Lessons learned from 20 years of management of invasive knotweed on an unregulated Western River

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10,000 Years Institute

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Omfishient Consulting

Working for healthy rivers…

10,000 Years Institute: Integrating practices that restore and protect the forests, rivers, wetlands and estuaries that sustain our communities and ecosystems.

Through development of innovative, science-based approaches to restore ecological integrity, we promote sustainable practices in landscapes.

Presentation Overview

- Hoh River Knotweed: Introduction and History
- Monitoring and restoration efforts through time
- Analyzing twenty years of data: temporal and environmental factors
- Lessons for adaptive management of knotweed
- Conclusions and next steps

Hoh River, Washington State

- 90 km undammed river on Olympic Peninsula
- Originates at Hoh Glacier on Mount Olympus
- Hoh Rain Forest, ~400K visitors each year
- Abundant wild fish populations

"The Hoh River sustains the greatest diversity of salmonids in the continental United States with 13 populations, including spring and fall Chinook, coho, chum and sockeye"

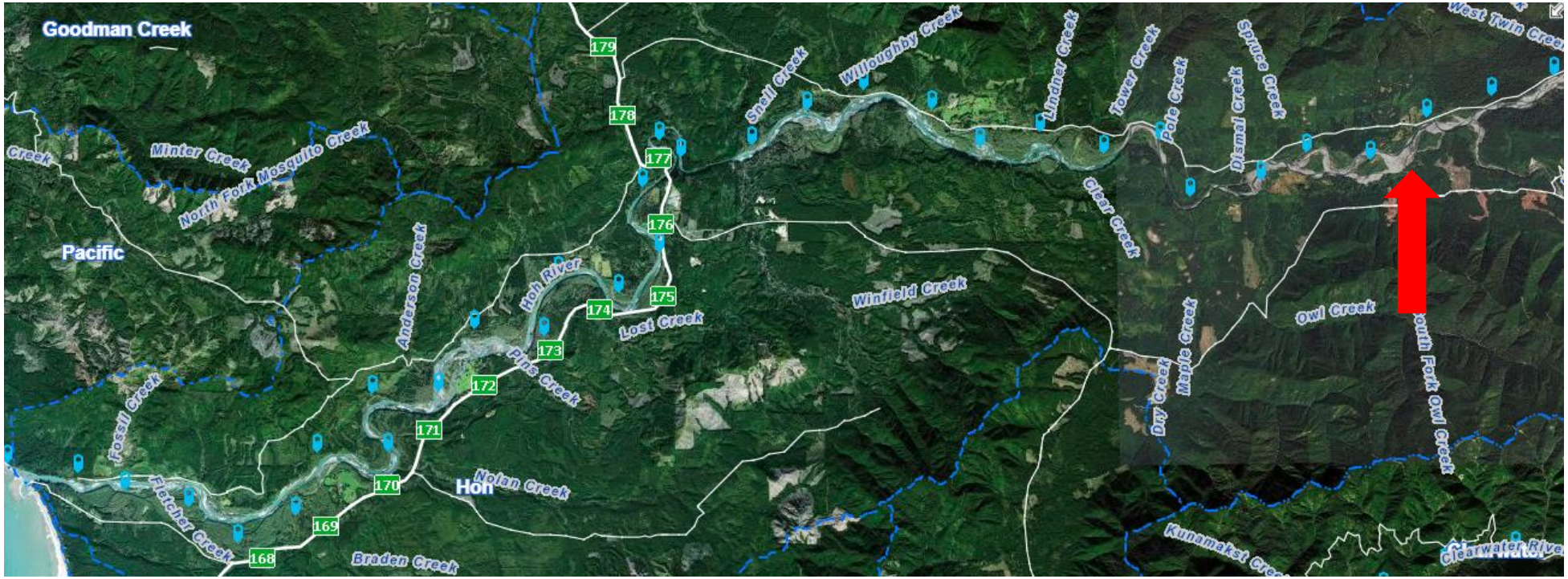
Western Rivers Conservancy

Kassler et al. 2010

History of Hoh River Work

