

A photograph showing a large dam constructed from a dense pile of sticks and branches, partially submerged in a muddy stream. A man in a black t-shirt with a beaver logo and the text 'DAM IT!', dark pants, and rubber boots stands on the muddy bank next to the dam. Two women are walking away from the camera in the background. The scene is set in a wooded area with bare trees.

The North American Beaver: Don't Believe Everything You Think

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TAKEAWAYS

If you build it they will come

Beaver and what you didn't learn in history class

Trout, Beaver, and Salmon coevolved

Using nature to restore nature

“I now suspect that just as a deer herd lives in mortal fear of its wolves, so does a mountain live in mortal fear of its deer.”

**Thinking Like a Mountain
Aldo Leopold**

















Bridge Creek, Oregon

- NOAA Funding
- Objective is to improve salmonid habitat
- 10 year study
- Beaver dam analogs
- Several meters of aggradation in 5 years







Outside the Box Thinking

- Direct flows into the hillside.
- Widens the floodplain and spreads out energy.
- Beaver dams trap sediment, increase floodplain connectivity, and establish wetlands.
- “Fight fire with fire.”

Beaver Dam Analogs – BDA's

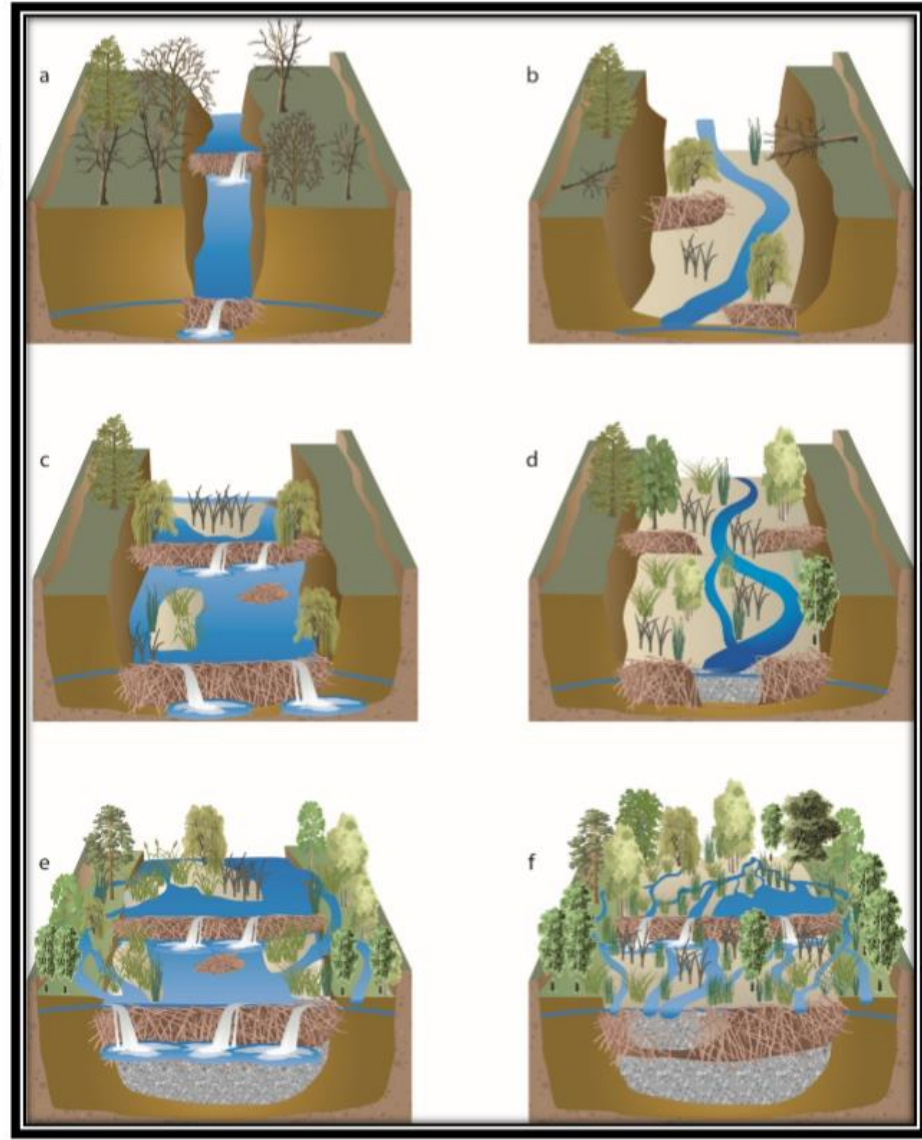


Beaver Dams and Beaver Dam Analogues



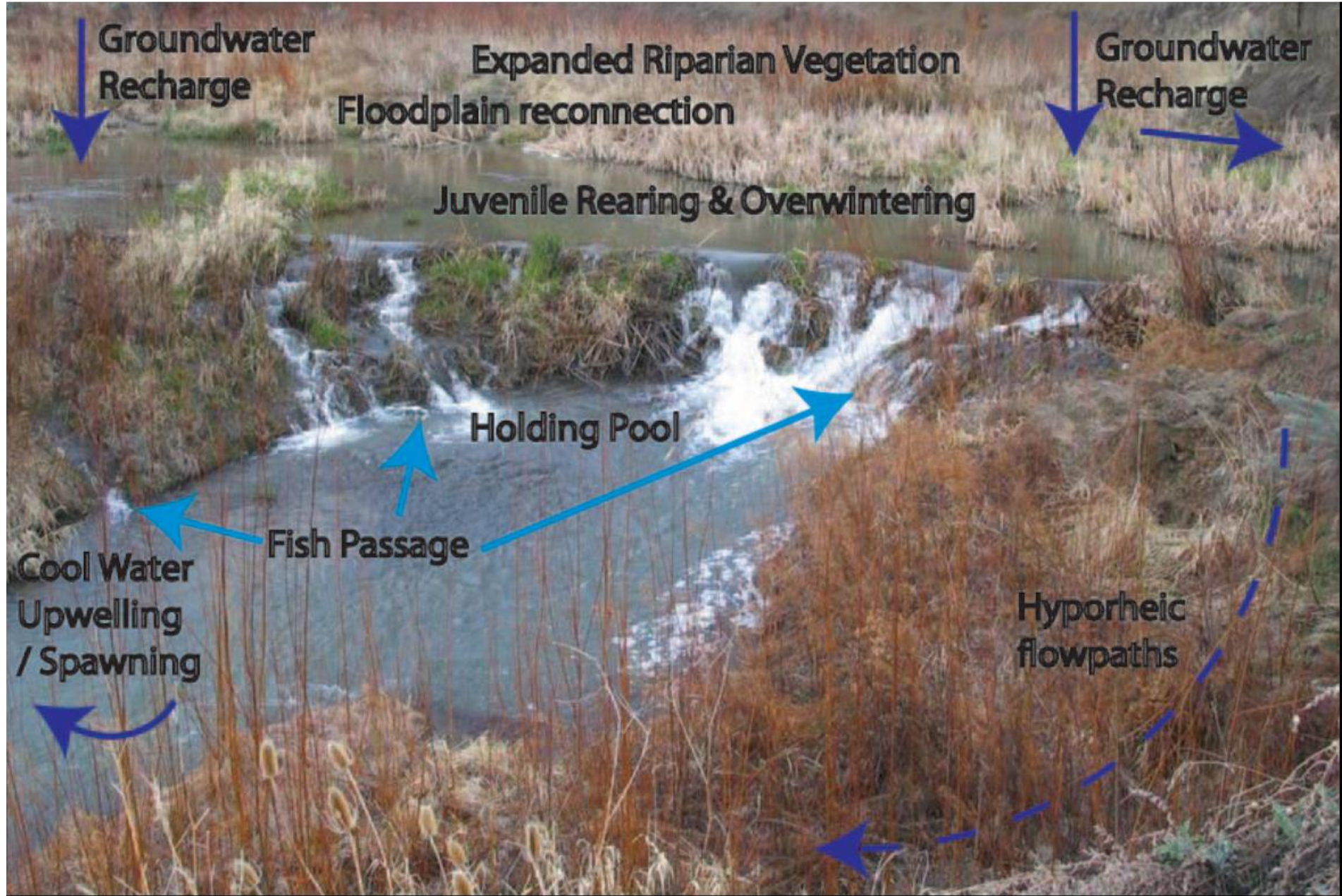
Beaver in incised streams

“Recovery possible in years to decades instead of decades to centuries”



Pollock et al., 2014. using beaver dams to restore incised stream ecosystems. *Bioscience*, 64(4).

Beaver dams create high value habitat





Is your creek
missing
me?



KEYSTONE

Stream Flow and Water Quality

- Beaver ponds increase stream flow in dry seasons by storing run-off in rainy season.
- Increases groundwater tables
- Remove sediment and pollutants
- Harmful bacteria reduced in beaver ponds
- Increased wetland functions

STATE OF THE BEAVER CONFERENCE

FEB 22-24,
2017

BRINGING
BACK BEAVERS
TO BRING BACK
LIFE.



