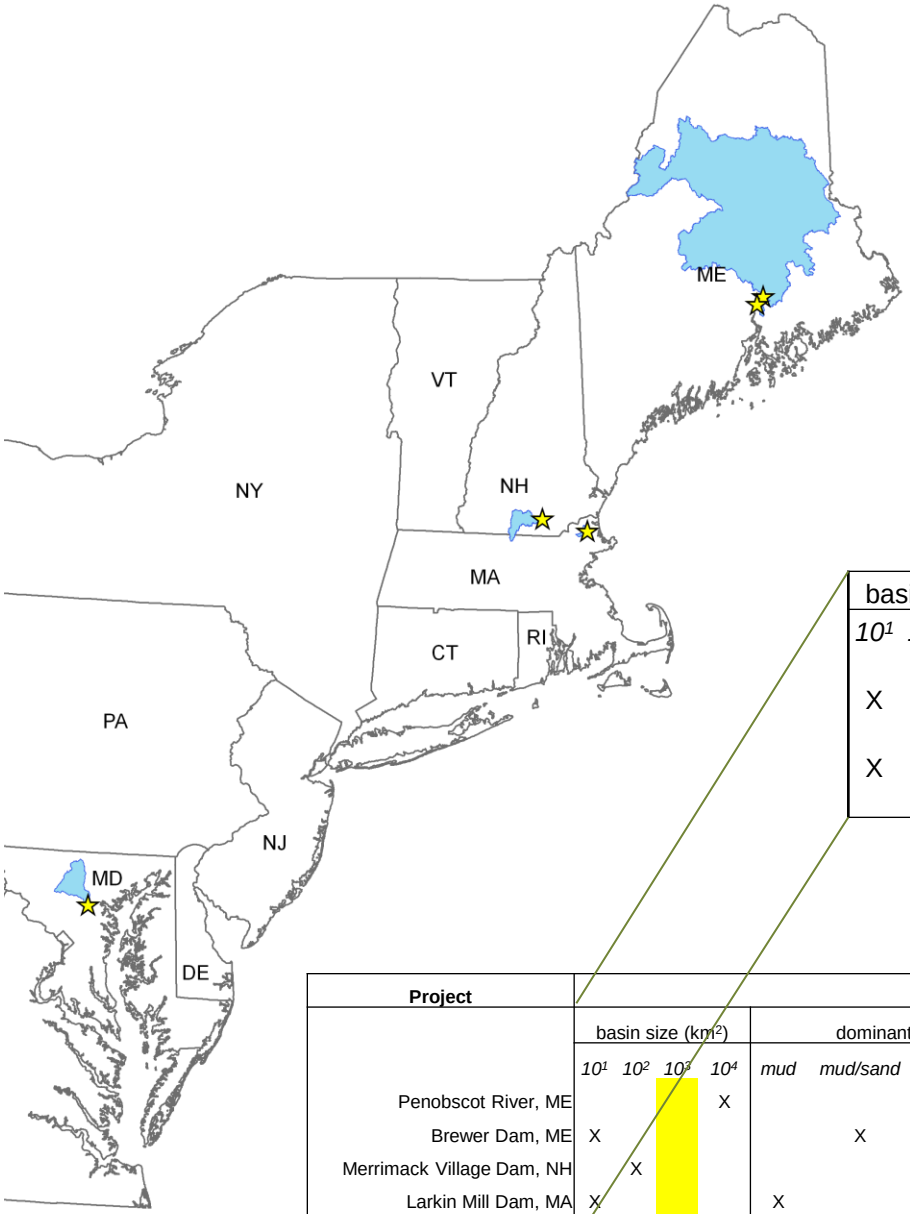


Northeast Region Tier II sites: dam removal

- Chosen to answer ecological or technique effectiveness questions of interest
- Chosen to represent regional fluvial habitat variability