1999

River channel avulsion captured the original knotweed clump at RM 29.75



History of Hoh River Work

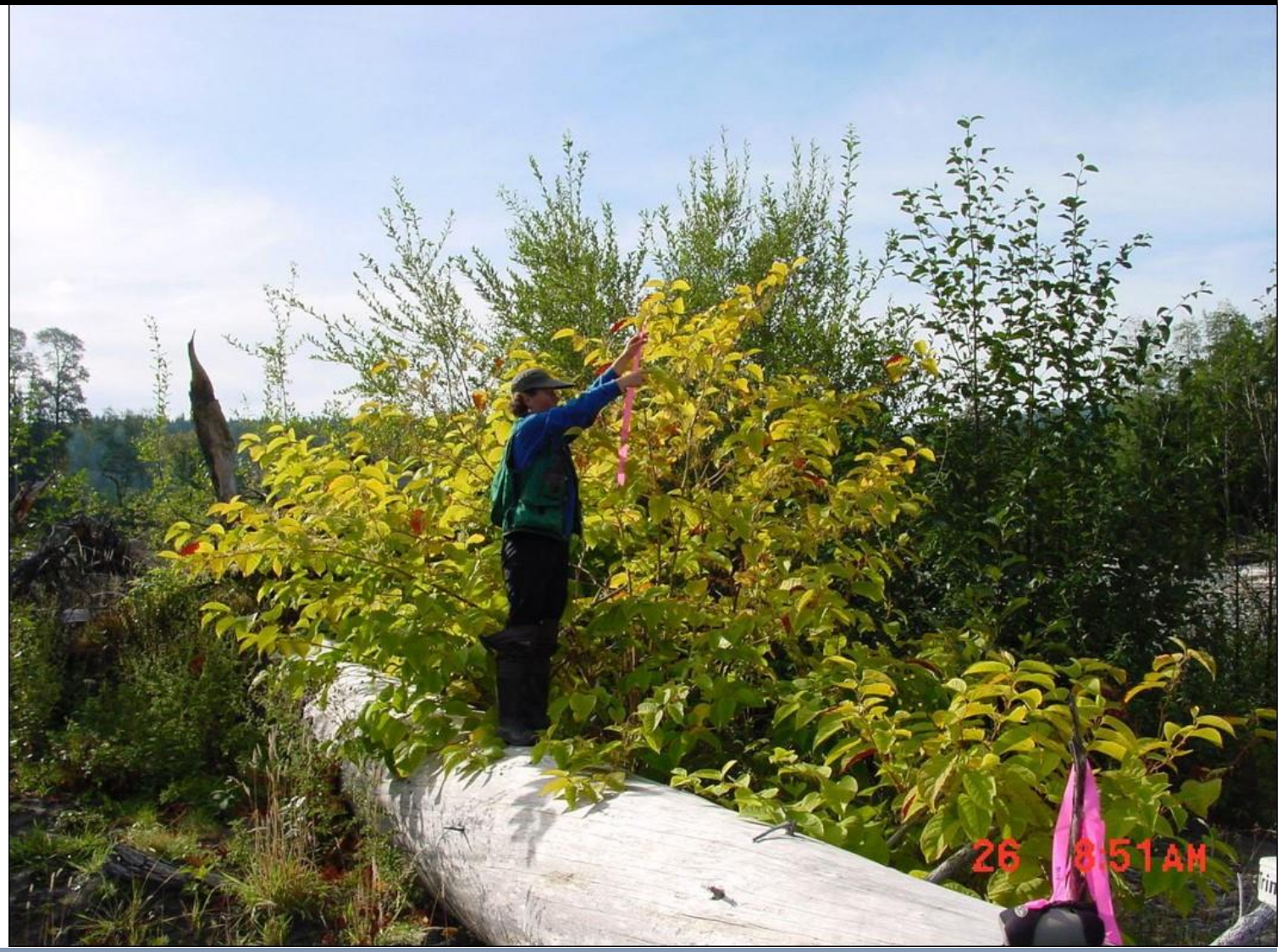
KW

1999 2001

Knotweed treatment begins

Funding

2001 Bureau of Indian Affairs



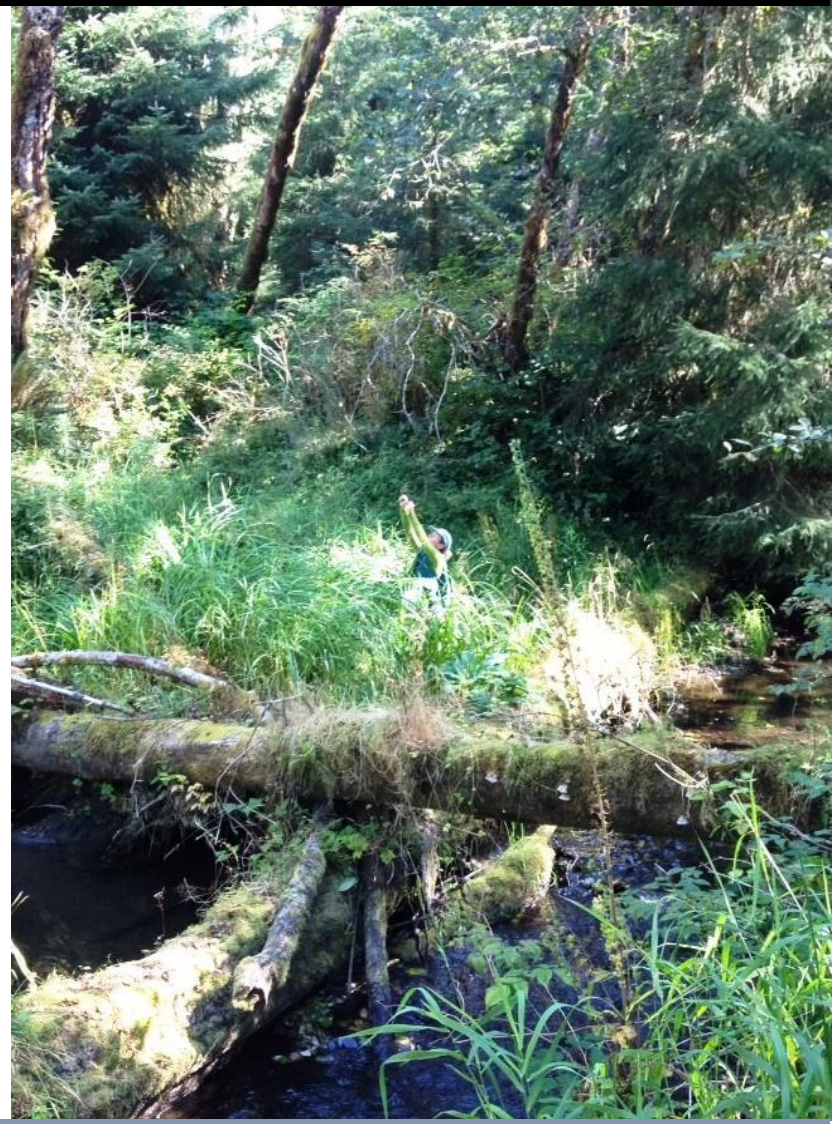
History of Hoh River Work

Funding

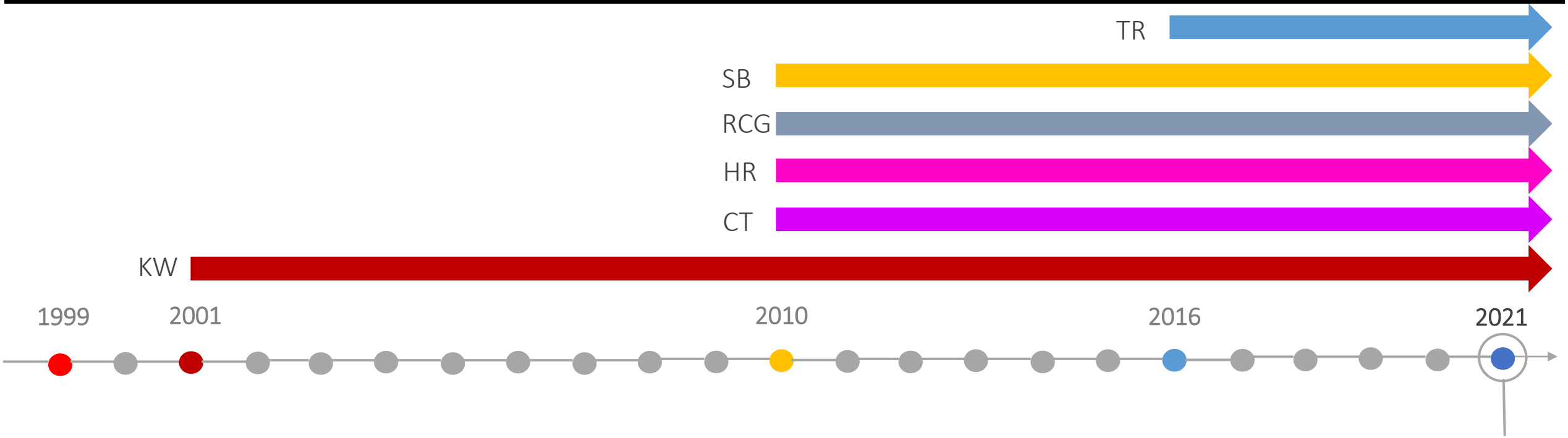
2001 - 2002 Bureau of Indian Affairs
2003 - 2004 Pacific Coast Salmon Recovery
2005 - 2007 National Fish & Wildlife Foundation
2007 - 2010 WA Department of Agriculture

Started treatment for:

- Scotch broom
- Reed canarygrass
- Herb Robert
- Canada thistle



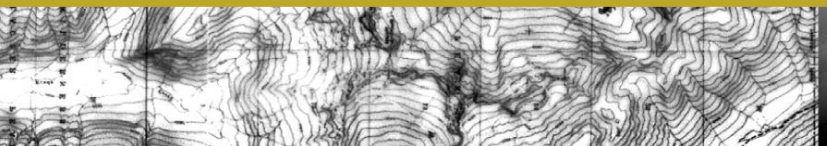
History of Hoh River Work



Funding

2001 - 2002 Bureau of Indian Affairs
2003 - 2004 Pacific Coast Salmon Recovery
2005 - 2007 National Fish & Wildlife Foundation
2007 - 2011, 2016 - 2017 WA Department of Agriculture
2012 - 2019 Salmon Recovery Funding Board
2015, 2018-2021 WA Coast Restoration & Resiliency Initiative

Continuing treatment under
Pulling Together in Restoration



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watershed ecological services

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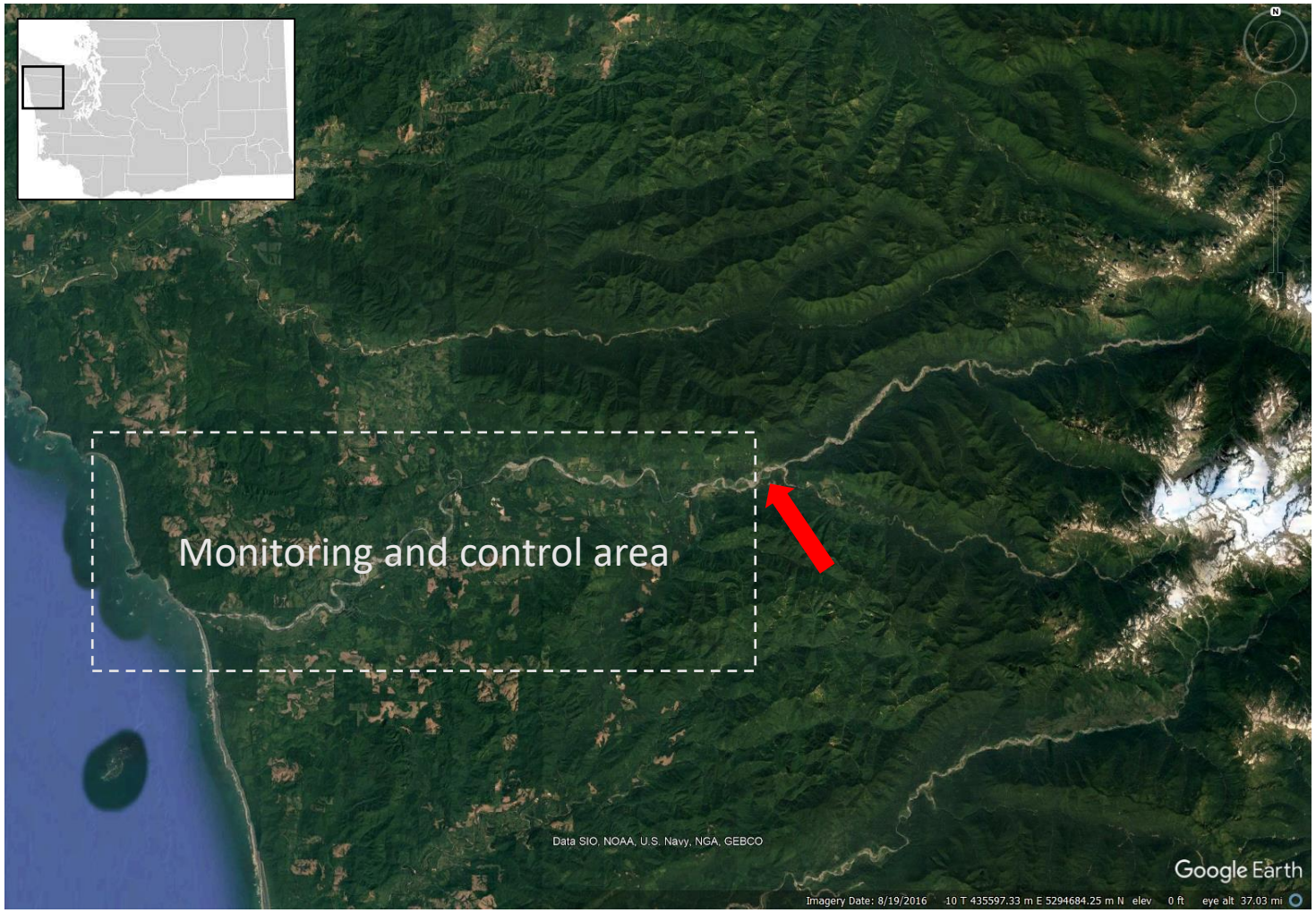
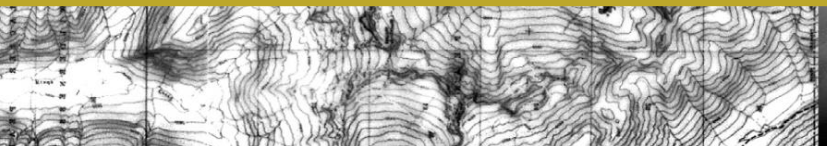
Hoh River, Washington State
10,000 Years Institute