AGENTS OF REGENERATION



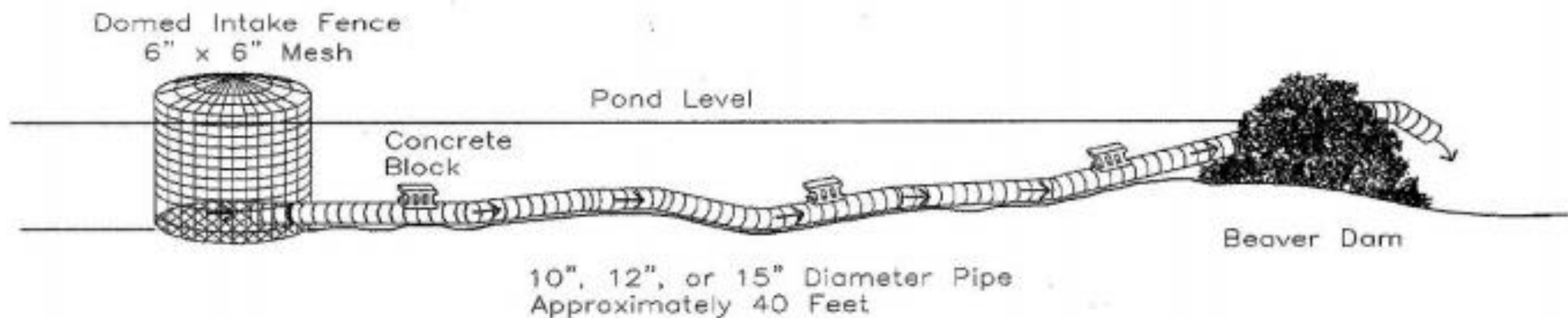




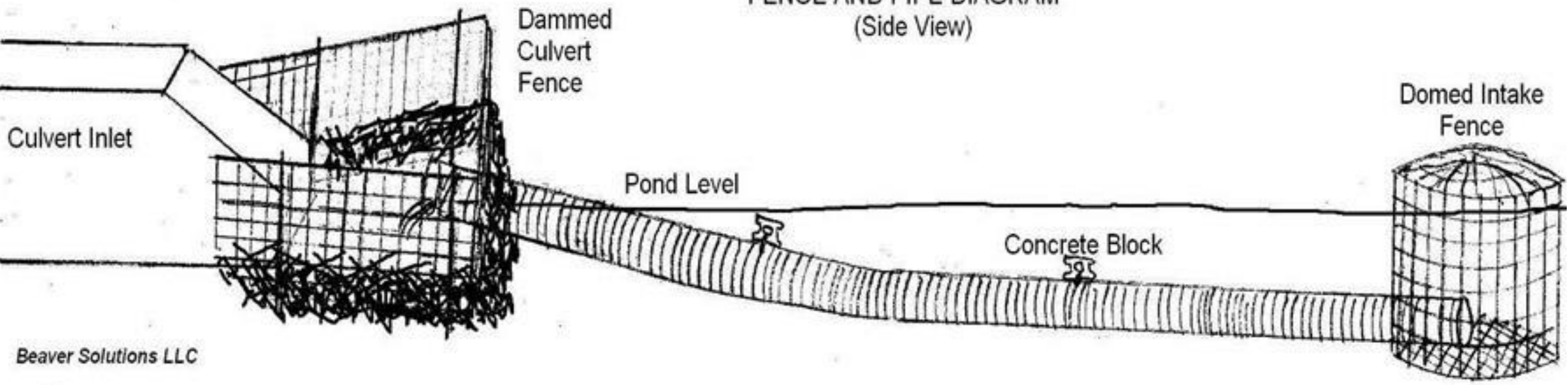
BEAVER
SOLUTIONS

Flexible Pond Leveler™

When flooding from a beaver dam threatens human property, health or safety, a Beaver Solutions Flexible Pond Leveler™ pipe system can be a very effective solution. This flow device will create a permanent leak through the beaver dam that the beavers cannot stop. This eliminates the need for repeated trapping despite the presence of beavers.



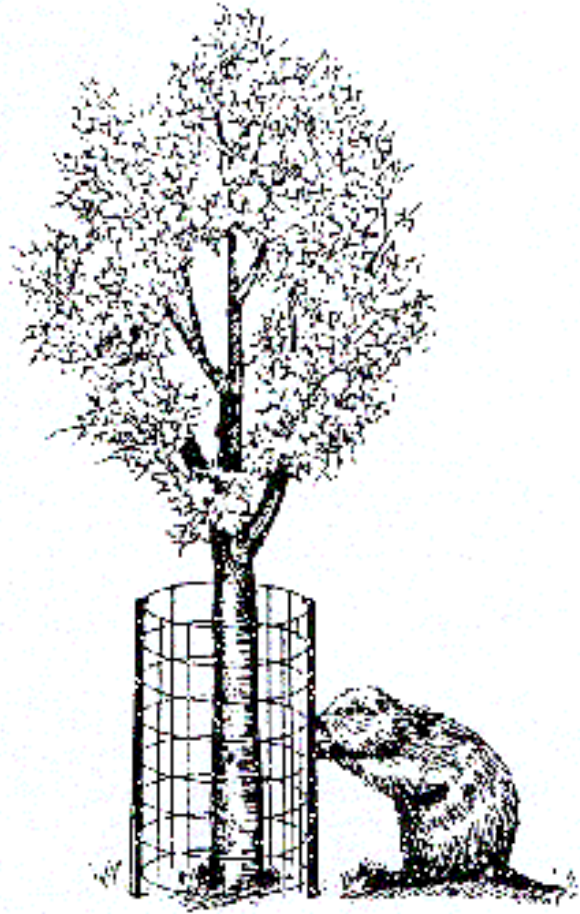
FENCE AND PIPE DIAGRAM
(Side View)







Tree Protection



Beavers in Devon

Enclosed Beaver Project

In 2011 a male and female beaver were introduced into a three hectare fenced enclosure in the Tamar headwaters, where their impacts are being studied in detail. Most of the results presented in this document are from this research site.

The Enclosed Beaver Project is situated on private land in the headwaters of the River Tamar and upstream of Roadford Lake.

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Ordnance Survey Licence number 100022021



The 900 m perimeter fence has electric strands to prevent beavers climbing and a weldmesh apron on the inside to prevent them burrowing underneath. This fencing cost approximately £35/m to construct.



The beavers live in a large lodge situated on the banks of a pond. The lodge has increased in size every winter as more sticks and silt are built on top by the beavers, and willow sticks and branches are placed in the water to create a nearby winter food cache.



Since 2011, 13 ponds of varying sizes have been constructed by the beavers. The dramatic engineering of the watercourse in this site has provided a perfect opportunity to study the impacts of beaver dams on a wide range of different subjects.

Partners and funders



The Enclosed Beaver Project site is owned by John and Elaine Morgan who have kindly allowed this wetland area within their farm to be managed by the beavers. Additional funding has come from Natural Level Stewardship (HLS).



The beavers are owned and managed by the Derek Gow Consultancy. The initial fencing and other infrastructure was funded by Viridor Credits Environmental Company and the Truell Charitable Foundation.

In 2012, Westland Countryside Stewards began funding the project allowing the University of Exeter to carry out detailed research work on the hydrological and water quality implications of the beaver dams.

Funding is currently being sought to continue this project.

River Otter Beaver Trial

In March 2015 two families of wild-living beavers of unknown origin were captured from the River Otter and proven to be healthy before being released back into the river as part of a five year licensed trial.

The River Otter Beaver Trial area covers the entire 250 km² of the Otter catchment containing 594 km of watercourse. The river rises in the predominately pastoral landscape of the Blackdown Hills, before flowing through highly productive agricultural land in its middle and lower reaches. The River Otter enters the sea at Budleigh Salterton.



In February 2015 five beavers were captured by the Animal and Plant Health Agency (APHA). They were given detailed health examinations by beaver experts from the Royal Zoological Society of Scotland (RZSS), who confirmed they were healthy Eurasian beavers and fit for re-release.

Photo:
Nick Upton / Naturepl.com



The beavers were released back into their territories in March 2015. At the start of the trial approximately nine beavers were identified, living in two family groups.

Photo:
Nick Upton / Naturepl.com



In the early stages, beaver activity was concentrated in the lower reaches of the river where there is sufficient deep water and so they have not needed to build dams. As their numbers have increased and they have moved into sub-optimal areas, they are beginning to build dams in the ditches and headwater streams. These are now the subject of detailed research work.

Partners and funders

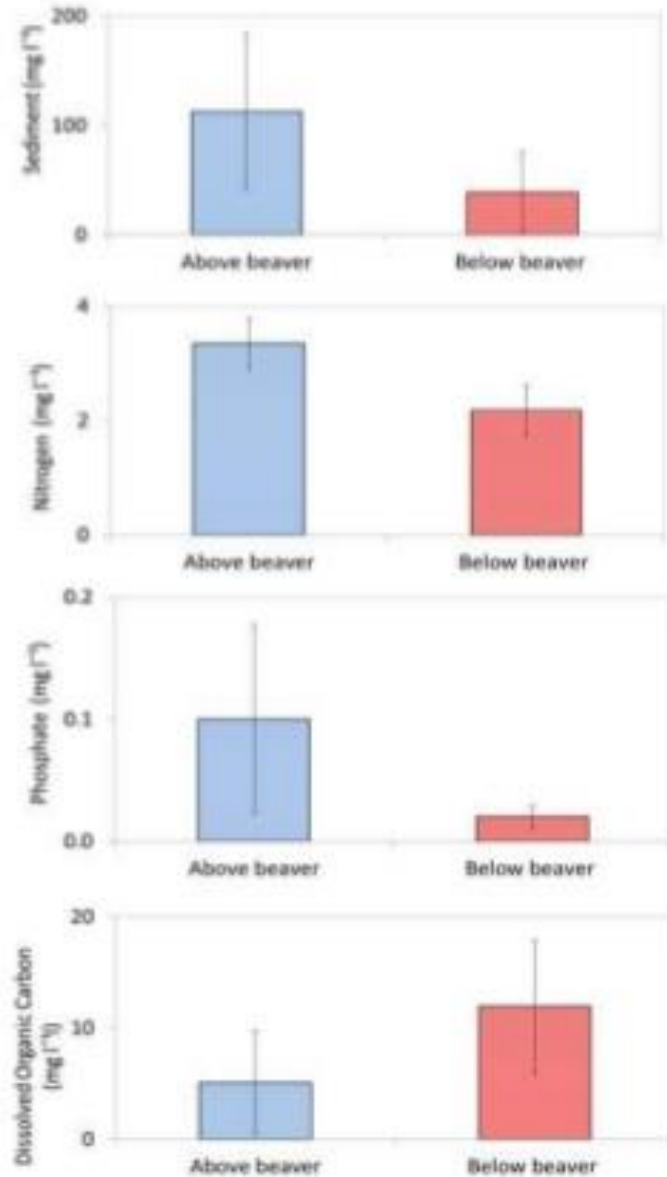
The River Otter Beaver Trial is led by Devon Wildlife Trust working in partnership with The University of Exeter, the Derek Gow Consultancy, and Clinton Devon Estates. Expert independent advice is also provided by the Royal Zoological Society of Scotland, Roisin Campbell-Palmer, Professor Alastair Driver, Professor John Gurnell, and Gerhard Schwab, an international beaver expert based in Bavaria.