Project	Fluvial Habitat Variability																							
	basin size (km^2)				dominant impounded sediment					reach gradient (%)				physiography						glaciated		climate		
	10^1	10^2	10^3	10^4	mud	mud/sand	sand	sand/gravel	gravel	<<1	<1	1-2	2-5	PU	PL	CP	NU	SL	HV	Y	N	Dfb	Dfa	Cfa
Penobscot River, ME				X					X		X						X			X		X		
Brewer Dam, ME	X					X					X						X			X		X		
Merrimack Village Dam, NH		X					X				X	X						X		X		X		
Larkin Mill Dam, MA	X				X						X							X		X			X	
Patapsco River, MD		X						X			X			X							X			X

Northeast Region Tier II sites: dam removal



basin size (km²)				dominant impounded sediment				
10^1	10^2	10^3	10^4	mud	mud/sand	sand	sand/gravel	gravel
			X					X
X					X			
	X					X		
X				X				
	X						X	

Project	Fluvial Habitat Variability																				
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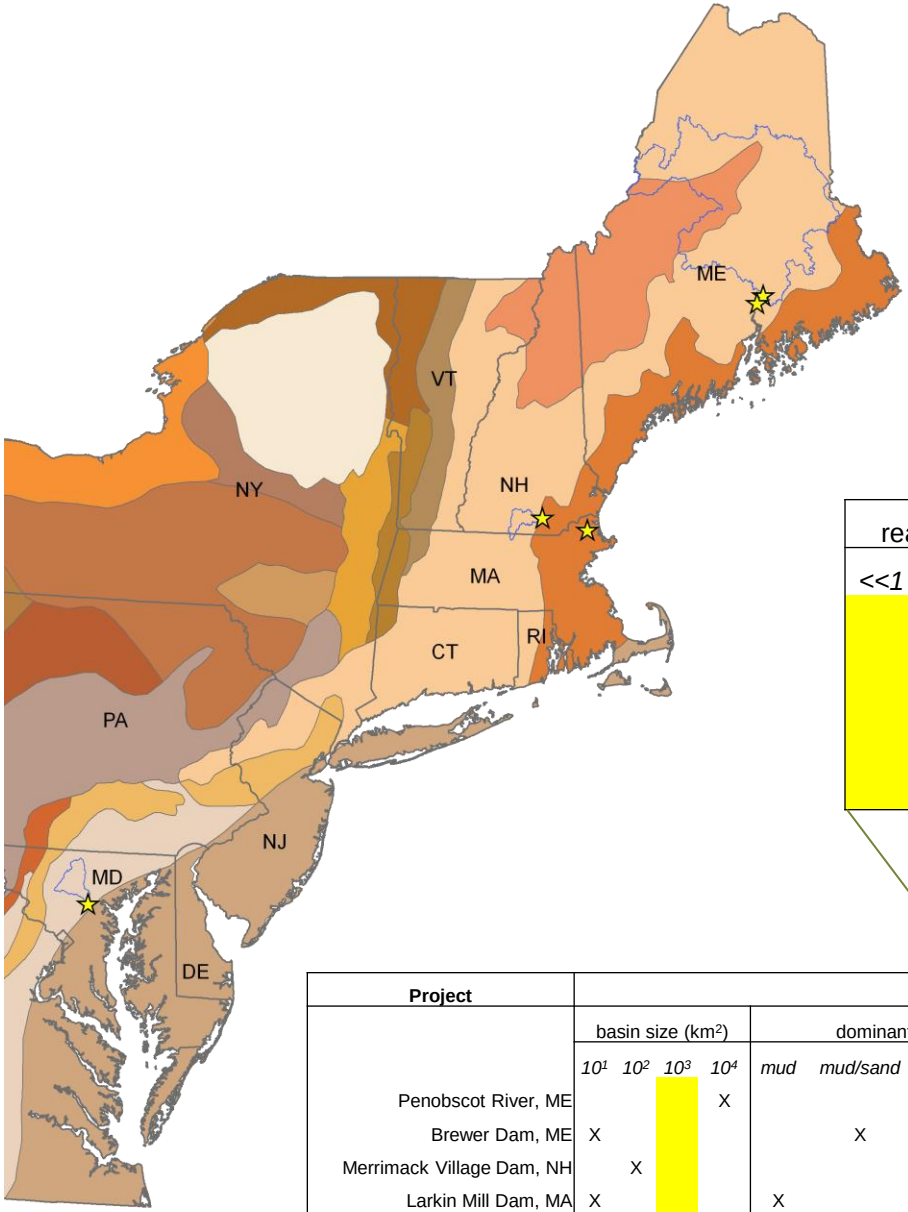
	10^1	10^2	10^3	10^4	mud	mud/sand	sand	sand/gravel	gravel	<<1	<1	1-2	2-5	PU	PL	CP	NU	SL	HV	Y	N	Dfb	Dfa	Cfa
Penobscot River, ME				X					X		X						X			X		X		
Brewer Dam, ME	X					X					X						X			X		X		
Merrimack Village Dam, NH		X					X				X	X						X		X		X		
Larkin Mill Dam, MA	X				X						X							X		X			X	
Patapsco River, MD		X						X			X			X							X			X