Monitoring and Restoration, 2002-Present

- Control area downstream of introduction RM 30 (RKM 48)
- Knotweed was surveyed and treated in most reaches and most years
- Treatment:
  - Glyphosate injection or spray (2002-2007)
  - Glyphosate and imazapyr mixed (2008-2011) or separate (2012 on)



Survey Challenges: Habitat diversity



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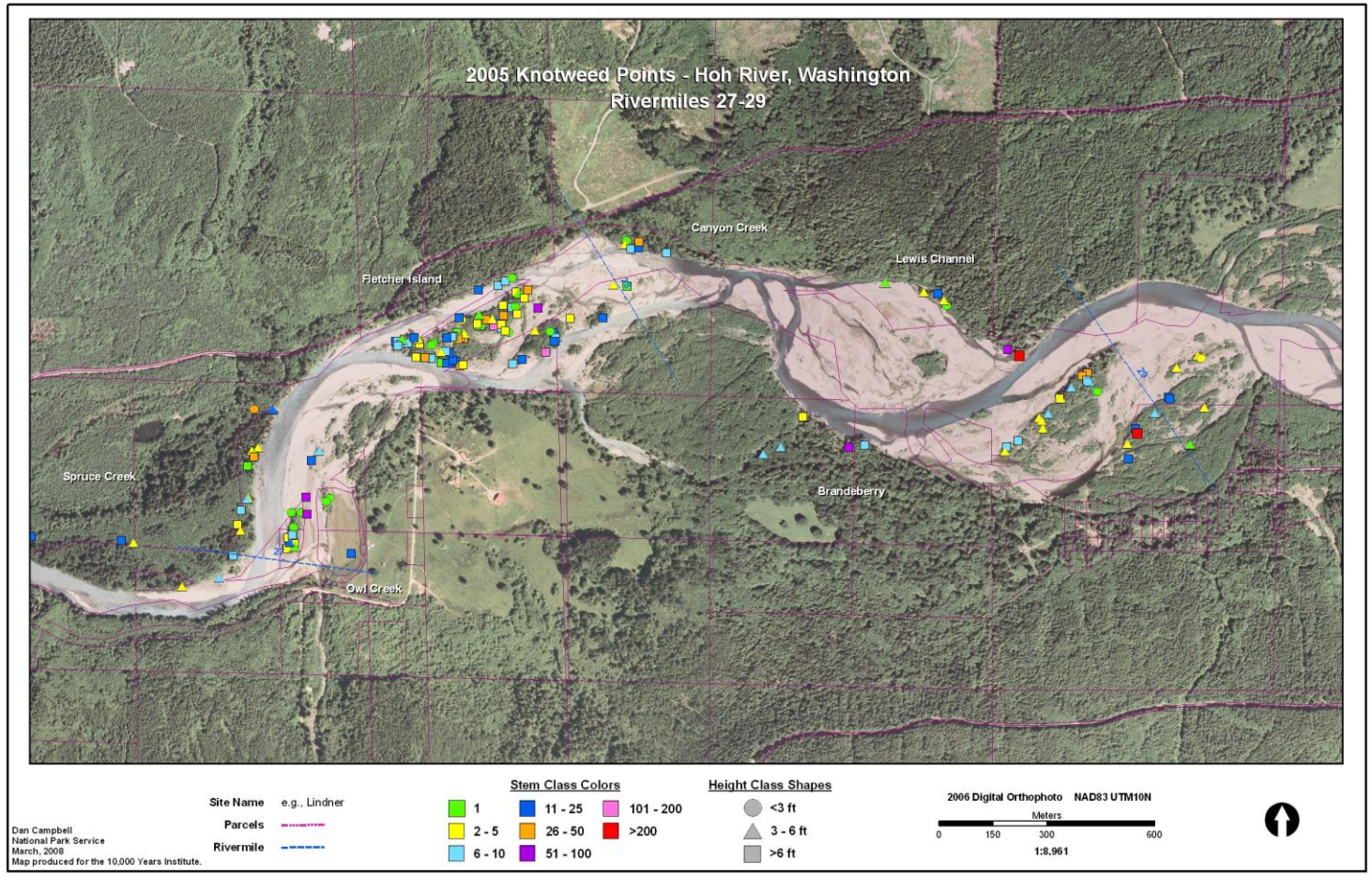
watershed ecological services

Survey Challenges: Floodplain movement

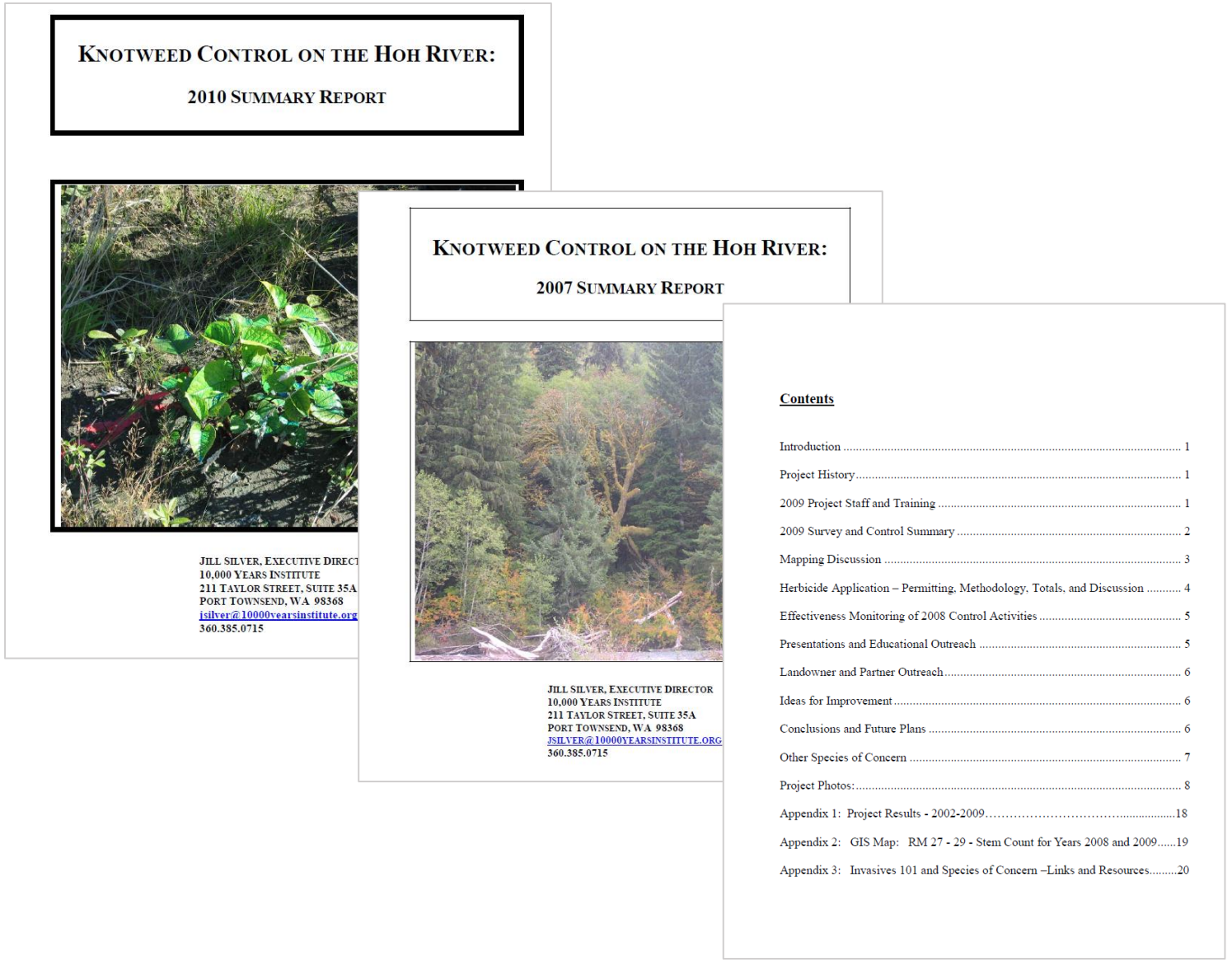
Research Objective 1

Analyze 20+ year spatial dataset to assess the environmental factors associated with **establishment** and **persistence** of knotweed