Funding for the ROBT comes from Devon Wildlife Trust (DWT), the Royal Society for Wildlife Trusts (RSWT), Peter de Haan Charitable Trust, Garfield Weston Foundation, University of Exeter and from the generous donations from the public.

In 2016, Devon Wildlife Trust launched a crowdfunding campaign to encourage the public to donate to the project in return for a series of unusual things such as beaver chips, guided walks or the appearance of Nora the beaver mascot at your event. www.supportdevonbeavers.org



Devon Beaver Project Results – water quality

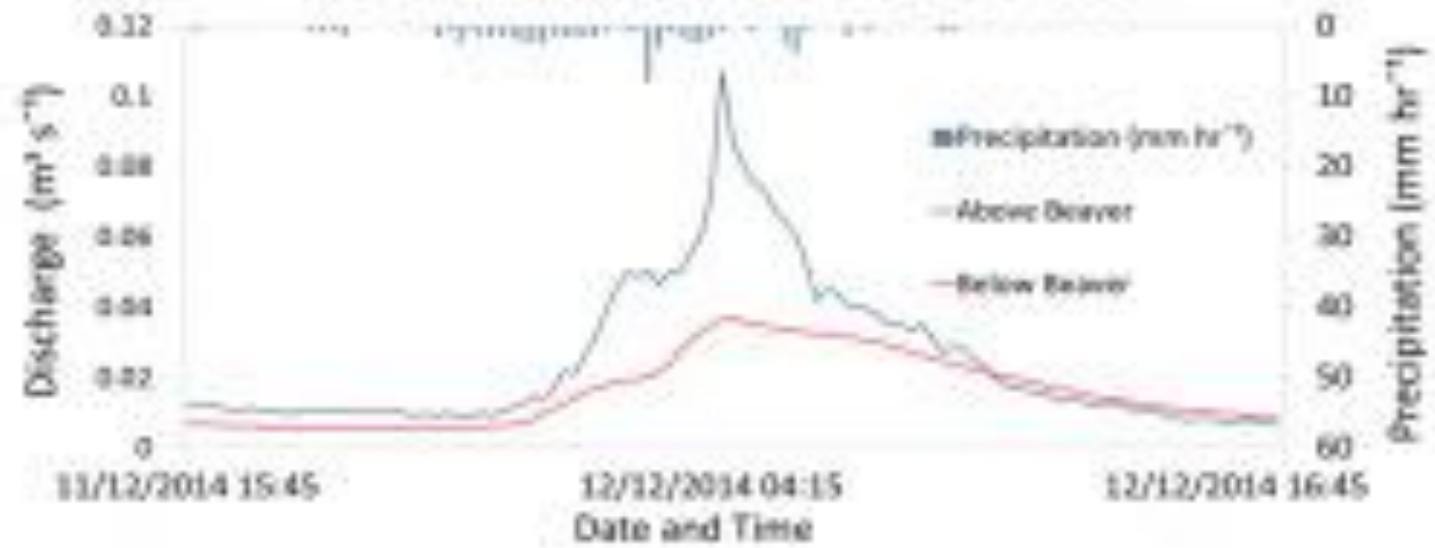


Storm monitoring (17 events, 178 samples above, 119 below), suggests site may act as a sink or filter for diffuse water pollutants from agriculture (suspended sediment, nitrogen and phosphate).

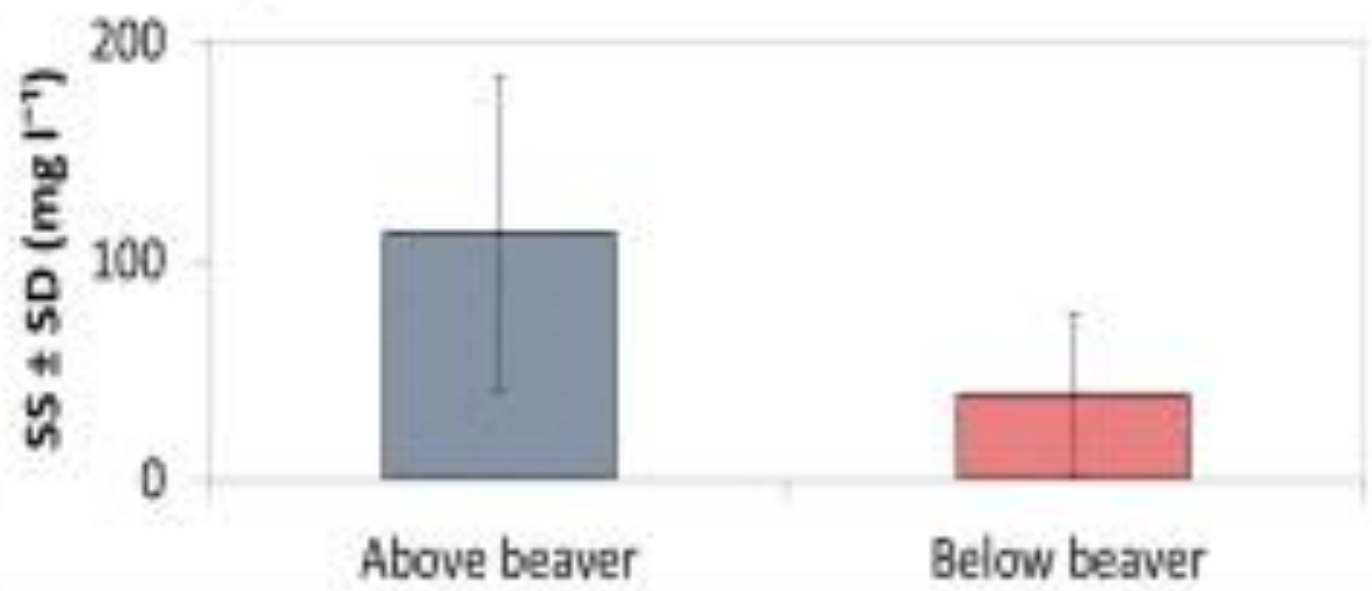
However, more organic matter in the site, so potentially results in a greater loss of dissolved organic carbon than comparative agricultural land.



Flow In and Out of Beaver Site

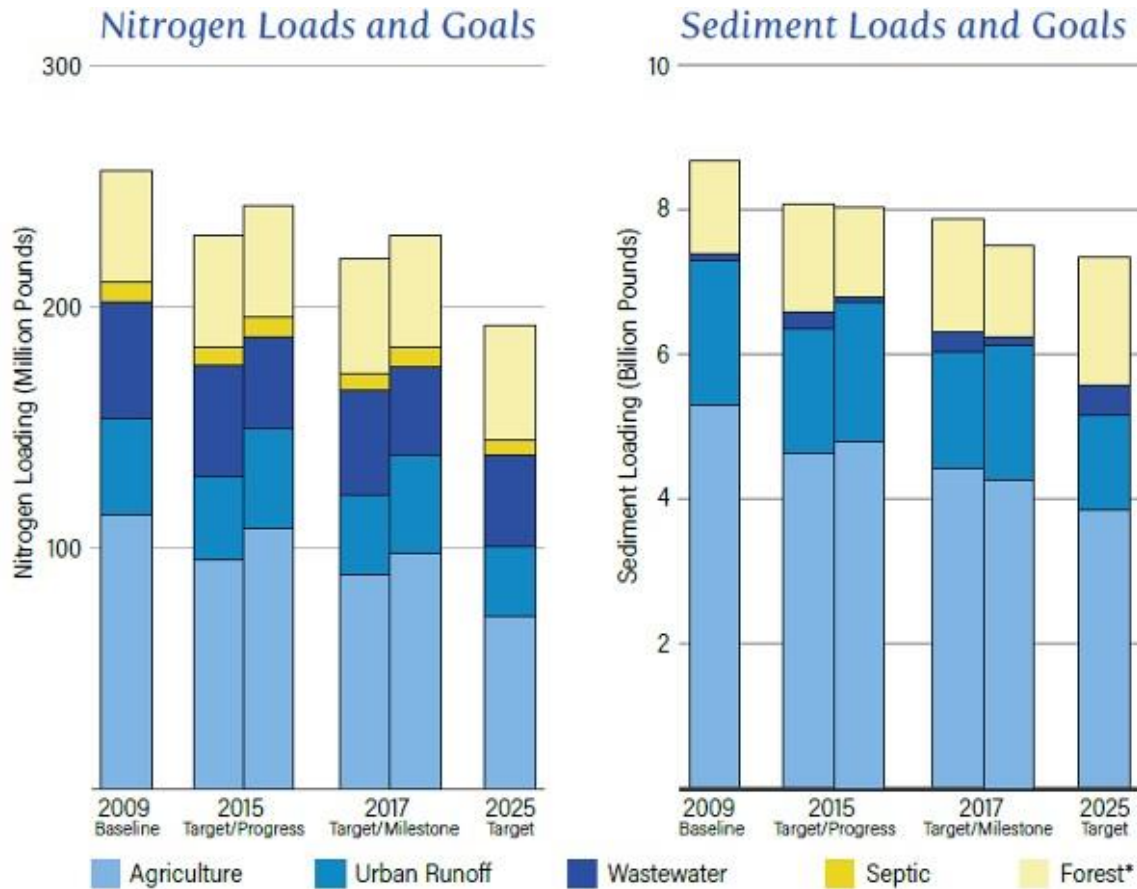


Suspended Sediment Above and Below Beaver Site



Chesapeake Bay TMDL Goals

Maryland



*Forest includes other sources

Maryland Chesapeake Bay TMDL Goals For 2025			
	2025 Goal	2009 Baseline	% Reduction
	million lbs	million lbs	
Nitrogen	39	49.8	21%
Sediment	1,219	1,394	13%

Difference from 2009 to 2025:

- 10.8 million lbs. nitrogen
- 175 million lbs. sediment

Sources

Nitrogen

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2. Correll D, Jordan T, Weller D. 2000. Beaver pond biogeochemical effects in the Maryland Coastal Plain. *Biogeochemistry* 49: 217–239. 10.1023/A:1006330501887.
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4. Lazar JG, Addy K, Gold AJ, Groffman PM, McKinney RA, Kellogg DQ. 2015. Beaver ponds: resurgent nitrogen sinks for rural watersheds in the northeastern United States. *Journal of Environmental Quality* 44:1684–1693. <https://doi.org/10.2134/jeq2014.12.0540>.
5. Bason CW, Kroes DE, Brinson MM. 2017. The Effect of Beaver Ponds on Water Quality in Rural Coastal Plain Streams. *Southeastern Naturalist* 16:584–602.
6. Puttock A, Graham HA, Carless D, Brazier RE. 2018. Sediment and nutrient storage in a beaver engineered wetland. *Earth Surface Processes and Landforms* 43:2358–2370.