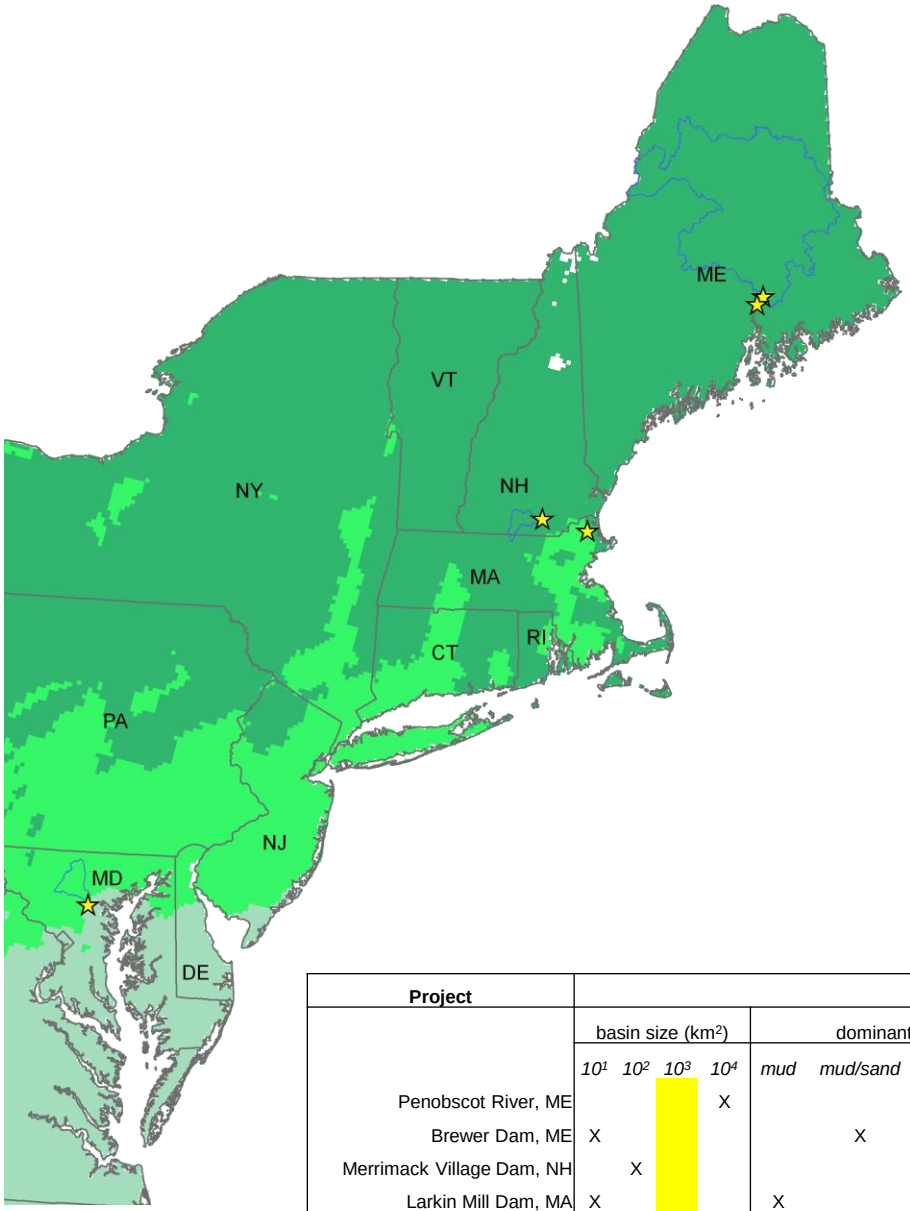
Northeast Region Tier II sites: dam removal