Research Objective 2

Summarize “lessons learned” from sustained management and control efforts, and identify priority research gaps



KNOTWEED CONTROL ON THE HOH RIVER:

2010 SUMMARY REPORT

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KNOTWEED CONTROL ON THE HOH RIVER:

2007 SUMMARY REPORT

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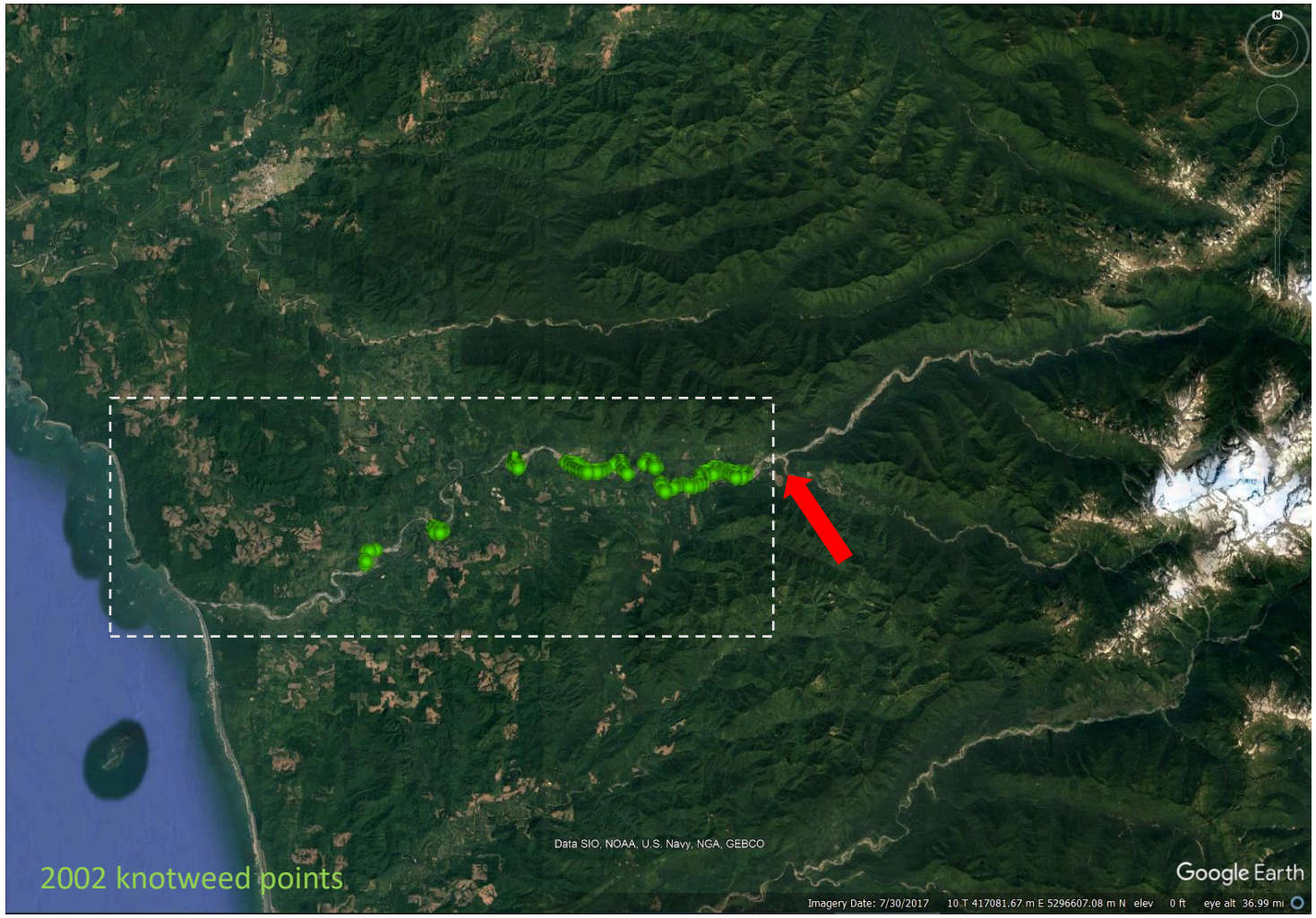
Research Objective 1: Methods

Assess the environmental factors associated with **establishment** and **persistence**

Knotweed Observations ~

Variable	H_0
RKM (proximity to source)	+
Year (treatment)	-
Active channel width	+
Channel braiding	+
Channel sinuosity	+
% Forested	-
% Emergent wetland	+

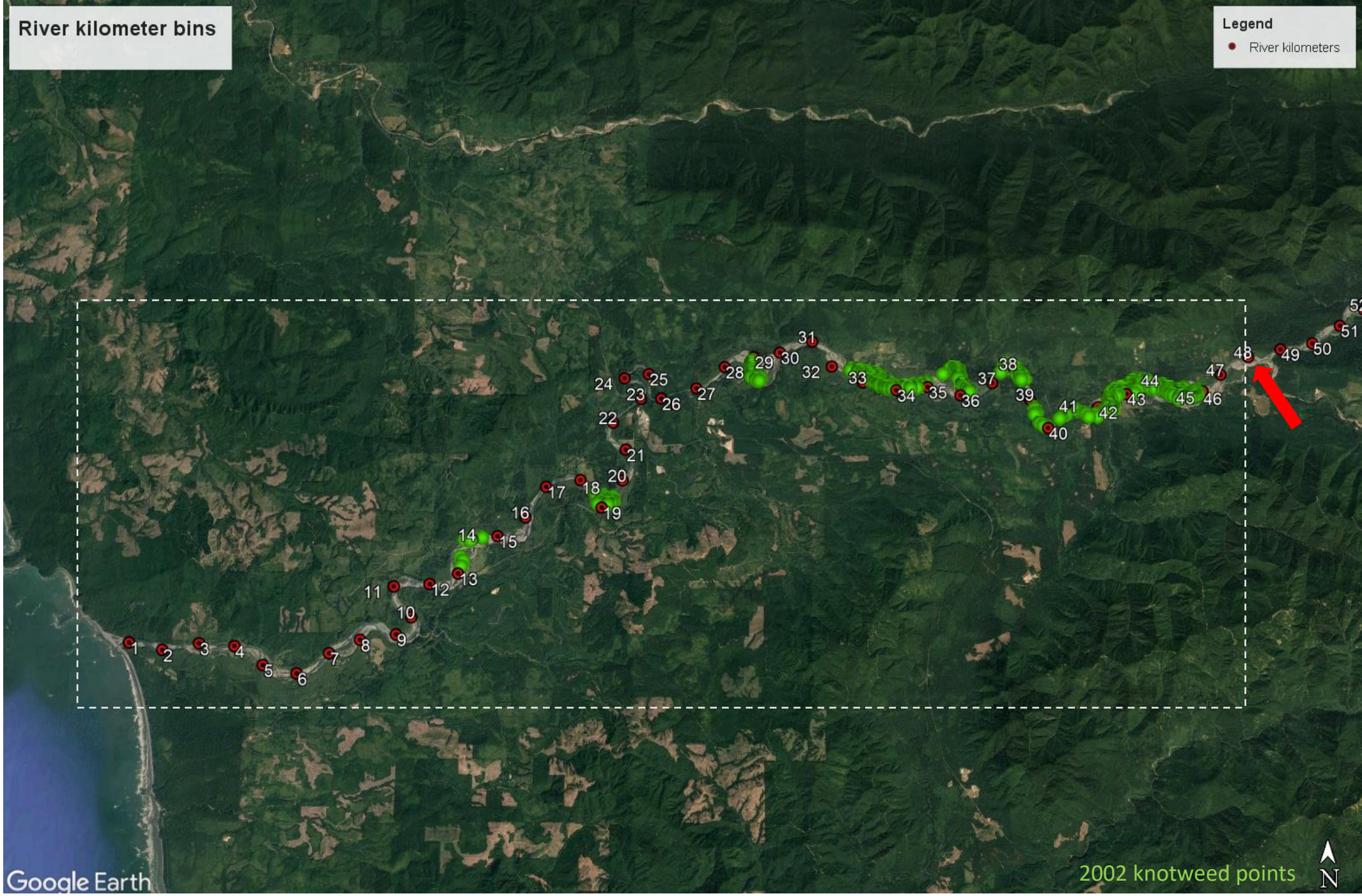


Steps:

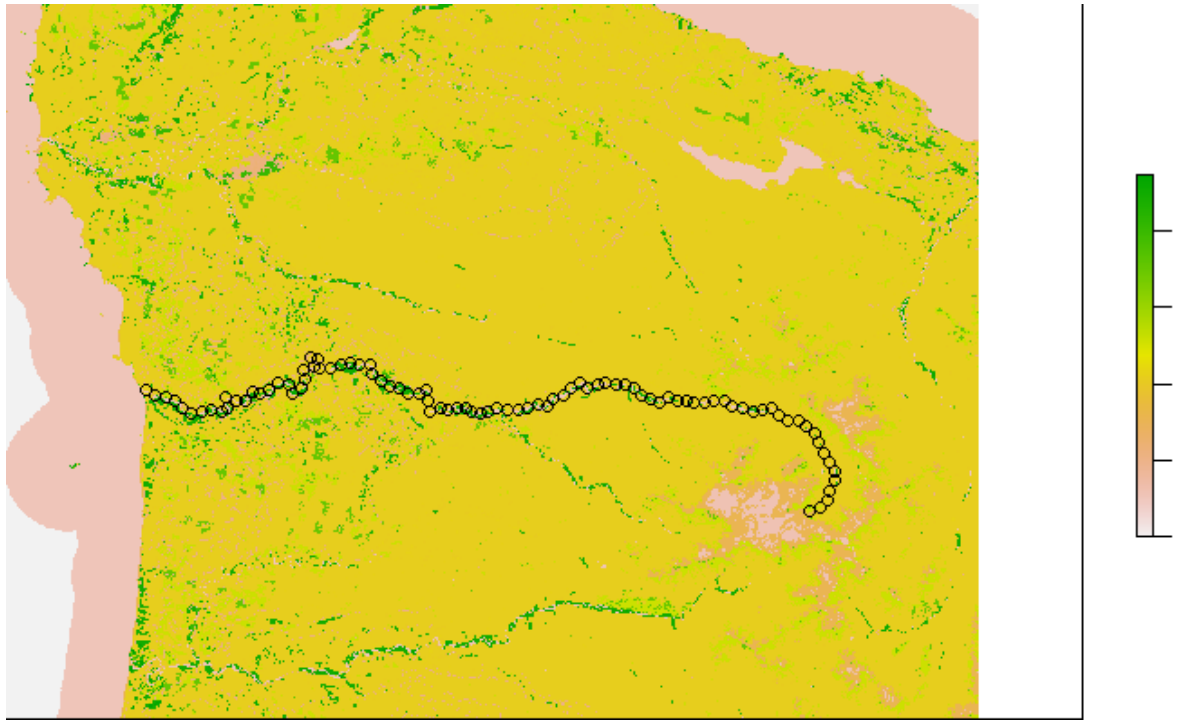
1. Assign knotweed points to RKM bins

2. Obtain covariates for each RKM bin

3. Model with year as factor



Covariates



- Active channel width
- Channel Braiding

4 samples/River km[1]; drawn in GE → shapefile

- % Forested[2]
- % Wetland[2]

500 m buffer around sample points (mean)

1 East et al. 2017, Channel-planform evolution in four rivers of Olympic National Park, Washington, USA
2 National Land Cover Database, 2019. US Geological Survey

Covariate Modeling

Candidate Model(s)

Variable*
RKM (proximity to source)
Year
Active channel width
Channel braiding
Channel sinuosity
% Forested
% Emergent wetland

Model selection using AIC

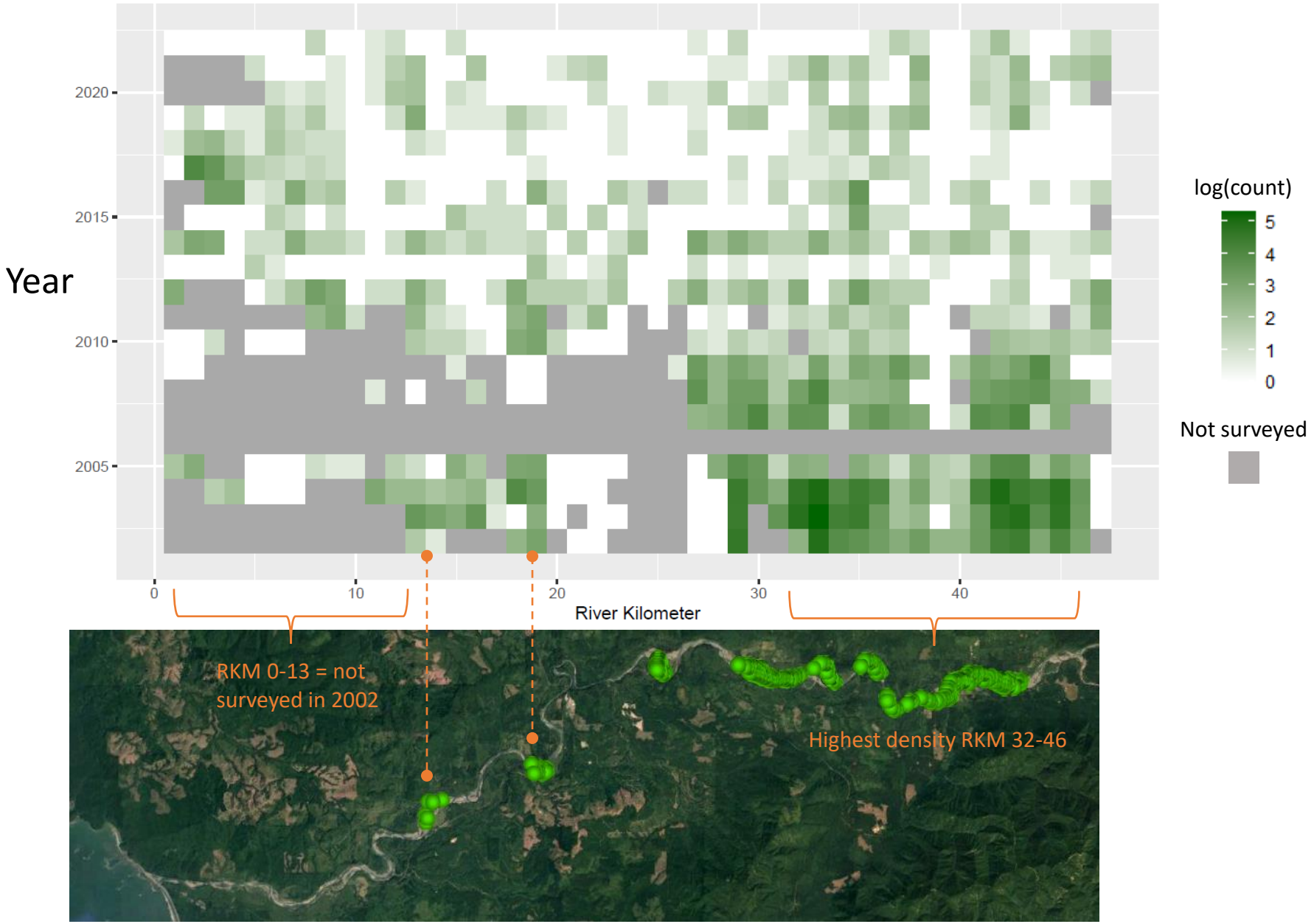
Final model

Variable
RKM (proximity to source)
Year
Active channel width
Channel braiding
Channel sinuosity
% Forested
% Emergent wetland