Sediment

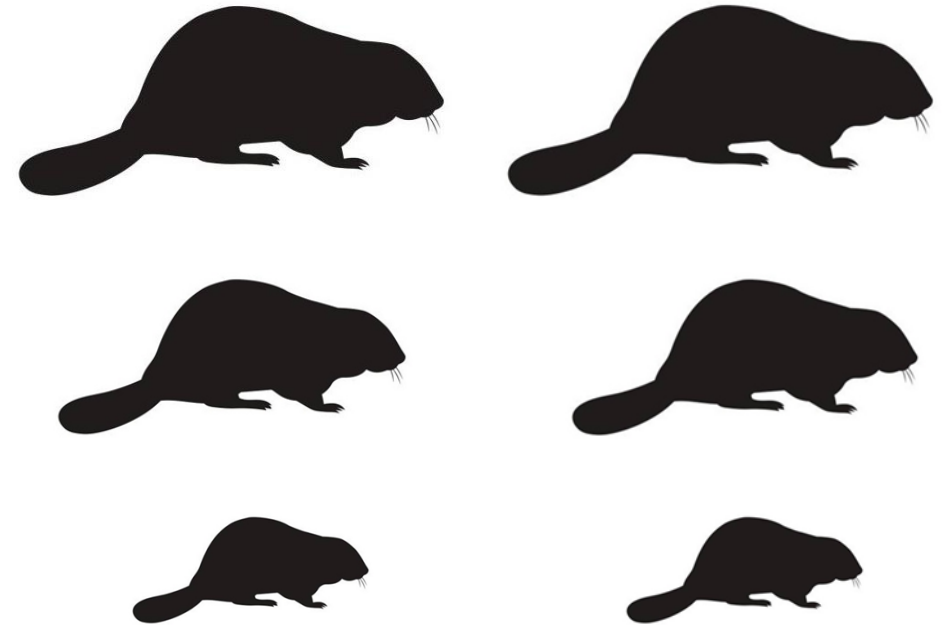
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2. Adams, P.W., and J.O. Ringer. 1994. The effects of timber harvesting & forest roads on water quantity & quality in the Pacific northwest: Summary & annotated bibliography. Oregon Forest Resources Institute. April.
3. Butler DR, Malanson GP. 1995. Sedimentation rates and patterns in beaver ponds in a mountain environment. *Geomorphology* 13:255–269.
4. Correll D, Jordan T, Weller D. 2000. Beaver pond biogeochemical effects in the Maryland Coastal Plain. *Biogeochemistry* 49: 217–239. 10.1023/A:1006330501887.
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7. Renwick W, Smith S, Bartley J, Buddemeier R. 2005. The role of impoundments in the sediment budget of the conterminous United States. *Geomorphology* 71:99–111.
8. Green, K.C. and C.J. Westbrook. 2009. Changes in riparian area structure, channel hydraulics, and sediment yield following loss of beaver dams. *BC Journal of Ecosystems and Management* 10(1):68–79.
9. Westbrook CJ, Cooper DJ, Baker BW. 2011. Beaver assisted river valley formation. *River Research and Applications* 27:247–256.
10. Levine R, Meyer GA. 2014. Beaver dams and channel sediment dynamics on Odell Creek, Centennial Valley, Montana, USA. *Geomorphology* 205:51–64.
11. Lazar JG, Addy K, Gold AJ, Groffman PM, McKinney RA, Kellogg DQ. 2015. Beaver ponds: resurgent nitrogen sinks for rural watersheds in the northeastern United States. *Journal of Environmental Quality* 44:1684–1693. <https://doi.org/10.2134/jeq2014.12.0540>.
12. Bason CW, Kroes DE, Brinson MM. 2017. The Effect of Beaver Ponds on Water Quality in Rural Coastal Plain Streams. *Southeastern Naturalist* 16:584–602.
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Beaver Colonies

- Average of 6 beavers
- Up to 12 beavers



1 colony creates and maintains a 5 acre pond




Nitrogen

- 3,906 beaver can meet the nitrogen TMDL goals for Maryland in 16 years



- 3,255 acres of pond



 = 500 beaver

Sediment

- 1,626 beaver can meet the sediment TMDL goals for Maryland in 16 years



- 1,355 acres of pond



 = 500 acres of pond

*Sediment reduction from Correll and Weller, 2000



Furbearer Seasons, Bag Limits, Locations and Resident Requirements, 2018-2019

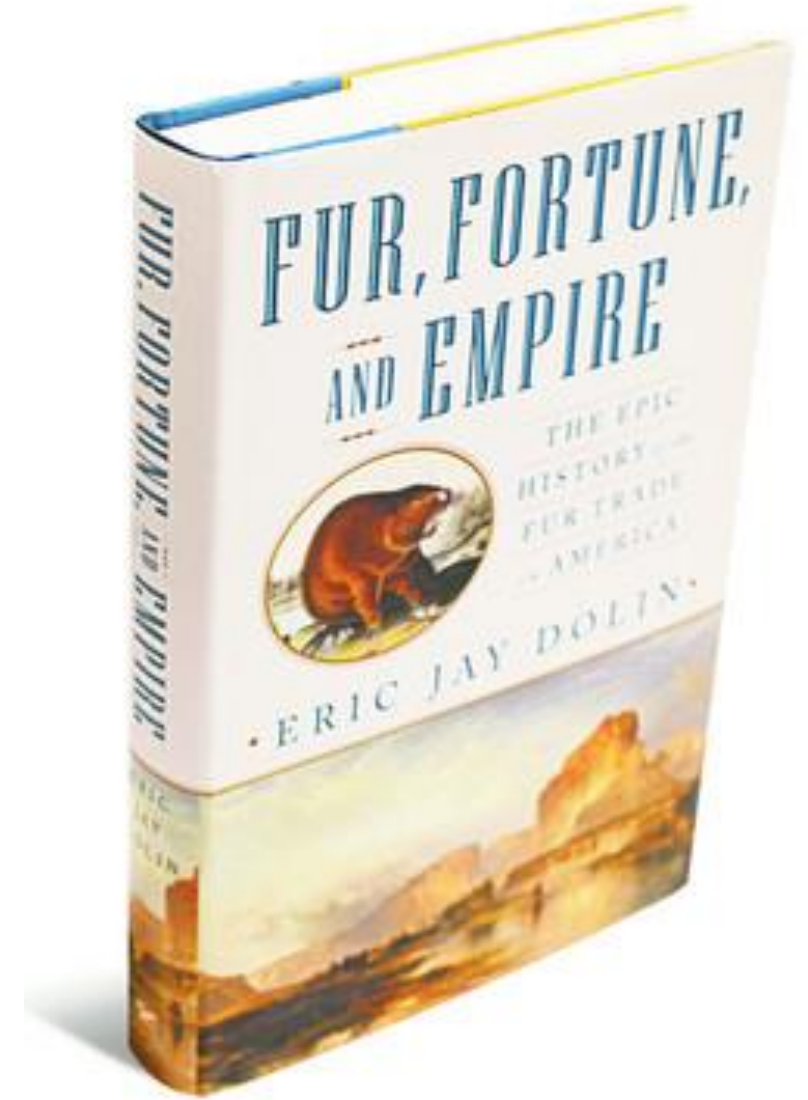
Species	Open Season	Location	Bag Limit	Possession Limit
Beaver – Trapping Only	Dec. 15- March 15	All counties except Allegany and Garrett	No limit	No limit
Beaver – Trapping Only	Dec. 1- March 15	Allegany and Garrett counties	No limit	No limit



Beaver Management in Maryland

- Approximately 1,000-3,000 beaver trapped and killed annually.
- Population is growing.
- Recreational and management trapping by landowners, County and State agencies.
- Live trapping and relocation infeasible/not permitted.
- Minimal use of low flow management devices.
- Most management involves trapping.





300 year history of beaver extirpation in US - economic, not necessarily biological extirpation

Timing of Beaver Trapping
in the Lower 48 States



Map courtesy of Jim Sedell, USDA Forest
Service (2001)

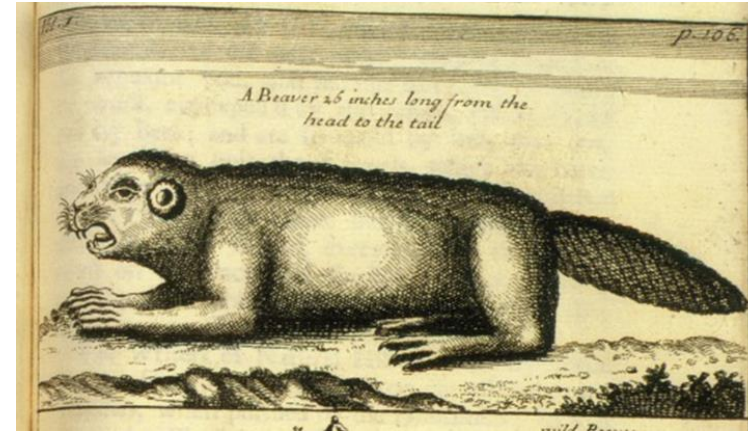


Photo Credit: Canadian Museum of History



Louis Armand, Baron de Lahontan drawing of a beaver circa 1687

Photo Credit: Newberry Library



"Claiborne's elaborate preparations and largescale operation brought in 7488 pounds of beaver pelts (worth £4493 at 12 s./lb.)...in the six years before Kent Island's takeover by Maryland in 1638." – Fredrick J. Fausz, "Present at the Creation"