reach gradient (%)				physiography						glaciated	
<<1	*<1*	*1-2*	*2-5*	*PU*	*PL*	*CP*	*NU*	*SL*	*HV*	*Y*	*N*
	X						X			X	
	X						X			X	
	X	X						X		X	
	X							X		X	
	X			X							X

Project	Fluvial Habitat Variability																							
	basin size (km²)				dominant impounded sediment					reach gradient (%)				physiography						glaciated		climate		
	10^1	*10^2*	*10^3*	*10^4*	*mud*	*mud/sand*	*sand*	*sand/gravel*	*gravel*	*<<1*	*<1*	*1-2*	*2-5*	*PU*	*PL*	*CP*	*NU*	*SL*	*HV*	*Y*	*N*	*Dfb*	*Dfa*	*Cfa*
Penobscot River, ME				X					X		X						X			X		X		
Brewer Dam, ME	X					X					X						X			X		X		
Merrimack Village Dam, NH		X					X				X	X						X		X		X		
Larkin Mill Dam, MA	X				X						X							X		X			X	
Patapsco River, MD		X						X			X			X							X			X

Northeast Region Tier II sites: dam removal



climate		
Dfb	*Dfa*	*Cfa*
X		
X		
X		
	X	
		X

Project	Fluvial Habitat Variability																							
	basin size (km²)				dominant impounded sediment					reach gradient (%)				physiography						glaciated		climate		
	10^1	*10^2*	*10^3*	*10^4*	*mud*	*mud/sand*	*sand*	*sand/gravel*	*gravel*	*<<1*	*<1*	*1-2*	*2-5*	*PU*	*PL*	*CP*	*NU*	*SL*	*HV*	*Y*	*N*	*Dfb*	*Dfa*	*Cfa*
Penobscot River, ME				X					X		X						X			X		X		
Brewer Dam, ME	X					X					X						X			X		X		
Merrimack Village Dam, NH		X					X				X	X						X		X		X		
Larkin Mill Dam, MA	X				X						X							X		X			X	
Patapsco River, MD		X						X			X			X							X			X

Tier II technique effectiveness example: Merrimack Village Dam (NH)

KEY QUESTION

- At what rates do sediments (sand) deliberately discharged to a downstream reach, and temporarily stored there, remobilize?