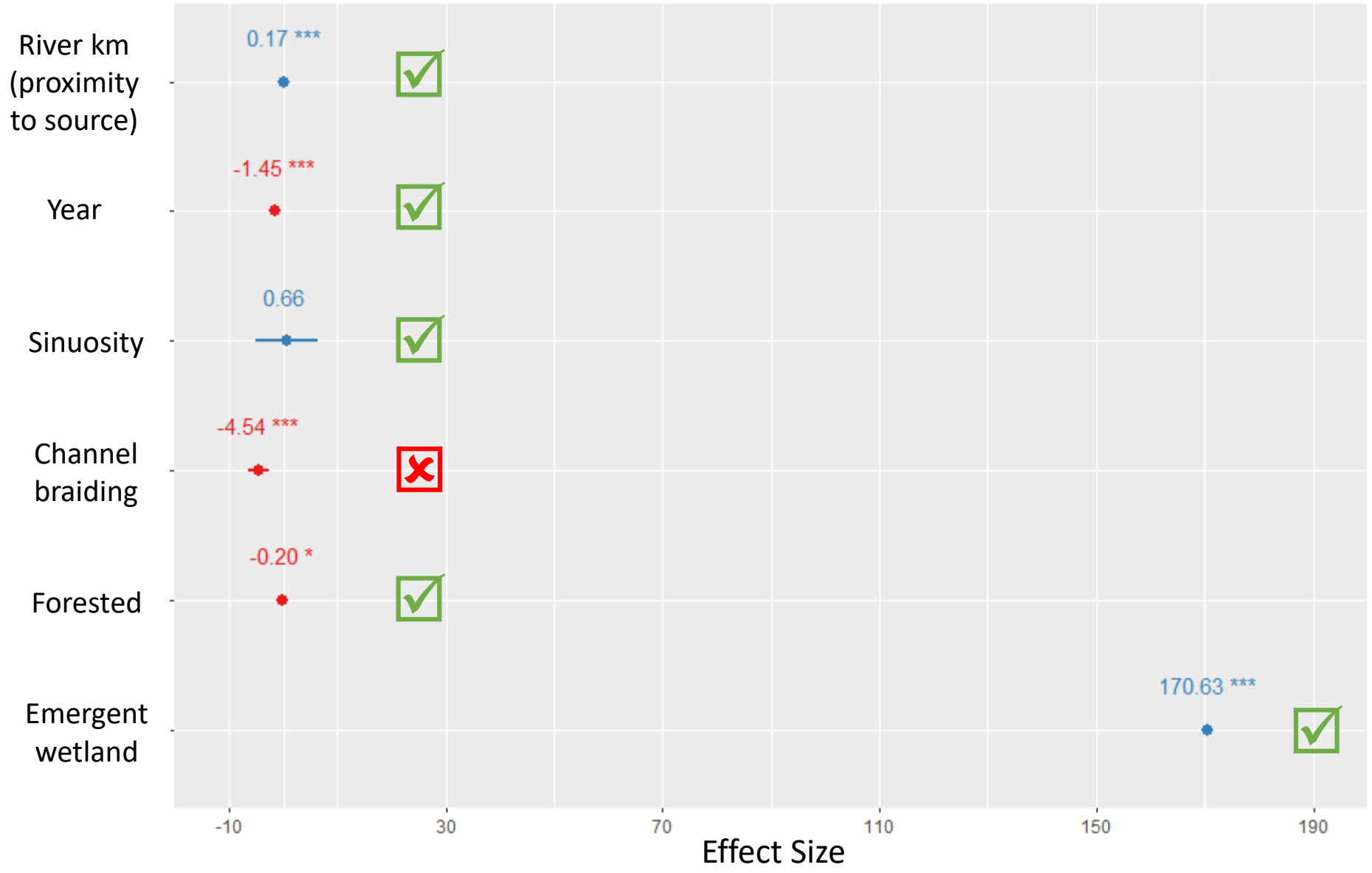
Evaluate effect sizes

**Variables are checked for collinearity prior to modeling*

Reduction in knotweed through time with sustained management



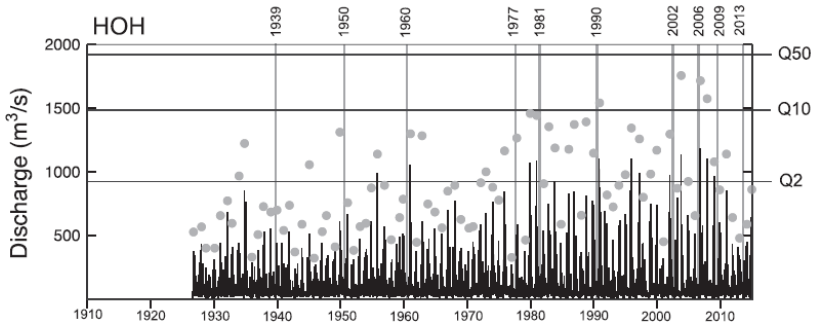
Influence of environmental factors on knotweed presence through time

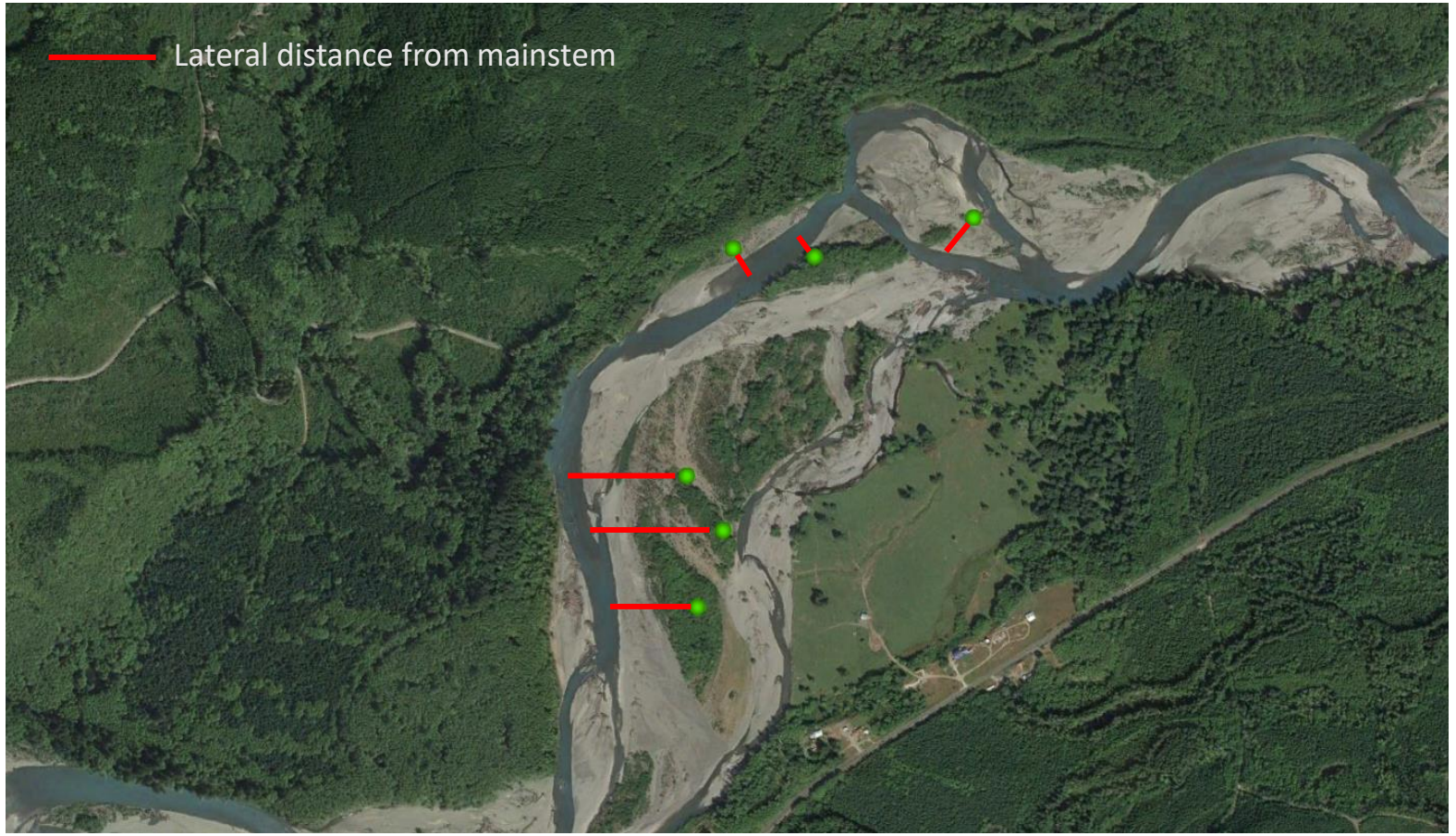


BUT!...Fixed effects = 0.28, Combined effects=0.38

Lateral spread from mainstem

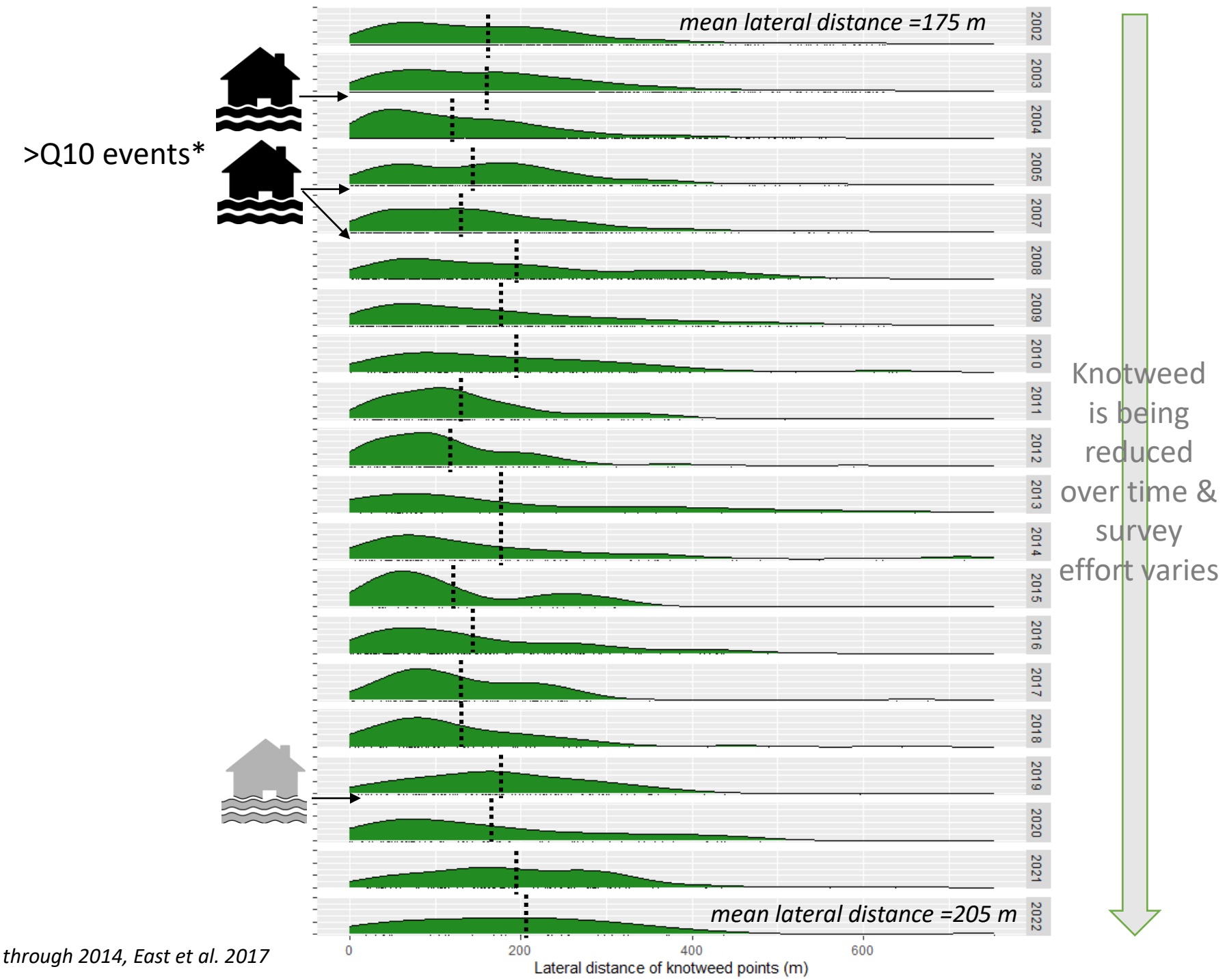
- Assess the extent of lateral spreading from the mainstem channel into side channels and terraces
- Can be used to model spread (rates and extent) in response to flood events[1]