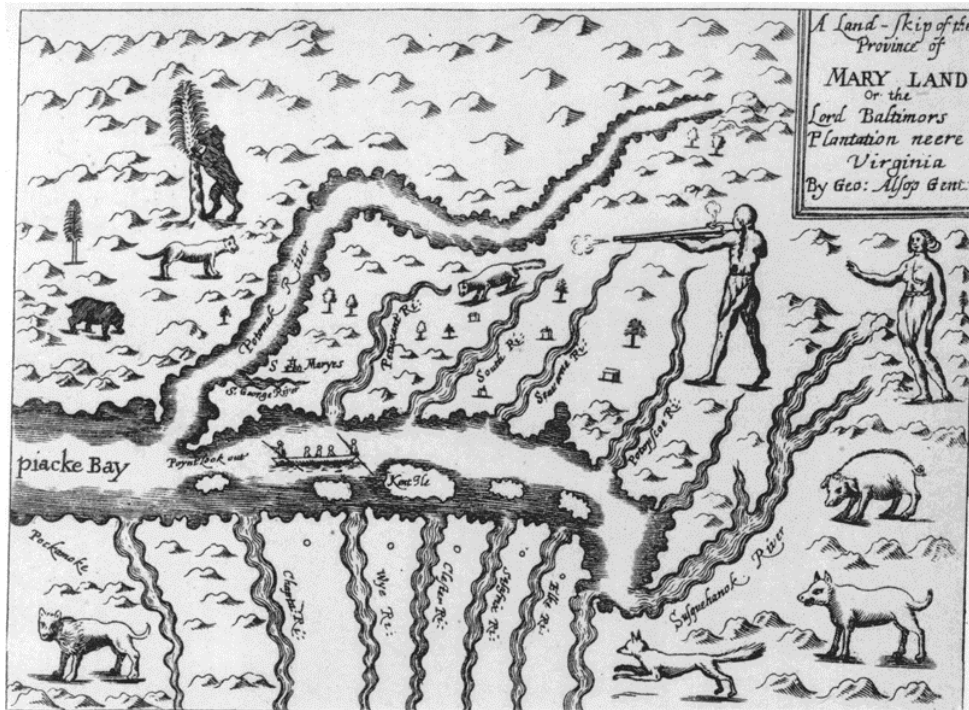
Captain John Smith's map of Virginia 1612



Photo Credit: Old-Maps.com

In spring of 1632, Henry Fleet returned to trade for beaver pelts along the Potomac River, only to find that...

"Charles Harmar...had just cleared both sides of the [Potomac] river, taking some fifteen hundred pounds of pelts back to the Eastern Shore. After receiving 114 pelts as a goodwill offering from the Piscataway tayac fleet, journeyed up to the Nacotchtanks and traded for eight hundred pounds of beaver...with the expectation of getting six thousand pounds the next year" – Fredrick J. Fausz, "Present at the Creation"



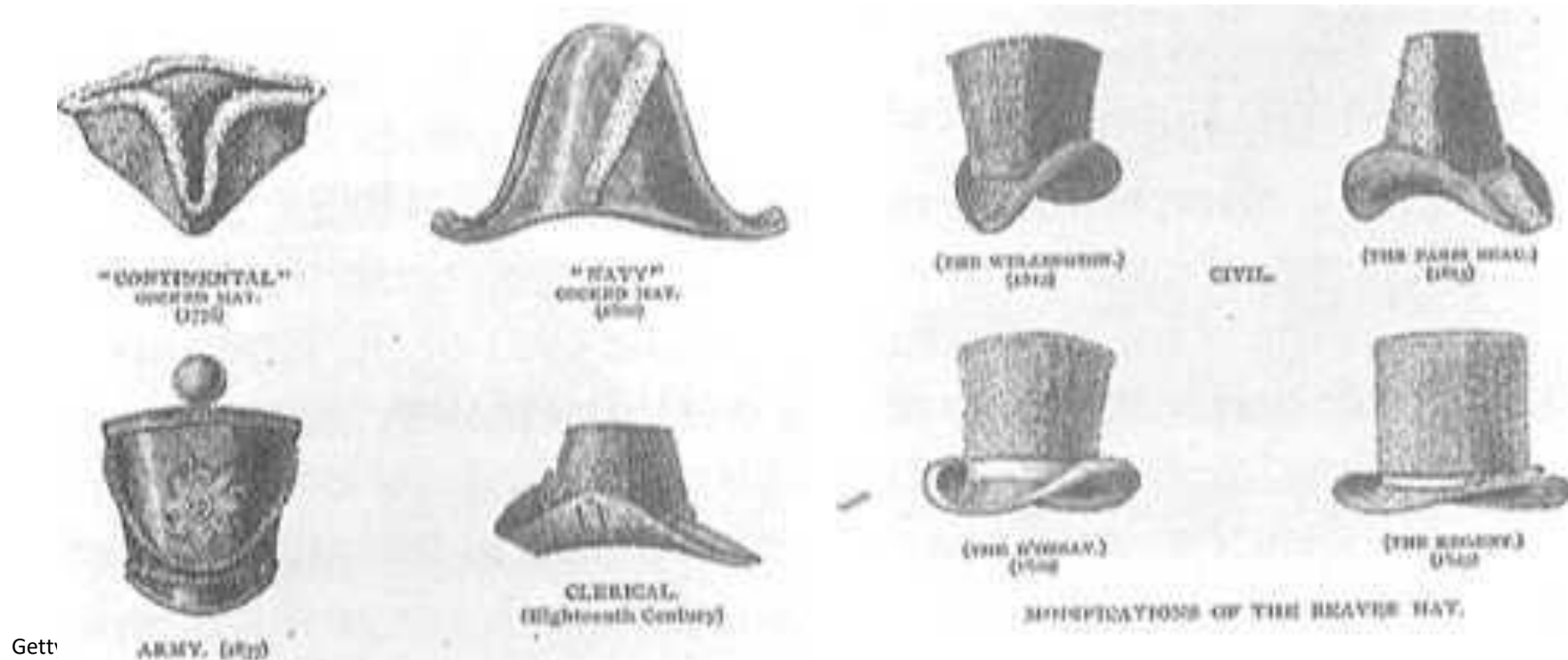
George Alsop's 1666 "Land-skip" map



Photo Credit: Canadian Geographic

Photo Credit: University of Delaware

"In 1643-44 also, over 5700 pounds of beaver pelts were mentioned in debt cases, at a time when one pound was worth between 12s. and 24s., or from 36 to 144 pounds of tobacco. Beaver prices in this two-year period were two to three times higher than they had been only five years before, whereas tobacco prices remained relatively stable (and low) at 3 to 4 pence per pound" – Fredrick J. Fausz, "Present at the Creation"



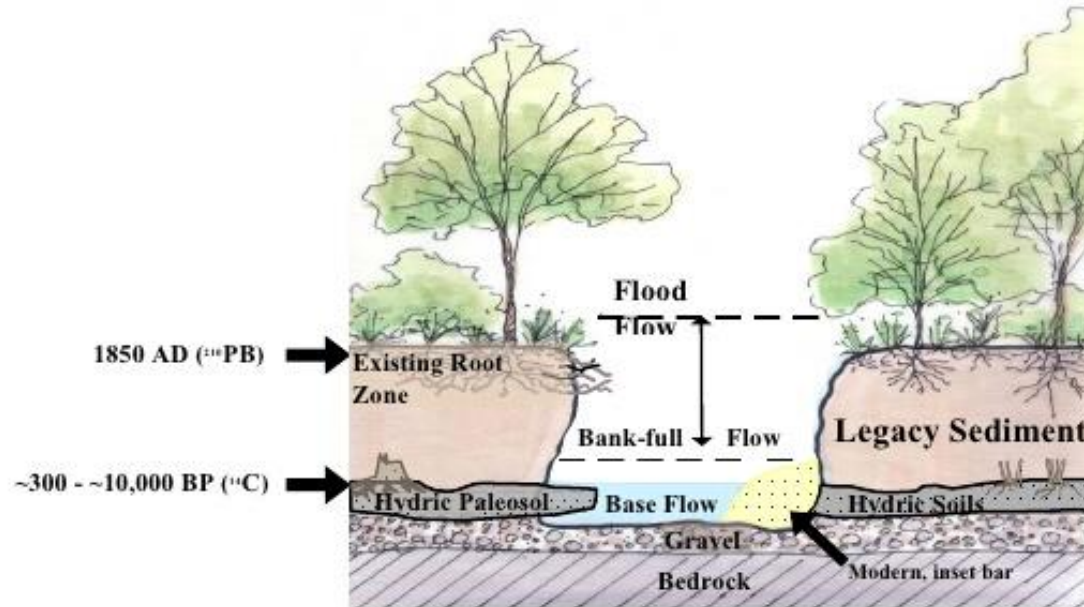
Gett

Photo Credit: Portland State University

"On more than one occasion, colonists found themselves so deeply in debt for beaver pelts that they mortgaged, or had to put up as security, a large portion of their property" – Fredrick J. Fausz, "Present at the Creation"



Typical Existing Condition



- Legacy sediment stored in valley bottoms predominantly was established by the combined effect of increased sediment supply from uplands and sediment trapping behind ubiquitous dams in many watersheds of the mid-Atlantic Region. (Walter and Merritts, 2008)
- Conceptual models linking channel condition and sediment yield exclusively with modern upland landuses are incomplete for valleys impacted by mill dams (Merritts, et al. 2011)
- Streambanks represent a significant sediment and nutrient source in watersheds where channels have incised through legacy sediment. (Walter, Merritts, Rahnis, 2007; 2010)



Historical Streams

- Property surveys reference swamps, pocosins, marshes, moors
 - Pocosin- of Algonquin origin meaning “swamp on a hill”
- Multithreaded wetland complexes

a marsh

Gibson's Marsh

Pocoson

a piece of swampy ground

a great swamp or pocuson

Long Marsh

requiring less than 700, 100 ac, some 224 $\frac{1}{2}$ ac, open swamps or being under water, having clear was added surplus and vacant land 297