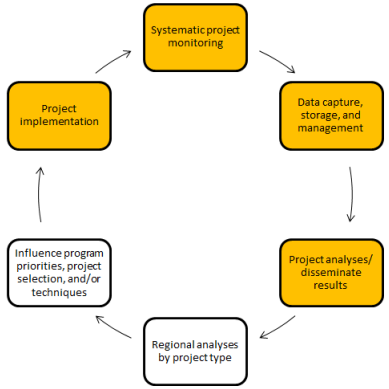
IMPACT

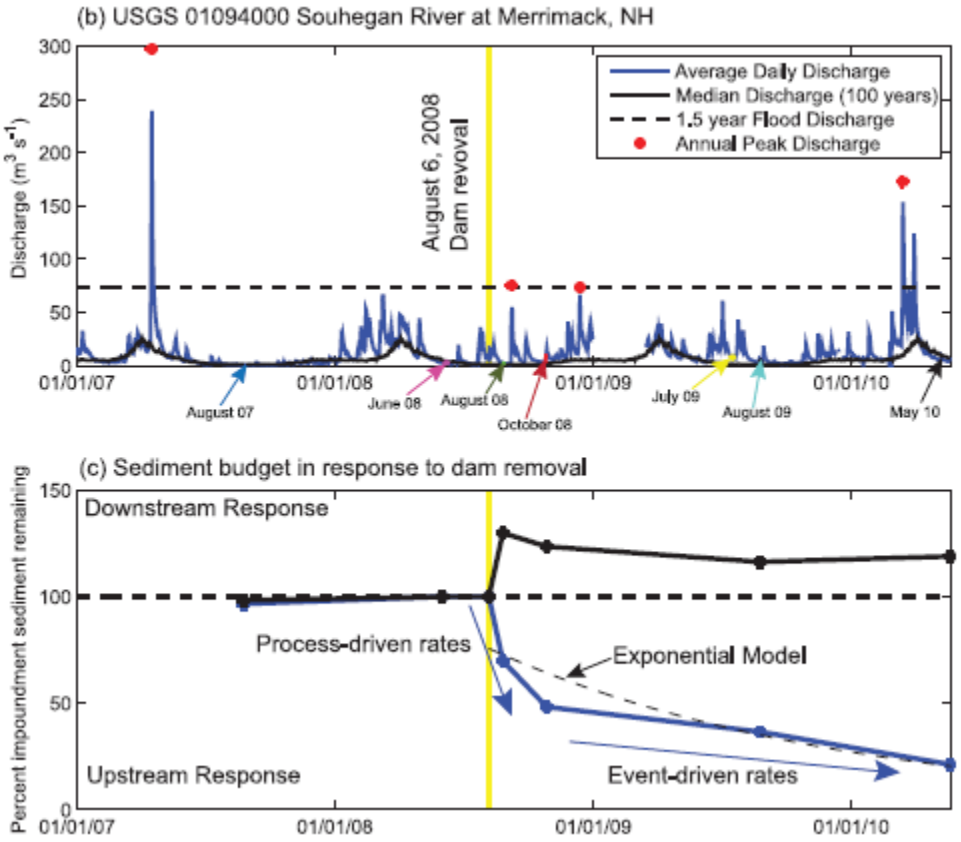
- Improved understanding of the potential impacts of sediment accretion on stream biota, infrastructure, flood stages, recreational uses of the river, and adjacent land uses

RESULTS

- Large downstream sand deposits remobilize surprisingly quickly
- Results directly impacted Patapsco dam removal design approach and regulatory process

after Pearson et al. (2011)