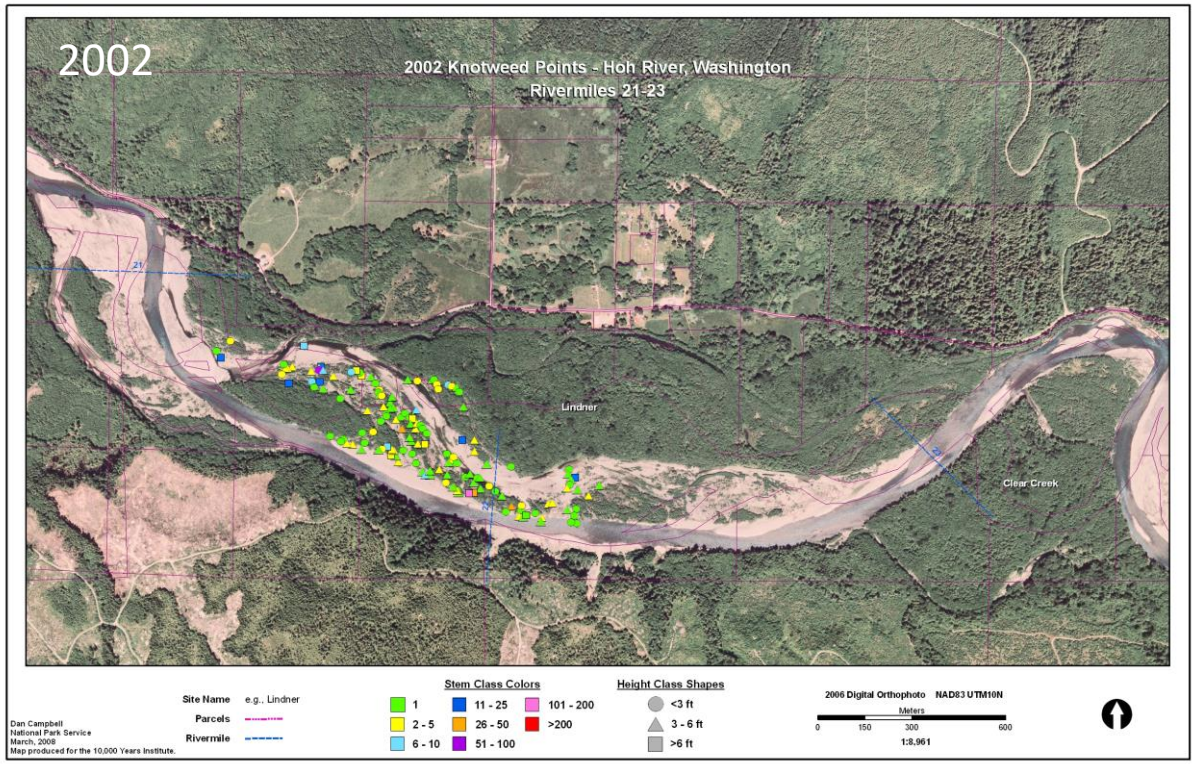
1 East et al. 2017, Channel-planform evolution in four rivers of Olympic National Park, Washington, USA

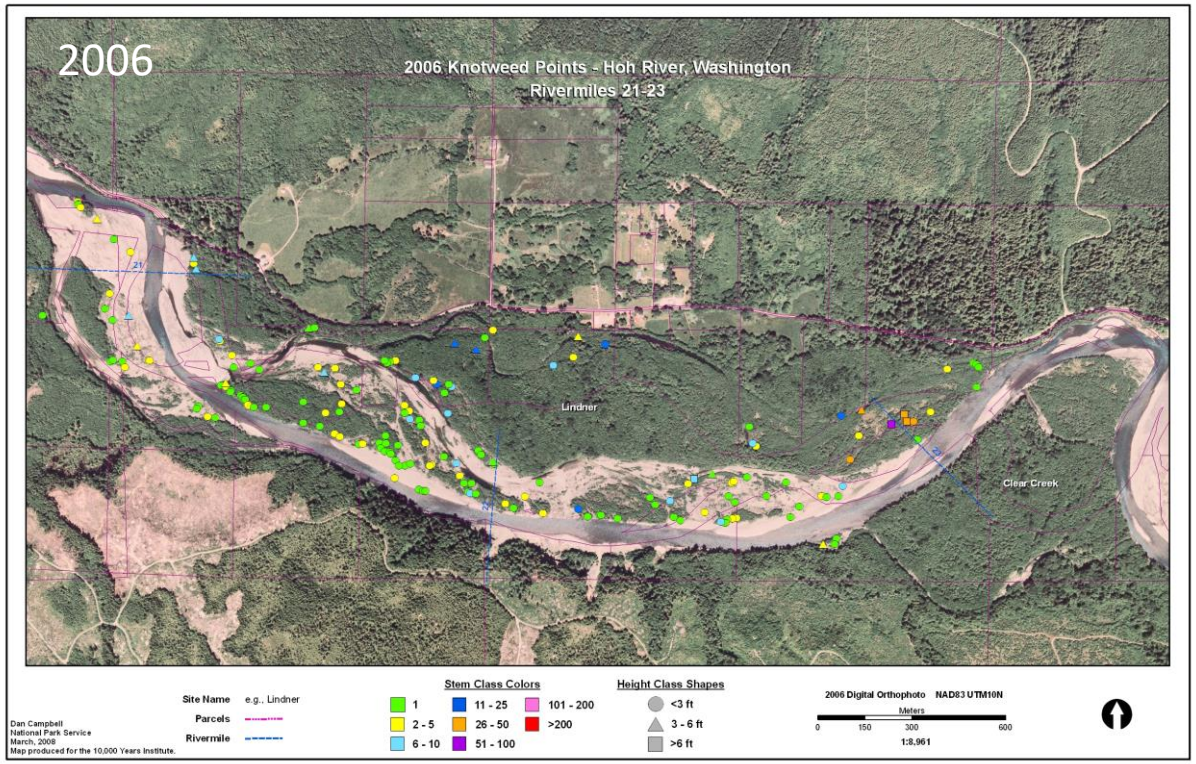
Change in lateral spread of knotweed through time



*Data through 2014, East et al. 2017

Lateral spread: next steps…





1. Contrast specific sites or reaches with comparable survey effort, pre and post floods
2. Use mainstem flowline specific to year (rather than single flowline for all years)

Takeaways and next steps

Results	Next steps
• Sustained management can reduce knotweed populations through time, even in a dynamic river	• Continue monitoring and treating small populations, in conjunction with monitoring & control for other species
• Documenting monitoring and control efforts through time allows identification of general patterns that can guide management efforts	• Communicate the importance of documentation, and support development and growth of data repositories at local, state and national scales
• Landscape factors (e.g., wetland presence, channel braiding) and flooding can explain some variance in population establishment and persistence	• Test and include additional variables (e.g., gradient, substrate); refine variable scale (i.e., year-specific and/or higher resolution) • Continue refining analysis of environmental factors to inform predictive model of invasion risk, spread, and persistence for other rivers