Dismal Swamp

pocuson

a hill and on the
the Cattail Marsh
near of Normandy

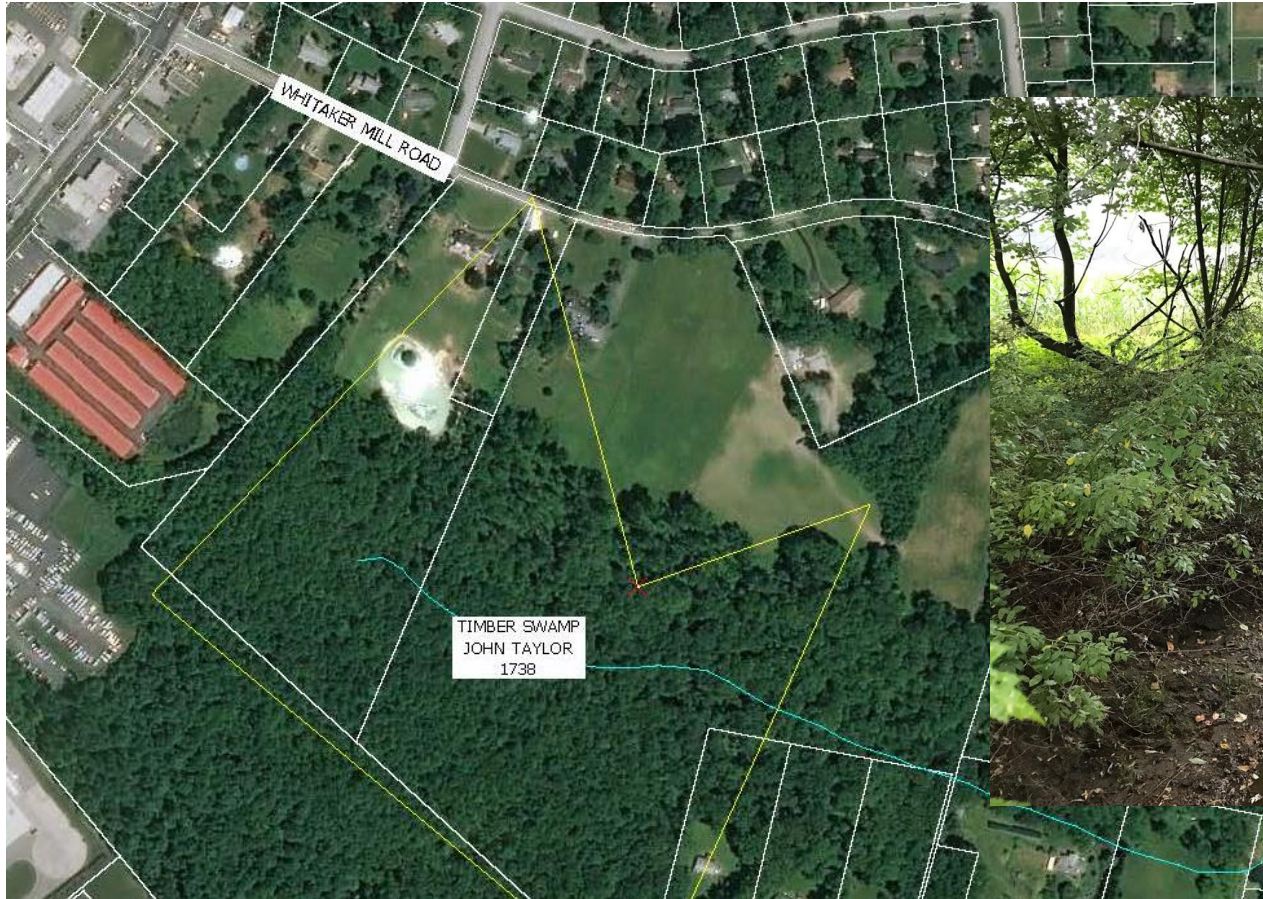
swamp

marsh

Fell's Swartmore (or Swampy more) and with said land reversely

79 - Timber Swamp - Surveyed 20 Aug. 1736; granted 3 Oct. 1738 to
from the original Patent
recorded in land office see
Lib. E. I., No 2, folio 76 -
C. B. N.

Aquila Pars for 30 acres - (The balance
of a Warrant for 50 ac. granted to him
(752 pt. 1) 31-) Beginning at a W.O. in a swamp