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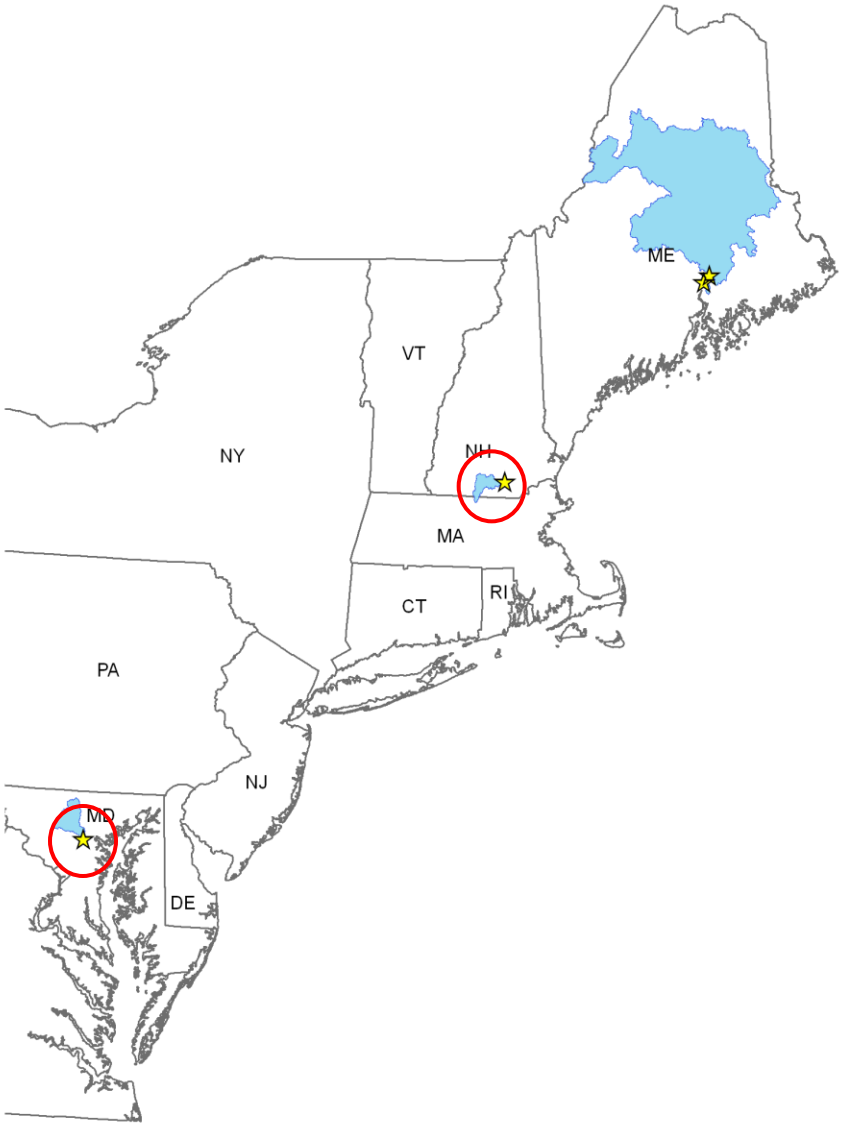
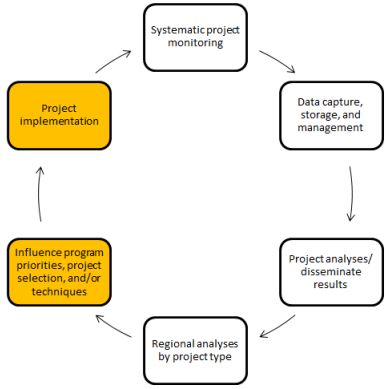
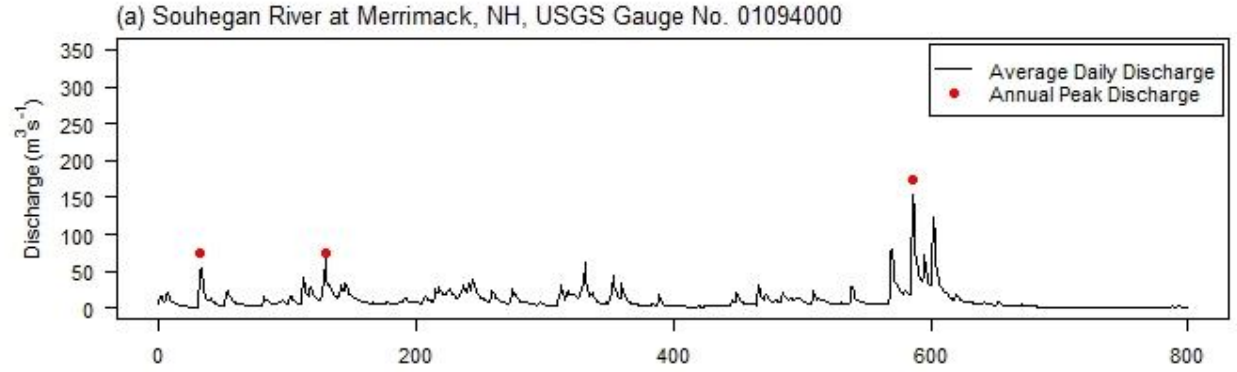
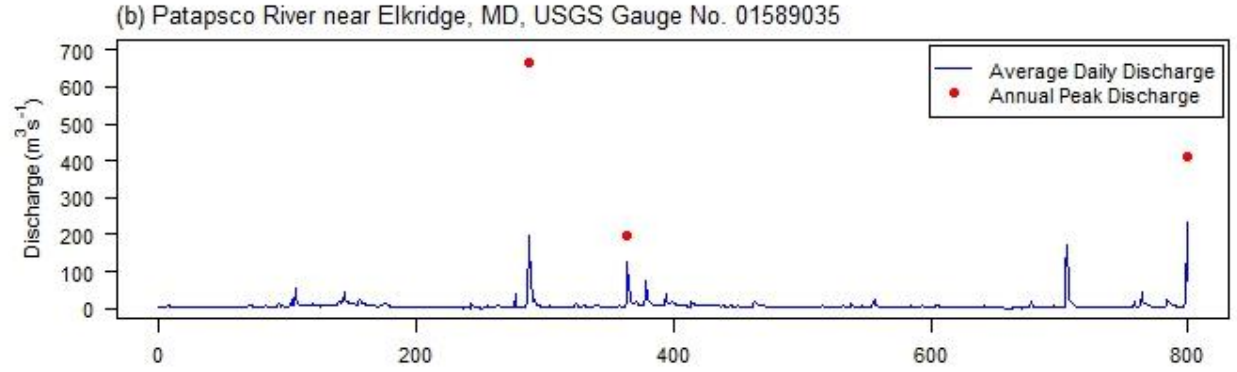
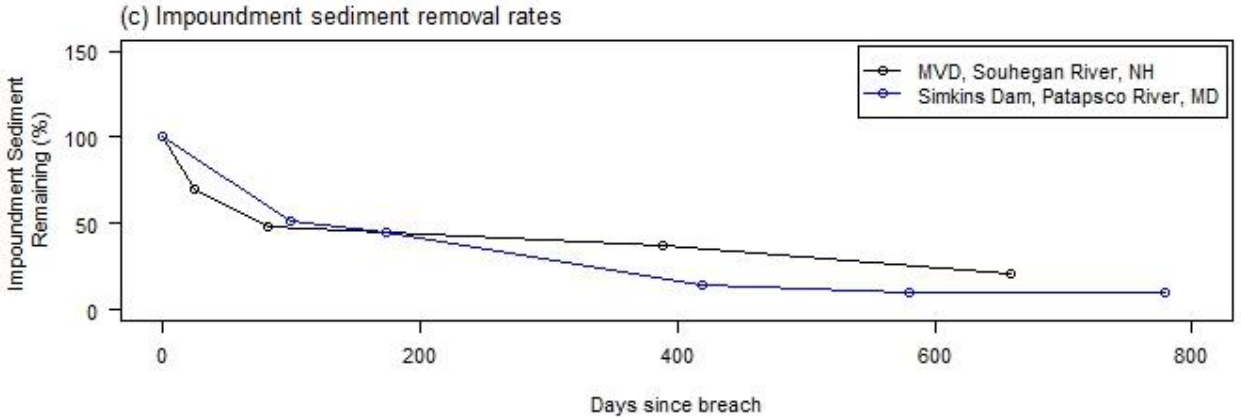