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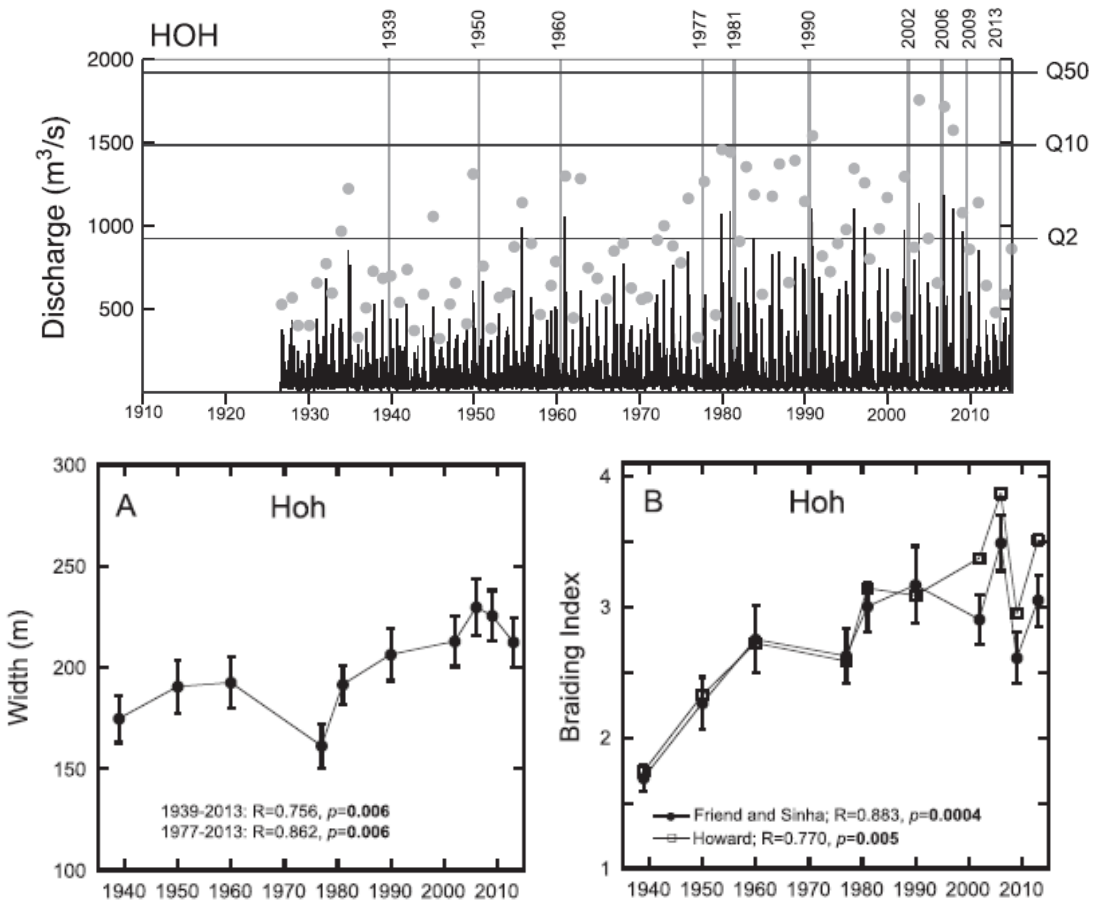
Importance and implications of changing climate

Changes in flooding, channel planform

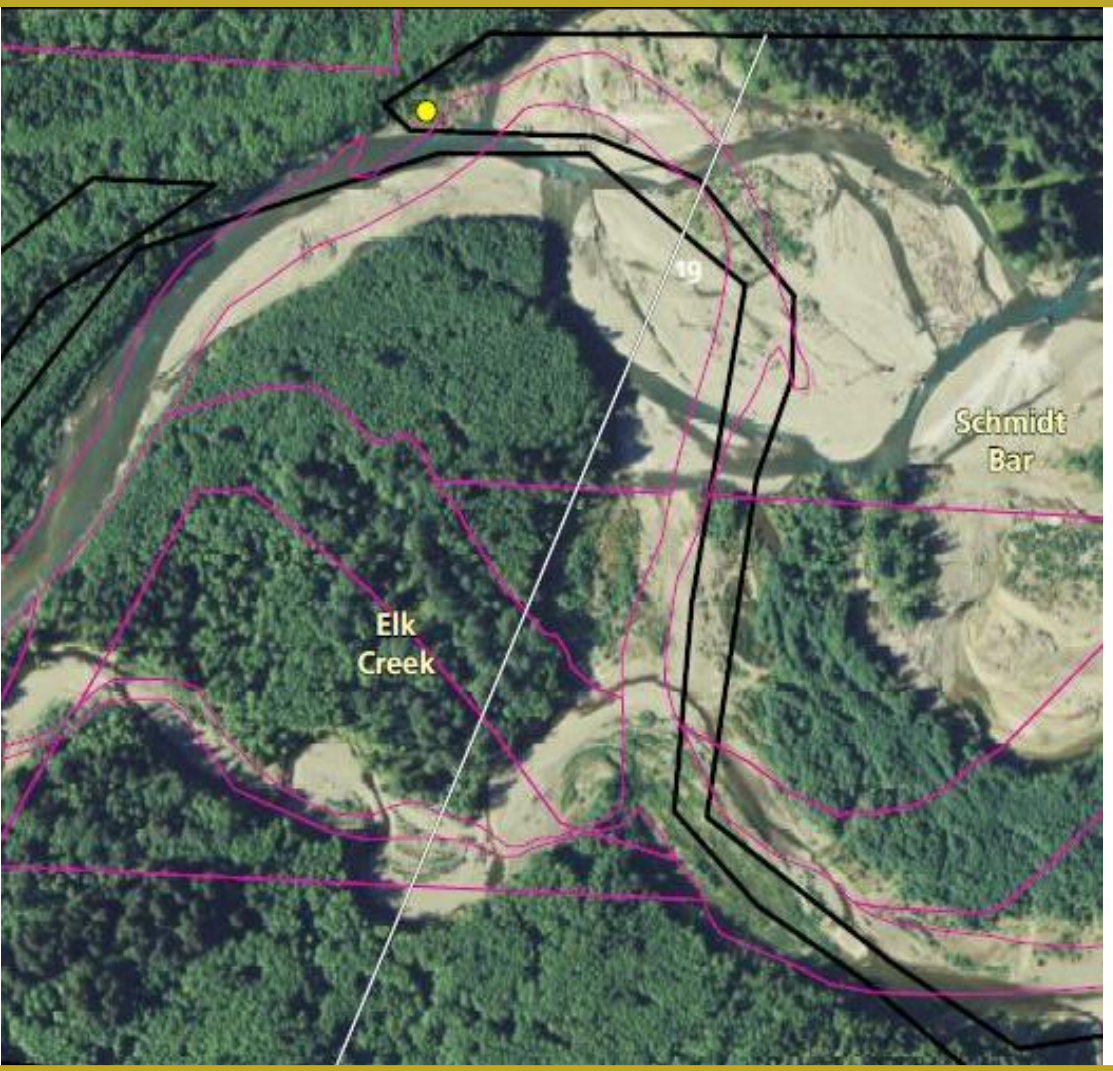


East et al. 2017

"The significant widening of all four rivers since the 1970s is attributable to the known intensification of regional flood activity…"

"…the strong temporal trend toward greater braiding of the Hoh River may result from increased sediment supply due to glacial retreat…"

Glacial retreat impacts: Hoh River at the Elk Creek Floodplain



Sediment aggradation causes:

- channel avulsions
- the loss of mature riparian zones
- creates large disturbance zones

Ideal habitat for invasive species...

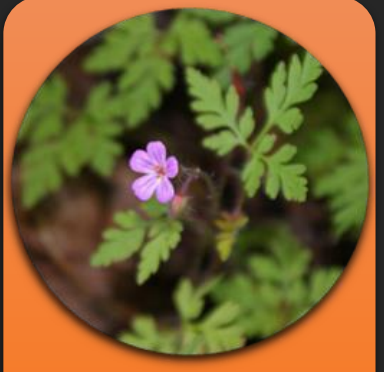
Research is Needed

Studies needed to inform resiliency and passive restoration:

Scotch broom

Reed canarygrass

Knotweed



Herb Robert allelopathy

Biogeomorphic influence of invasive plants

Glacial retreat

USCS, PNW

CSP, ONP, PTIR

Jefferson Co, TU, CSP

Key Takeaway:

Partners, Collaborators, and Funders

Quileute Nation

City of Forks
forkswashington.org

University of Washington

University of California Santa Cruz

Northern Arizona University

WSDA

Washington State Recreation and Conservation Office

North Pacific Coast Lead Entity for Salmon Restoration

Coast Salmon Partnership

Quileute Indian Tribe

Pacific Coast Salmon Coalition
Volunteers making a difference.

Wild Salmon Center

the Hoh River Trust

The Nature Conservancy

Fruit Growers Supply

Trout Unlimited

Quinault Indian Nation

Jefferson County Washington

Grays Harbor County 1854

Clallam County 1854

Washington Department of Natural Resources

Forest Service U.S. Department of Agriculture

National Park Service

WSDOT