Long Green Creek
400 meters+/-
below Hydes Road

1993









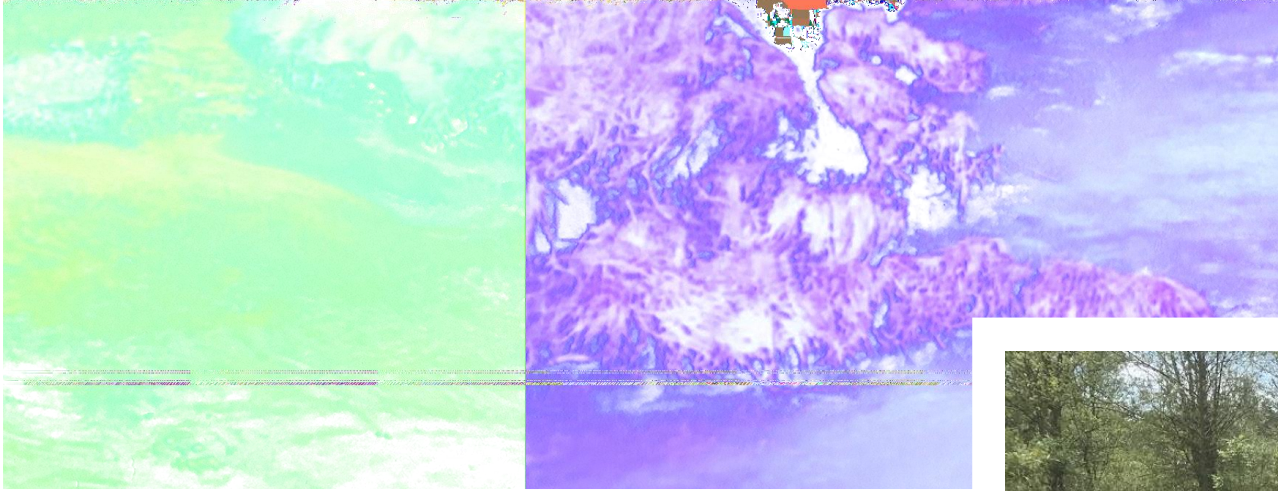




2019

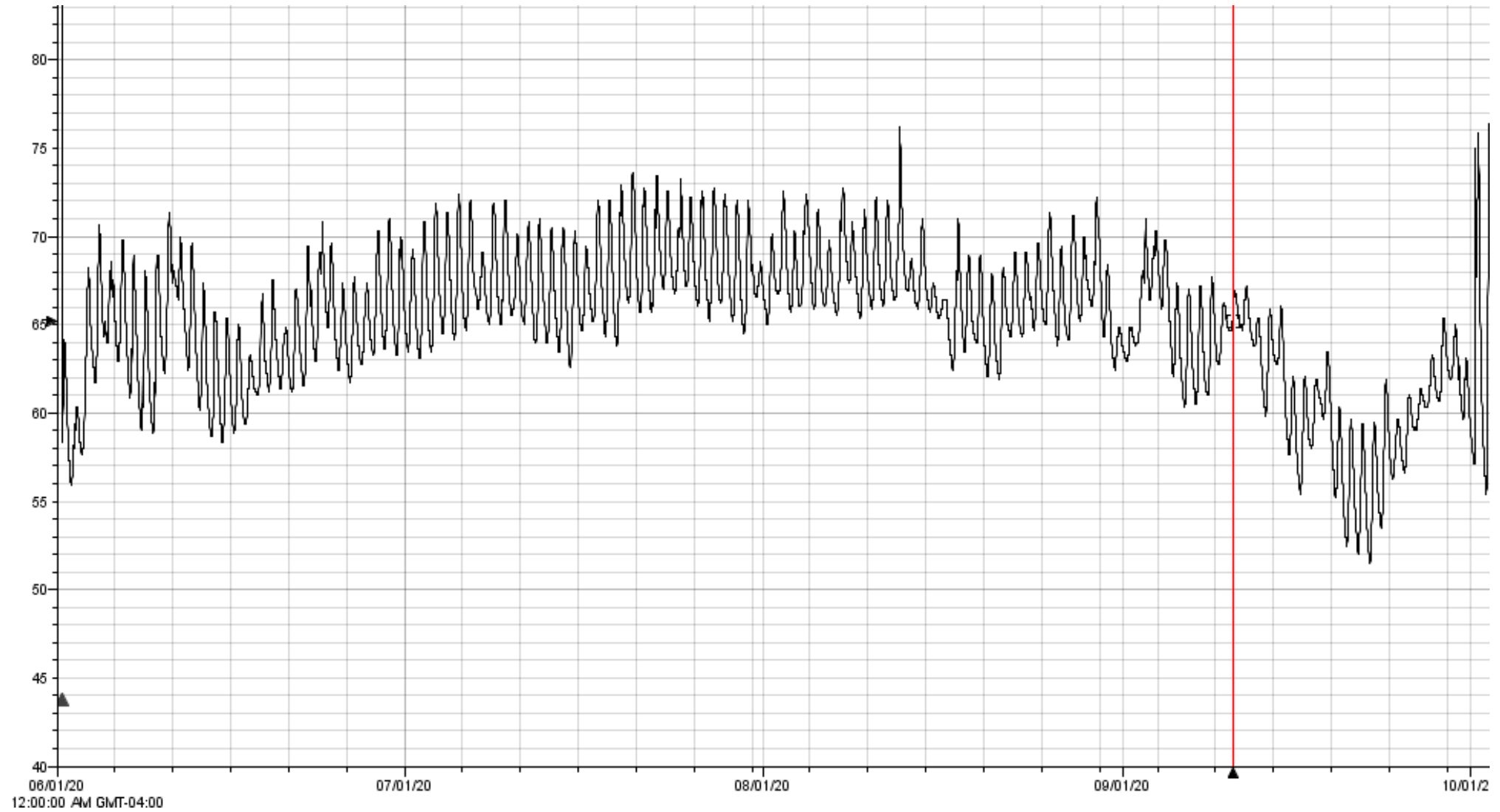
2020



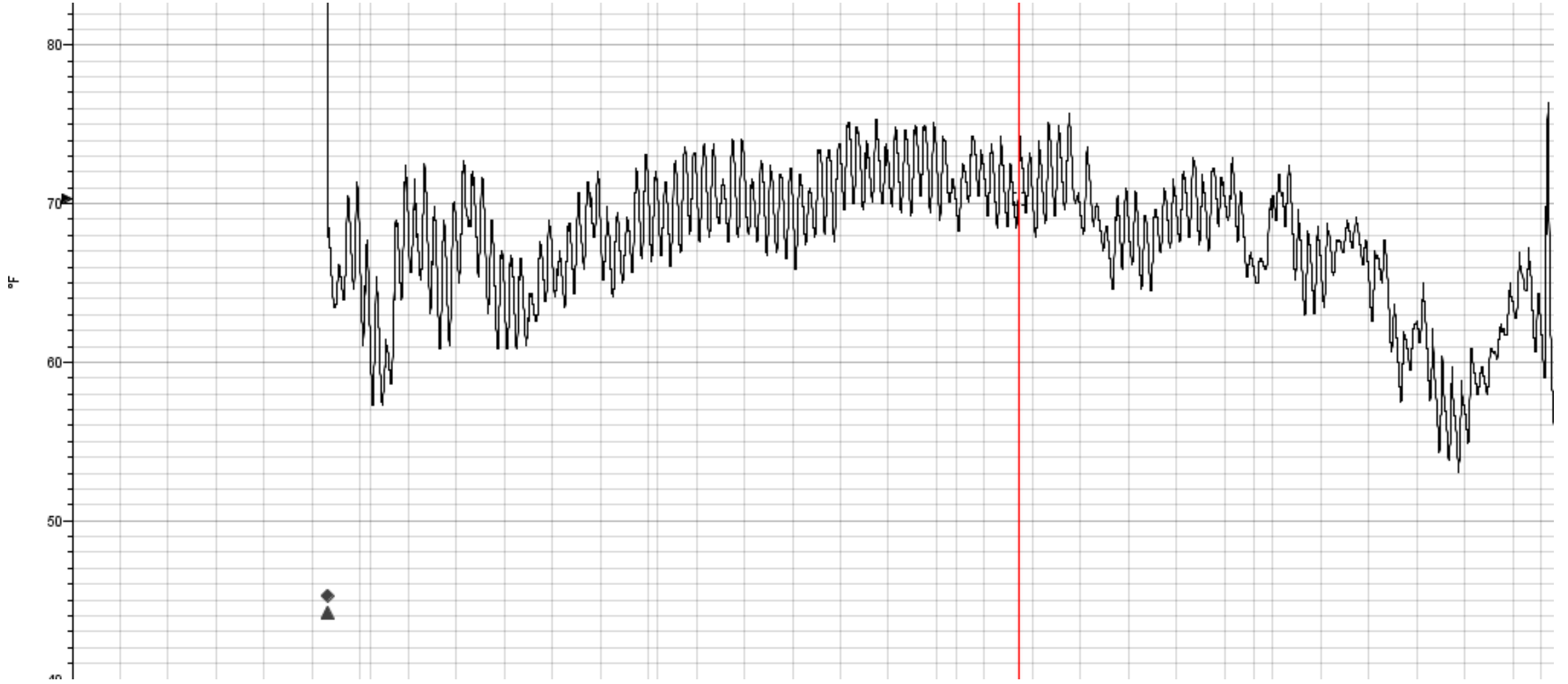




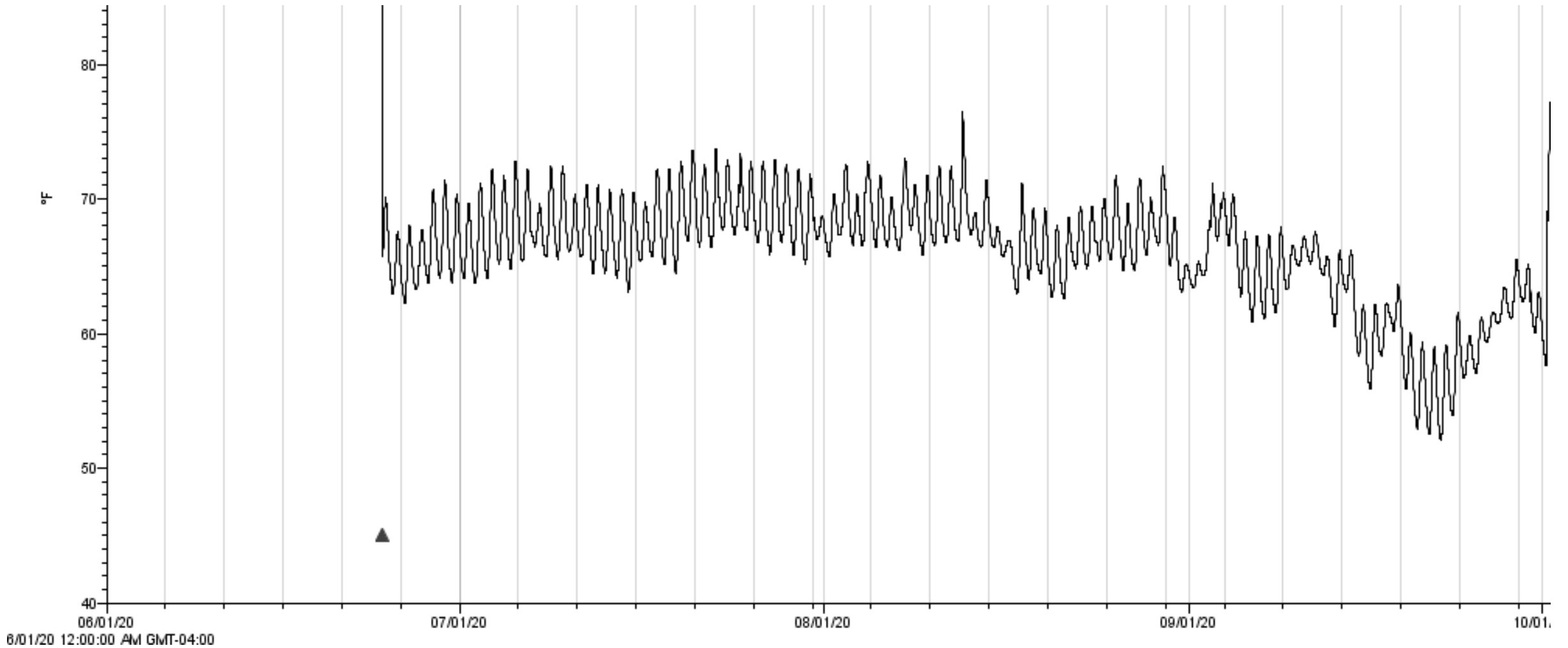
Summer Water Temperatures upstream of beaver pond



Summer Water Temperatures DOWNSTREAM of beaver pond



Summer Water Temperatures IN beaver pond





Stream restoration design to encourage beaver colonization

- Disperse energy across the ENTIRE floodplain.
- Leave oxbows, wet meadows
- Regenerative species - willow, alder, dogwood
- Wide easement
- Landowner education
- low stream power per unit width





















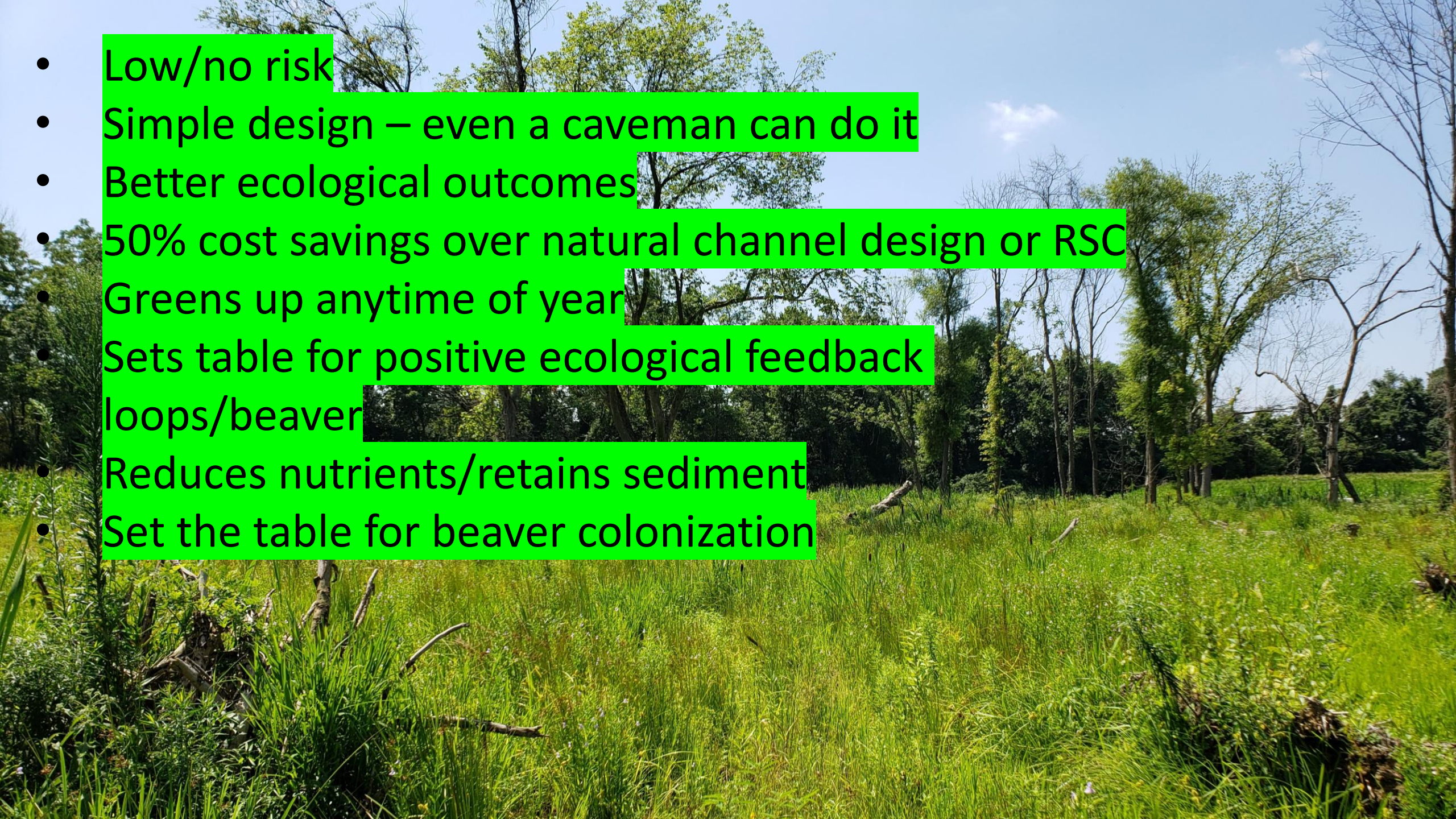








- Low/no risk
- Simple design – even a caveman can do it
- Better ecological outcomes
- 50% cost savings over natural channel design or RSC
- Greens up anytime of year
- Sets table for positive ecological feedback loops/beaver
- Reduces nutrients/retains sediment
- Set the table for beaver colonization