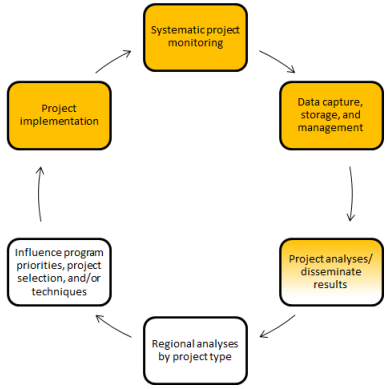


- Simkins dam removal site (MD) analogous to Merrimack site
  - Sediment volume, grain size, and quality
  - Watershed size
  - Low gradient downstream reach
- Simkins project team seeking passive sediment management


(a) Souhegan River at Merrimack, NH, USGS Gauge No. 01094000
Discharge ($m^3 s^{-1}$)
Average Daily Discharge
Annual Peak Discharge
0
50
100
150
200
250
300
350
0
200
400
600
800


(b) Patapsco River near Elkridge, MD, USGS Gauge No. 01589035
Discharge ($m^3 s^{-1}$)
Average Daily Discharge
Annual Peak Discharge
0
100
200
300
400
500
600
700
0
200
400
600
800


(c) Impoundment sediment removal rates
Impoundment Sediment Remaining (%)
MVD, Souhegan River, NH
Simkins Dam, Patapsco River, MD
0
50
100
150
0
200
400
600
800
Days since breach


Systematic project monitoring
Data capture, storage, and management
Project analyses/ disseminate results
Regional analyses by project type
Influence program priorities, project selection, and/or techniques
Project implementation

Further Work

- Improve Tier II network's representation of regional habitat variability
- Formalize a process for identifying monitoring questions of programmatic importance
- Strengthen many components of the integrated monitoring process


Questions?