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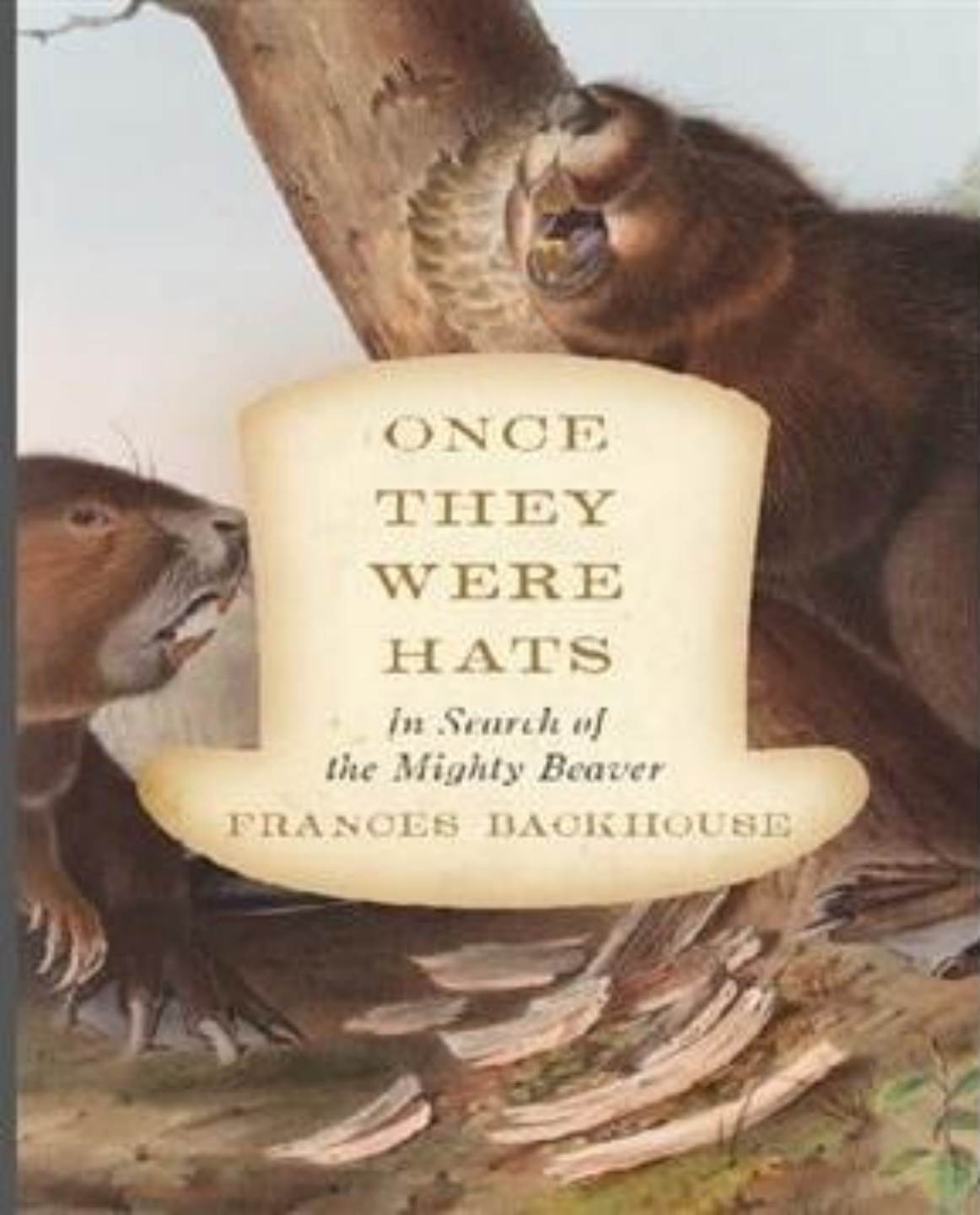
#BeaverCON #BeaverCON2020

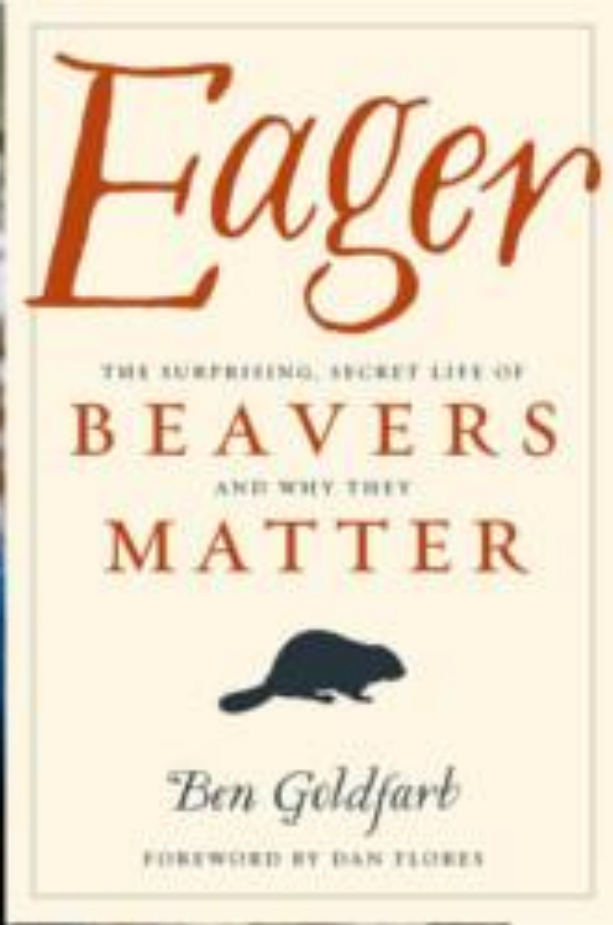


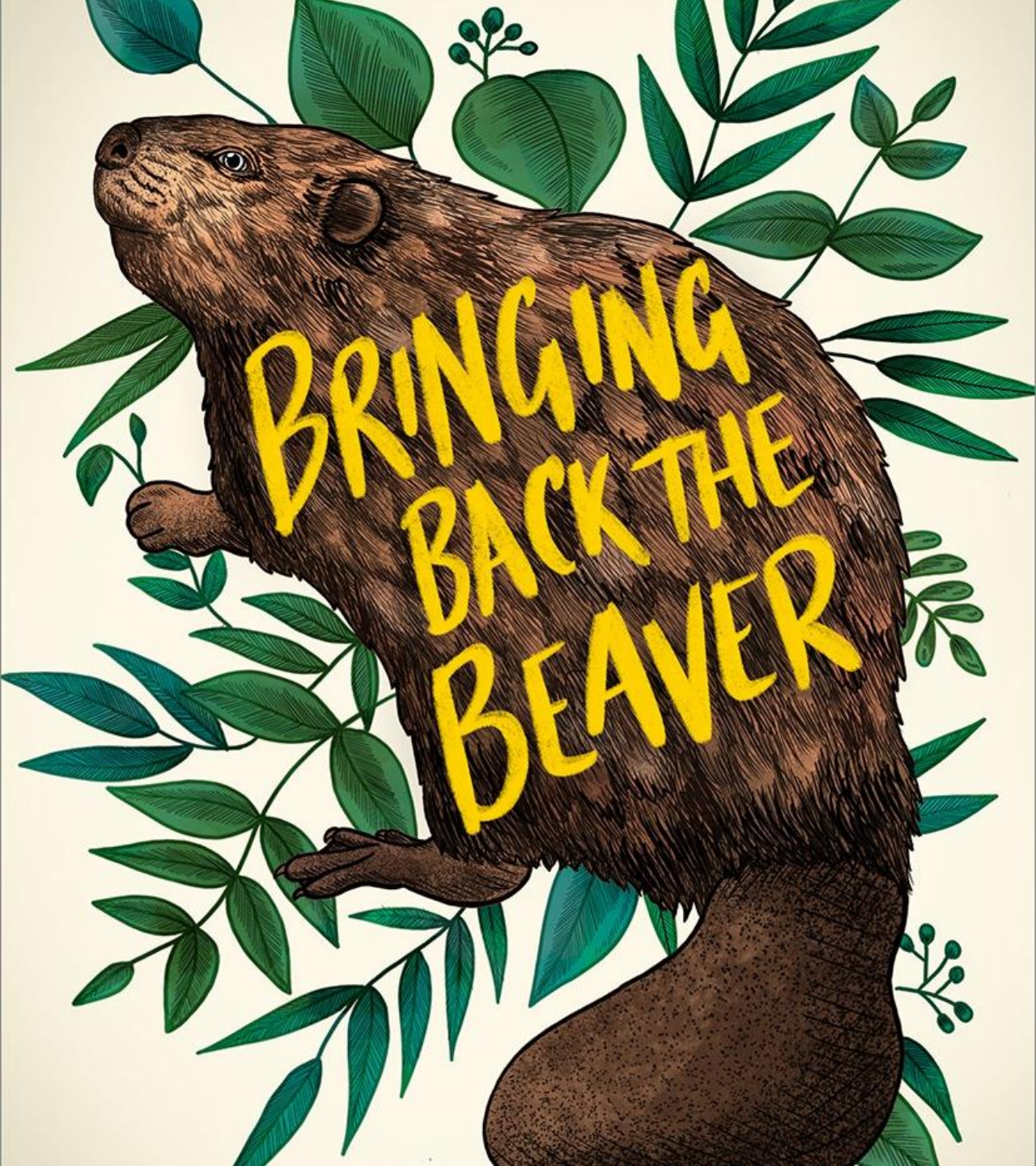
BeaverCON is a biennial, international conference on the east coast of the United States for professionals, researchers and practitioners to learn what works in beaver conflict management and watershed restoration.

Pictures from:











Questions?



ecotone
ecological restoration

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Beavercon.org



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THINK LIKE A MOUNTAIN